

# Worksheets

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# KeeCo

- Assistive Technology -  
*cooking with cognitive impairments*

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**MSC04 - 03 INDUSTRIAL DESIGN**  
Aalborg University, may 2016

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**TEAM 3**

Anca Gogu  
Giulia Dalle Nogare  
Ulla Tanderup Gade

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**Activity:****First meeting with Karl Damkjær Hansen****Objective:**

Gain a general understanding of the Master Thesis's topic, what the project consists of and align the team's objectives with the researcher's objectives (Karl Damkjær Hansen, postoc at AAU, Department of Electronic Systems).

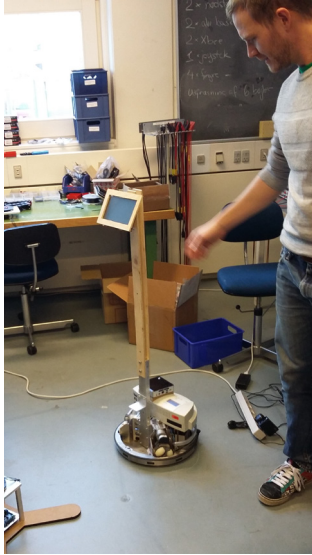
**Experiment/data:**

On 17th of January, the first face-to-face meeting took place with Karl Damkjær Hansen, whom proposed the Master Thesis topic: A Socially Assistive Robot for patients with frontal lobe brain damage.

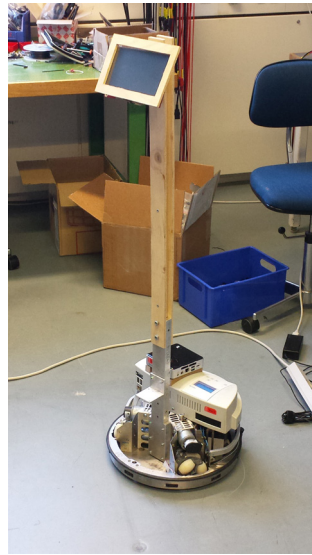
CONTEXT: Welfare Technology - Social Robot for patients (no rehabilitation).

MAIN NOTES from the meeting:

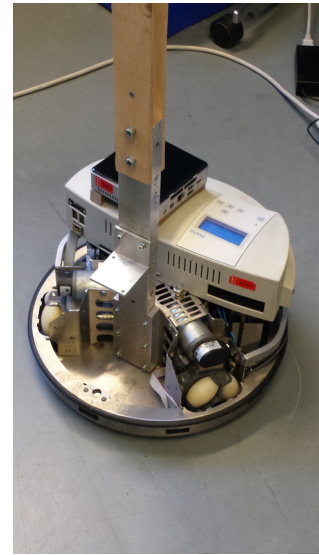
- The robot is meant for patients with frontal lobe brain damage. Since these patients' ability to decode gestures is preserved (this ability is located in the back part of the brain and therefore is not influenced from the injury) they are very important to be implemented in the robot.
- The number of robots to insert in the center depends on the specific context. The ideal scenario is to have one robot for each person.
- Karl has been in contact with a brain damage center located in Tønder which he wants to collaborate with.
- The Center in Tønder hosts patients with frontal lobe injuries that are between 18-28 years old. They are all in wheel-chairs and have no longer a long term memory, but still a short term memory. They are no longer able to understand complex systems and systems in general. The patients reverse to a childhood-like phase where they do not want to share things with other people and want to be the center of attention.
- Main points for the robot: helping patients with daily tasks and routines, remind them of events. It could be a planner tool that the patients can use, because they, e.g. do not understand how to use a phone.
- Karl's current robot's technical components: Stewart platforms positioned at different height to give the possibility to the robot to move like a torso; large base compared to the upper part to ensure stability (the base would contain the main parts of the engine); still have to choose the type of battery to use, depending on the number of hours of autonomy that are needed, and consider that the robot could go in sleeping mode to save energy when not in use).
- How can this robot be fitted into the environment it is designed for? Depending on the appearance of the robot, people will expect it to have certain functions. If the robot does not meet the expectations, people might get disappointed (e.g. If a robot has arms, people will expect it to be able to use them to grasp things or perform other tasks that involve arms).
- The purpose is to have as little features as possible, while ensuring to satisfy all the patients needs. The aim is not to create a human-like robot because the robot is intended to be a tool (look at M. Mori's Uncanny Valley).
- Technical aspects: ensure safety (Karl's robot is currently using a depth camera and a laser to check the surroundings). The sensors in the robot's base are able to detect if the robot clashes with something and a laser could be used as tool to catch attention as a way to point towards objects.



III. 1.Karl with prototype



III. 1.Robot prototype



III. 1.Robot base

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### Evaluation:

The meeting offered a better understanding of the context, topics to explore and related challenges that the team will have to face during the design process.

### Reflection:

It is necessary to develop a plan to organize the research effort.

The research should cover all the main topics that need to be explored in order to get an insight of the whole system related to the project, e.g. understanding the context for which the product is thought, understand the injury, technical and aesthetic aspects, etc.

**Activity:****Existing Socially Interactive Robots (SIR)****Objective:**

The intention of this research is to get an overview and gain knowledge about existing Socially Interactive Robots on the market, their functions, design and uses.

**Experiment/data:**

Researchers have tested different kinds of robots that are created to improve physiological and psychological health for the elderly. These robots look and have the same size as teddy bears. Studies have shown an increase in happiness among the elderly that have been in contact with these robots. They smiled and laughed more, were more social and less hostile to their caretaker (Ill. 1) (Batalka, 2010).

One of these robots is called PARO (Ill. 1) and is a robot that looks like a baby seal. Tests have shown that PARO contributes to increase the elderly's life quality and helps the caregivers; it reduces stress, it stimulates interaction, it improves relaxation, motivation and socialization.

PARO was designed in Japan in 2003 and tested in both Japan and Europe. It has five kinds of sensors: tactile, light, auditory, temperature and posture. With these sensors, PARO is able to perceive people and the surrounding environment. The light sensor makes it capable of recognizing light and darkness. It feels being touched due to the tactile sensor and being held thanks to the posture sensor. With the audio sensor, it is capable of recognizing the direction from which a voice is coming and recognize words such as its name and greetings. PARO is also able to learn and recognize situations. It can therefore become exactly in the way the user prefers. It can learn to respond to a new name and to react in a specific way when being pet. It will remember last time its name was called or it was being pet. Like any living pet, it also moves a little all the time to show that it is alive (PARO Therapeutic Robot, 2014) (Batalka, 2010).

Other smaller robots as Sony AIBO (Ill. 3) and The Huggable from MIT (Ill. 2) have the same purpose and similar functions (Tapus, A., Mataric, M.J., Scassellati, B., 2007).

**Reference list:**

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**Illustration list:**

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Huggable Bedside Robot Outsmarts Even The Smartest Bear (2015) [Online image] Available at: <http://www.medgadget.com/2015/04/huggable-bedside-robot-outsmarts-even-the-smartest-bear.html> (Accessed: 2 February 2016)

Sony AIBO ERS-7M2 (2004) [Online image] Available at: <http://www.pcmag.com/article2/0,2817,1742094,00.asp> (Accessed: 2 February 2016)



Ill. 1. (Batalka, 2010)



Ill. 2. Huggable Bedside Robot Outsmarts Even The Smartest Bear (2015)



Ill. 3. Sony AIBO ERS-7M2 (2004)

**Evaluation:**

The needed knowledge was obtained, but it is mostly the positive aspects that are reviewed about the robots. The functions of these robots have been identified and will be taken into consideration when creating the robot for this project.

**Reflection:**

Further investigation will be needed to get an understanding of how and when these robots are beneficial to be used. Furthermore another worksheet with SAR robots and prices needs to be created.

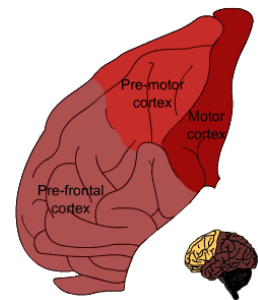
**Activity:****Investigation of Frontal Lobe Brain Injury****Objective:**

Gain a deeper understanding of the type of brain injury Karl's robot-project is intended for, together with the repercussions of such injury, causes and treatment, using on-line research.

**Experiment/data:**

The Frontal Lobe is located at the front of the cerebral cortex and is one of the four lobes of the cerebral cortex. The frontal lobe is divided into three main divisions: prefrontal cortex, the premotor area and the motor area. It is responsible for the motor functions, higher order functions, planning, reasoning, judgment, impulse control and memory. Personality expressions and planning of complex cognitive behaviors are managed by the prefrontal cortex, while the execution of voluntary muscle movement is controlled by the premotor and the motor area. (Bailey, 2014)

The Frontal Lobe is the most common area for brain injuries to occur (Healthline Editorial Team, 2015) when the head hits an object - car accidents, falls, firearms, etc. (Frontal Lobe Brain Injury, 2015). The consequences of such injuries vary from mild to moderate traumatic brain injury (TBI), depending on the area of the lobe that is affected.



Ill. 1. Frontal Lobe (2010)

**Possible consequences are:**

- Disturbance of motor functions which can lead to loss of fine movements and strength of the arms, hands and fingers.
- Display of little spontaneous facial expression.
- Difficulty in speaking.
- Impact on divergent thinking, flexibility or problem solving ability.
- Continuing interference with attention and memory, even after treatment and good results from a TBI.
- Diminishing of the "behavioral spontaneity": fewer spontaneous facial movements, decreased speech ability( left frontal lesions) or excessive (right frontal lesions);
- Difficulty in interpreting the feedback from the environment: repeating a response, risk taking, non-consent of rules and impaired associated learning, etc;
- Impacting the ability of orienting the body in space;
- Dramatic changes in the social behavior, especially when both of the sides are injured. In case of left frontal damage, the person can suffer of pseudo depression, while in case of right frontal injury, pseudo psychopathic damage can occur;
- Atypical sexual behavior as a consequence of orbital frontal damage, or reduced sexual interest from dorsolateral lesions (Centre for Neuro Skills, 2016).

These injuries have no cure, however specialists are offering treatment and rehabilitation programs that help the patients regaining as many functions as possible. Neuropsychologists, psychiatrists, physical therapists, social workers play an important role in assessing the injuries, helping in the process of recovery. Likewise they are assisting the patient and relatives on the process of coping with their new life. (Frontal Lobe Brain Injury, 2015)

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**Evaluation:**

Frontal Lobe Damage is an injury acquired as a consequence of car accidents, falls or firearms. It can have impact on the personality expressions, planning of complex cognitive behaviors and the execution of voluntary muscle movement, depending on the area of the Lobe that is damaged. It is not curable, but specialists are trained to detect the affected areas, train the patients to recover and assist the relatives to cope with the changes.

For this reason, each person can manifest very different consequences in relation to the injury. This means that also the related issues and needs greatly variate from case to case.

**Reflection:**

The research helped in understanding what this injury is about, what are the possible consequences and causes. As further steps, a research on the numbers of centers, patients, professionals is required for a better overview of the injury impact on the population.

Furthermore it could be useful to understand if, despite the difference among the different cases, it is still possible to outline some common issues or needs that are constant for all the individuals suffering from frontal lobe injury.

**Activity:****Numbers and Facts****Objective:**

The objective is to make an online research regarding the numbers of patients that suffer from traumatic brain injuries, more specific people having cognitive difficulties caused by the brain injury. Furthermore, the number of people suffering from cognitive difficulties caused by other diseases will be investigated. Both Scandinavia and USA will be investigated.

**Experiment/data:****Scandinavia****Denmark**

In Denmark, more than 120.000 people live with a brain injury - 75.000 caused by a stroke and 47.000 acquired by other cause.

**The frequency of stroke**

10-12.000 people in Denmark each year suffer from a stroke.

20-25% do not get affected.

About 15% die within the first month.

30% of the people that survive a stroke will never get home again.

Stroke is the 3rd most frequent cause of death in the western world, and every 7th Dane will eventually be hit by a stroke.

Everybody is at risk for getting a stroke, but 70% of the people getting a stroke are 65 years or above.

**The frequency of acquired brain injury**

Close to 9.000 people in Denmark each year suffer from a brain injury caused by a blow to the head, a fall, traffic accidents, diseases, lack of oxygen, tumor, etc.

13% die within the first month.

58% are under 65 years and 23% are under 45 years.

Young men are most exposed to traumatic brain injuries - especially those between 18 and 24 years caused by violence, traffic accidents and lack of oxygen from a heart attack.

**When getting a brain injury, the functions of the body might change dramatically. Some of the changes are as follows:**

**Depression and anxiety**

About 40% of the people that get a stroke experience a mild to moderate depression within the first year.

About 25% experience anxiety. Depression and anxiety often go together.

People with a traumatic brain injury have a higher risk for getting a depression.

**Tiredness**

30% of the people suffering from a stroke feel tired as a consequence of the brain injury. Especially the people that are affected physically.

Depression and tiredness are often seen together, but are independently of one another.

**Aphasia**

Aphasia means lost ability to understand or express speech, caused by an acquired brain injury.

Approximately 1/3 of the people suffering from a brain injury caused by a stroke experience aphasia, when they are hospitalized. After half a year, 25-50% regain the ability to talk.

**Cognitive**

Both people with a brain injury caused by a stroke and people with traumatic brain injuries might experience difficulties regarding their cognitive skills. This is regarding their attention, concentration and memory.

People with a traumatic brain injury may also have difficulties controlling their emotions after the accident.

**Spasticity and Pain**

Between 17 and 36% of the people suffering from a brain injury caused by a stroke develop spasticity and spasms with reduced mobility. This causes difficulties in executing daily tasks because of pains. By 30-40% of the affected people the pain is located in the shoulder of the spasticity part of the body (Hjerneskadet i tal, 2014)(Voksne med erhvervet hjerne-skade, 2015).

## Sweden:

More than 70.00 people get a brain injury each year. 80% are considered mild, 10% moderate and 10% are considered severe (Om hjärnskador, no date).

## Norway:

About 16000 people each year get a brain injury.  
40 people get a brain injury every day.  
30% die within the 3 first months.  
80% brain injuries are caused by a stroke (Omfang, no date) .

## Numbers and facts about people suffering from dementia

### Denmark

84000 people are diagnosed with dementia (Forekomst af demens i Danmark, 2015)

### Sweden

160000 people are diagnosed with dementia (Demenssjukdomar, no date).

### Norway

70 000 people are diagnosed with dementia (Demensplan, 2015).

## Numbers and facts about people suffering from ADHD

### Denmark

It is estimated that 1-3% of the adults in Denmark suffer from ADHD. The exact number is unknown (ADHD i tal, no date).

### Sweden

not available

### Norway

not available

## America

### USA

The number of people diagnosed with traumatic brain injury (TBI) is 2.5 million every year.  
From this number 75.000 die, 275 are hospitalized and 1,365 million are treated and released from the emergency department (Center-TBI, 2016).

### The causes of TBI are as follows:

Falls	- 35.2%
Motor vehicle-traffic crashes	- 17.3%
Struck by/against events	- 16.5%
Assaults	- 10%
Unknown/Other causes	- 21%

### Who is at highest risk for TBI?

Males are about 1,5 times as likely to sustain a TBI compared to females.  
The age groups that are at highest risk for TBI are children from 0 to 4 years and from 15 to 19 years old.  
Certain military duties (e.g., paratrooper) increase the risk of sustaining a TBI.  
Furthermore, African Americans have the highest death rate from TBI.

### What are the costs of TBI?

An estimated cost for TBI in 2000 was \$60 billion in the United States. This includes medical costs and indirect costs such as lost productivity caused by TBI.

### What are the long-term consequences for the United States in relation to TBI?

The Centers for Disease Control and Prevention estimate that at least 5.3 million Americans currently have a long-term or lifelong need for help to perform activities of daily living as a result of a TBI. According to a study, about 40% of the hospitalized people with a TBI have at least one unmet need for services one year after their injury. The most frequent unmet needs were:

- Improve memory and problem solving;
- Manage stress and emotional upsets;
- Control one's temper;
- Improve one's job skills.

TBI can cause a wide range of functional changes affecting thinking, language, learning, emotions, behavior, and/or sensation. It can also cause epilepsy and increase the risk for conditions such as Alzheimer's disease, Parkinson's disease, and other brain disorders that become more prevalent with age (Facts About Traumatic Brain Injury, No date).

### **Cognitive Disorders**

In the United States, more than 16 million people live with cognitive impairments, mostly caused by Alzheimer's disease (Cognitive impairment, 2011).

### **Reference list:**

Hjernesker i tal (2014) Available at: <https://hjernesker.dk/om-hjernesker/tal-og-fakta-om-hjernesker/>

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Facts About Traumatic Brain Injury (No date) Available at: <http://www.brainline.org/content/2008/07/facts-about-traumatic-brain-injury.html> (Accessed 10 March 2016)

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### **Evaluation:**

The numbers of how many people diagnosed with a Brain injury and Dementia are found for Scandinavia. It was not possible to find an estimate of how many that suffer from cognitive difficulties. An estimated percentage of how many people suffering from ADHD has also been found for Denmark, but not for Norway and Sweden.

Furthermore, the number of how many people suffering from traumatic brain injuries and cognitive difficulties have been found for the USA.

Since the number of people suffering from brain injuries and cognitive difficulties is relatively low in Denmark in relation to mass production, expansion to other disorders and countries is needed. At first, an expansion to other disorders with similar difficulties will be made, such as Dementia and ADHD.

In order to expand to other countries, a further investigation of food-cultures has to be made.

### **Reflection:**

A basic understanding of the brain injury extent has been achieved, but it is still unknown how many people suffer from cognitive difficulties. This number has unfortunately not been available.

**Activity:****Existing Socially Assistive Robots****Objective:**

The intention of this research is to get an overview and gain knowledge about existing Socially Assistive Robots on the market, their functions, design and uses.

**Experiment/data:**

There are multiple robots on the market today and for the past 10 years there has been a big development within SAR area. Some of the robots that are considered to be SAR are: NAO, Buddy Jibo and Pepper.

**NAO** (Ill. 2) and **Pepper** (Ill.1) are both created by Aldebarans. They can both be personalized and are able to learn how to behave and develop new skills by observing people.

NAO is a small robot which is only 58 cm tall and Pepper is 120 cm tall. Both robots are able to have different applications installed to fulfill the user's specific needs.

Pepper is hailed as the first humanoid robot and is designed to live with people, to detect specific emotions and react to them. E.g. Pepper will try to tell you a joke if you are sad and if you are happy it will try to join the joy. Pepper is on wheels and NAO has legs to move around.

Pepper has a goal of constant adaptation and self-improvement. It aims to learn from humans and acclimate to their behavior (Who is NAO?, No date) (Who is Pepper?, No date).

**Buddy** (Ill. 3) is a robot created by the French tech start-up: Blue Frog Robotics. It is an open source device, meaning that people can make their own programming. The intention with this robot was to make a companion robot that appeal to everybody. It can both be programmed to be your personal assistant to remind you of scheduled appointments and to keep you on the right track. Buddy can also patrol your home when you are not home and alert you if something is out of the ordinary. Furthermore, buddy can also provide entertainment.

This robot has no arms and work therefore a little like a voice activated smartphone. This limits the functions to verbally assistance and entertainment. Like a smartphone buddy can be used to make video calls to friends and family (Hurst, S., 2015).

Another type of social robot is: **Jibo** (Ill. 4), Jibo is a social assistive robot for the home. It can see, hear, speak, learn, help and relate to people. It can be a personal assistant, a messenger, a photographer, a storyteller and even a companion. When people mention its name, it will pay attention to that person at do as being told. Similar to voice control on a smartphone.

It has a small building camera that actives by movement and are therefore able to patrol when people are not home. Likewise, it can use the camera to recognize people, take pictures and make video calls. Compared to the other robots mentioned, Jibo is much smaller and are not able to move around on its own.

Furthermore, several projects with Socially Assistive Robots are currently being conducted. Some of them have been analyzed:

**Bandit** (Ill. 6) is a hands-off therapist robot designed at University of Southern California/Interaction Lab. It has been designed to engage elderly users in physical exercise aimed at achieving health benefits and improving quality of life while focusing on maintaining engagement through personalized social interaction.

Bandit, is a biomimetic anthropomorphic robot platform that consists of a human-



Ill 1. Pepper - (Roborage, No date)



Ill 2. NAO - (Find out more about NAO, No date)



Ill 3. Buddy - (Hurst, S., 2015)

oid torso (developed with BlueSky Robotics) mounted on a MobileRobots Pioneer 2DX mobile base. The torso contains 19 controllable degrees of freedom (DOF): six DOF arms (x2), one DOF gripping hands (x2), two DOF pan/tilt neck, one DOF expressive eyebrows, and a two DOF expressive mouth.

A standard USB camera is located at the waist of the robot, and used to capture the user's arm movements during the exercise interaction, allowing the robot to provide appropriate performance feedback to the user. The robot's speech is generated by the commercially available NeoSpeech text-to-speech engine and a speaker on the robot outputs the synthesized voice to the user. The robot's lip movements are synchronized with the robot's speech so that the lips open at the start and close at the end of spoken sentence.



Ill. 4. JIBO - (MIT JIBO, No date)

Another similar robot one is called Nico (ill. 5) which is an upper-torso humanoid that has been designed to match the body structure of the average 1-year-old male child. This platform serves as both an interaction stimulus and as a testbed platform for models of social development. Nico has been developed at Yale University by developed by Brian Scassellati and Justin Hart. Nico is capable of self awareness. In fact it has been successfully able to identify the location of its arm in space by referring to its reflection in the mirror. This task required some fairly sophisticated spatial recognition software, and it did indeed mark the first time that a robot was able to reference the location of a part in three-dimensional space by using a reflection.



Ill. 5. NICO - (Scassellati, B. M., 2001)

Clara is another SAR project which has been developed with the aim of being a therapist robot which monitors and encourages a cardiac patient during breathing (spirometry) exercises (Tapus, A., Mataric, M.J., Scassellati, B., 2007).

Cardiac patients post-surgery need to perform regular lung exercises in order to prevent infection and facilitate recovery. The spirometry exercises must be performed ten times per hour for several days, in some cases weeks, after cardiac surgery. The robot control architecture includes:

- Navigation: The robot, Clara, avoids obstacles and navigates autonomously in a hospital room and locates the patient bed which is marked with a laser-reflective marker
- Patient Interaction, Clara interacts with the patients via its speech and video interface: pre-recorded instruction movies and a speech recognition system. The patients communicate with Clara by answering to her yes/no questions.
- Spirometer Tracking: During the spirometry exercise, Clara's vision system counts the patient's breaths by tracking fluorescent color markers on the spirometer.

#### Reference list:

Who is NAO? (No date) Available at: <https://www.aldebaran.com/en/cool-robots/nao> (Accessed: 16 February 2016)

Who is Pepper? (No date) Available at: <https://www.aldebaran.com/en/cool-robots/pepper> (Accessed: 16 February 2016)

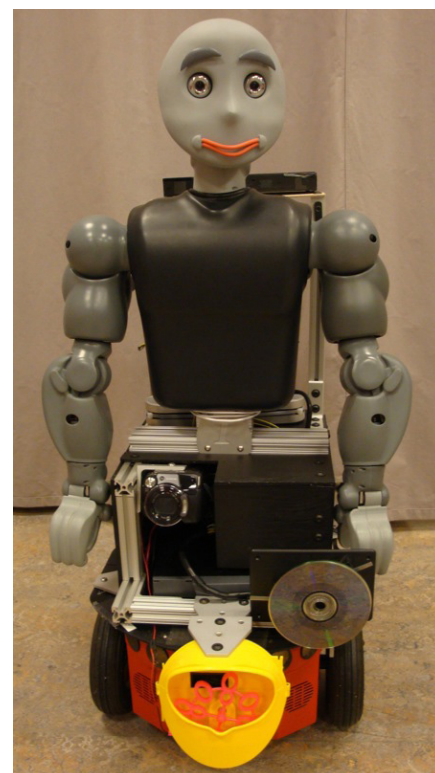
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Ill. 6. Bandit -

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Tapus, A., Mataric, M.J., and Scassellati, B. (2007) *Socially Assistive Robotics, the grand challenges in helping humans through social interaction*. Los Angeles: IEEE Robotics & Automation Magazine.

Feil-Seifer, D., and Mataric M.J. (2005) *Defining Socially Assistive Robotics*. In proceeding of the 2005 IEEE 9th international Conference on Rehabilitation Robotics, Chicago, IL, USA.

#### **Illustration list:**

III 1. Roborage (No date) [Online image] Available at: [http://feber.se/pryl/art/334374/fyllo\\_blev\\_arg\\_i\\_telebutik\\_spa/](http://feber.se/pryl/art/334374/fyllo_blev_arg_i_telebutik_spa/) (Accessed: 16 February 2016)

III 2. Find out more about NAO (No date) [Online image]. Available at: <https://www.aldebaran.com/en/cool-robots/nao/find-out-more-about-nao> (Accessed: 8 February 2016)

III. 3. Hurst, S. (2015) 'tonsofnews', 2014 Robot Christmas Gift Guide [Online image]. Available at: <http://tonsofnews.com/lifestyle/106-2014-robot-christmas-gift-guide/> (Accessed: 11 February 2016)

III. 4. MIT JIBO (No date) [Online image] Available at: <http://www.itmedia.co.jp/enterprise/articles/1407/17/news057.html> (Accessed: 16 February 2016)

III. 5. Scassellati, B. M. (2001), [Online image] Human-Robot Interaction Projects, Available at: <http://www.cs.yale.edu/homes/scaz/Research.html> (Accessed: 16 February 2016)

III. 6. Garcia, D., (2010) Bandit, Little Dog, and More: University of Southern California Shows Off Its Robots [Online image] Available at: <http://www.cs.yale.edu/homes/scaz/Research.html> (Accessed: 16 February 2016)

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#### **Evaluation:**

This research led to a much clearer understanding of the current Socially Assistive Robots on the market, but since the material is written by people that are trying to sell these robots, it only reflects on their positive aspects and functions.

#### **Reflection:**

In general, these robots have a lot of the same functions, and the differences are more based on the size and movements. It seems like the creators behind the robots have almost the same intentions with the robots.

These robots are created to help "normal functioning" people, so in order to make them work for people with some kind of handicap, they will need some adjustments.

**Activity:****Aalborg Sygehus contact**

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**Objective:**

Obtain information about the process that takes place at the hospital when a person get a brain injury. Research made through phone call.

**Experiment/data:**

Information received from the conversation with Aalborg Sygehus:

The patient arrives at the operation area at Aalborg Sygehus either brought by the ambulance after the accident took place, or from the neurology department. The patient is diagnosed with Brain Injury and is operated in the hospital. Depending on the type of brain injury, the operation will either take place in Aalborg or in Aarhus. After the surgery has taken place, the patient is kept in the hospital for few days. The next step varies from patient to patient, according to the evolution of the surgery and the type of injury (it is very different from patient to patient). The patient can either be sent to a neuro-rehabilitation center, or home and then the Hospital will follow the patient with periodic MRs. In relation to rehabilitation centers, Aalborg hospital sends their patients to either Brønderslev or Hammel rehabilitation centers.

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**Evaluation:**

The group obtained information about the first steps in the process that a person follows when suffering from a brain injury.

**Reflection:**

The conversation was clarifying enough for the group to understand the events that take place at the hospital and which should be the next steps: contact rehabilitation centers, patients of brain injury, families of the patients.

**Activity:**

**Market boards - Robots currently on the market**

**Objective:**

In order to find out what robots are currently on the market and in which tasks they are helping, four Market boards have been made. Through those Market boards, the aesthetics of existing robots has been explored, together with their main functions and field of work.

**Experiment/data:**

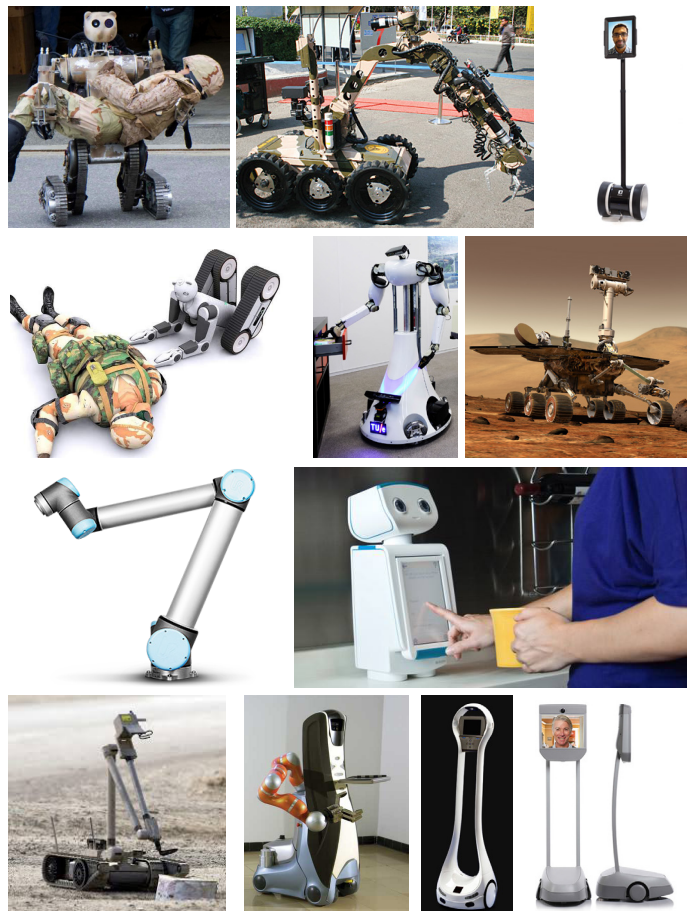
Four Market boards have been made. Market board one and two is presenting Assistive Robots (AR)( III. 1 and III. 2), The first board (III. 1) is created with robots found within the healthcare sector and the second board (III. 2) is created with robots found within other fields of work. Market board three is presenting Socially Interactive Robots (SIR) (III. 3) and is created with SIR robots found within the healthcare sector. The fourth and last Market board is presenting Socially Assistive Robots SAR (III. 4) and is created with robots found within different fields. This Market board is a little different from the other Market boards inasmuch the intention with this project is to create a SAR robot. Therefore, a more detailed description for each robot has been made on this board. Furthermore, there have not been found that many robots within SAR which led to the decision of making a description of each robot.

**Assistance robot (AR)**



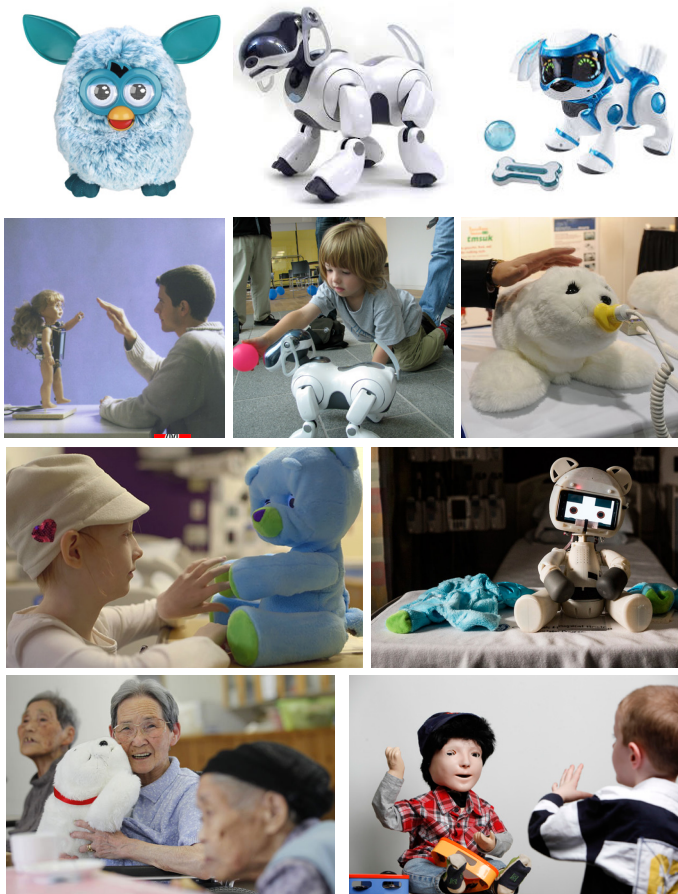
III. 1 - AR within the healthcare sector

**Assistive robot (AR)**



III. 2 - AR within other fields of work

## Social Interaction robots (SIR)



III. 3 - SIR within the healthcare sector

## Socially assistive robot (SAR)



### NAO

58 cm in height, NAO is Aldebarans first humanoid robot. He has continually been evolving since the beginning of his adventure in 2006. Currently in his 5th version, 7,000 NAOs have already been sold throughout the world. NAO is an endearing, interactive and personalizable robot companion. Everyone can construct his own experience with specific applications based on his own imagination and needs.



### Buddy

Buddy the robot comes from French tech start-up Blue Frog Robotics and is an open source device being claimed as the "companion robot accessible to everyone." So what can the robot do?

Buddy can be your personal assistant and remind you of scheduled appointments and keep you on task. Buddy will patrol your home when you are away and alert you if there is anything out of the ordinary. He is a hands-free helper, much like a voice activated smart phone, and can also be used to entertain children with fun games. Lastly, Buddy uses its camera to connect you with loved ones via video chats.



### Jibo

Another crowdfunding success story, Jibo offers similar components to Buddy and is being marketed as the "first social robot for the home." Jibo can be a personal assistant, a messenger, a photographer, a storyteller and even a companion.

What is limited in Jibo, compared to Buddy, is movement. While Buddy can move freely around the home, Jibo stays fixed in one spot, usually on a desk or tabletop. Although, it swivels and follows with its camera, making it always aware of what happens in the room it is in.



### Pepper

Pepper from Aldebaran Robotics is hailed as "the first humanoid robot designed to live with humans."

Pepper is the most emotionally-based robotic invention of the bunch, designed to specifically converse with users, recognize and react to emotions, and move and live autonomously. Pepper is designed to detect specific emotions and base how it acts off of this. So if you are sad, expect Pepper to tell you a joke. If you are happy, Pepper will want to join in on the joy.

Pepper has a goal of constant adaptation and self-improvement. It aims to learn from humans and acclimate to their behavior. Aldebaran's goal is to have Pepper be the foremost robotic product to have in the home.

<http://techembuilder.com/emagazine-articles-1/rise-social-robot-fact-fad>

III. 4 - SAR with a description of each robot

## Evaluation:

This task met the objectives and gave a basic insight in the existing robots on the market.

## Reflection:

It gave a good starting point and overview of what kinds of robots are currently on the market. A deeper exploration has to be made to fully understand the potential of these robots, both compared to replace human power and safety. A further exploration will also give an understanding of the mechanical, technical and software related parts of a robot.

**Activity:****SenhjernesgadeCenter Nord in Frederikshavn description****Objective:**

Describe the SenhjernesgadeCenter Nord in Frederikshavn, how does the system of the center work, the management of the employees, the residents, the building's structure. The research is made by visiting the center and interviewing some of the people there, together with desk research.

**Experiment/data:**

The SenhjernesgadeCenter Nord in Frederikshavn (SCN) is a residential facility established in 2012 that offers 24 hours staff coverage and integrated day care for people that suffer from brain injuries. They are called residents since they are not considered as patients, but as normal people that have their homes in the center.

The groups of adults that are entitled the right to join the center are:

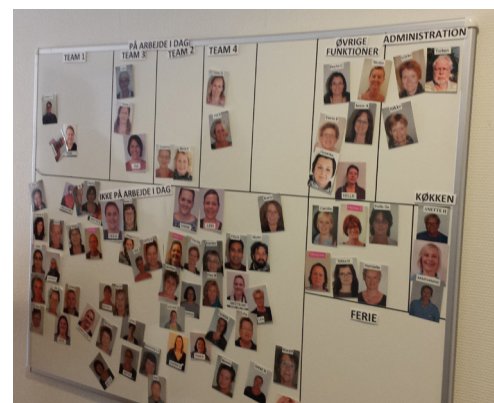
- Adult citizens with acquired brain injury with moderate to very severe cognitive and functional decline.
- Adults that have completed the health care treatment.
- Adults entitled to special residential facilities.
- Adults for whom assistance cannot be provided through another option.

The center is established as a Living Lab facility, due to the interest of optimizing the circumstances and living conditions for people suffering from brain injuries (Frederikshavn Kommune 1, 2016).

SCN Living Lab is an approach that works on creating knowledge, products and solutions to be used within the area of acquired brain injuries. It allows users to be involved in innovation processes with the goal of beginning new innovation collaborations with citizens, relatives, employees, researchers and companies. The opportunities are to innovate in areas like brain injury communication, the good interaction between residents and staff, interior design, interactive rehabilitation and solutions for which they have an open network for private companies and research institutions (Frederikshavn Kommune 2, 2016).

The center comprises of 24 apartments, out of which 20 are currently rented. The center is divided into two wings, the west and the east wing, with the administrative building in between. On each wing of the building, there are approximately 10 residents.

In total, there are more than 80 employees working at the center. On an everyday basis, there are about 15 employees, without counting the administrative staff. They have a board where all the employees' pictures are placed, according to their working program (Ill. 1). The core competencies of the different employees hired at SCN can be found in the following list:



Ill. 1. Board with employees' schedule

**Occupational therapists** assess the residents' skills, functional level, need for compensating aids, accessibility in the home and its surroundings. Likewise, they help with training and daily activities.

**Physical therapists** instruct the residents in scheduled training such as balance, coordination, endurance and body functions. Likewise, they also assess the residents standing and sitting positions, walking, muscle strength, range of motion etc.

**Nurses** assess the residents' need for care and personal assistance. They prepare scientific assessments with e.g. incontinence problems and pressure sores.

**Pedagogues** are working with initiatives that contribute to life quality, learning and personal development. This could be the development of social skills and relationships.

**Social and healthcare assistants (SSA)** are focusing on undertaking basic nursing tasks for each resident, as well as care assignments and tasks (SCN Living Lab, 2014).

For every 5 residents there are 3 from the staff that take care of them. And even so, there are moments when the caretaker feels overwhelmed by the tasks to perform.

The staff arrange activities for the residents such as: bowling, cooking, playing creative games, play music, visit farms, play board games. Pictures from these activities are placed on a board in the center.

The age of the current residents at the center is from 28 to over 70. They are free to walk in all areas of the center, go outside and those who are capable, can go shopping by themselves. They are completely free, to do as they want within the center's area. The privacy is highly respected so the caretaker always knocks at their door before coming in. The caretakers also propose activities, that the residents can participate in if they want to.

The residents have very different degrees of independence: Some of them have a brain damage that only affects the cognitive skills and other patients are fully paralyzed and therefore completely dependent on caretakers. As an example, one resident is completely paralyzed and had a tablet with the alphabet in front of his face, where he could use his sight to type in his thoughts.

The residents' conditions is very different from one another and even so they are all classified as "severe brain injury" because they are not able to cope with everyday activities by themselves. Diversity in needs and conditions of brain injured people is therefore a very important factor to take into account.

Some of the residents have rehabilitation programs, either every week or more rare, depending from case to case.

### Information from the interview with Stine, pedagogue

There are 3 shifts: Stine works on two shifts: the morning and the afternoon shift. For the night shift, there are other people coming.

She tells that the center is the last place the patients can come to, after all the rehabilitation has taken place. This means that the person's state is relatively stable and is not expected to change or improve.

They have meetings with the residents where they propose what they would like to do, such as: trips, going to the swimming pool, cooking together, etc. According to the proposal and the circumstances that are involved, they decide.

They have a writing specialist coming once in a while - a person from outside that comes to the center and helps the residents learn how to speak.

Furthermore the residents get massage and go to swimming.

### Observations on the building

Most of the building is on the ground floor and only a few rooms are located on 1st floor such as meeting rooms and creativity rooms. The environment is very cozy, big and spacious (III.4). There are big common areas for meetings, where all the residents can gather, chat, drink coffee, play, etc (III.2). There are outdoor areas where residents are able to spend their time (III.3).

The doorsteps inside the building are very low, about 1 cm, so the wheelchairs are able to pass without problems (III.4, III.5, III.6). The doorsteps at the exit doors are a little more pronounced - they could pose some problems for the future robot (III.7). They have parquet or concrete as a floor, and a few small carpets lying around.



III.2. Area for creative activities - play piano



III.3. Outdoor area



III.4. One of the common areas



III. 5. Doorstep inside the building



III. 6. Doorstep at an exit door

### References:

Frederikshavn Kommune 1 (2015) *SenhjernesgadeCenter Nord i Frederikshavn*. Available at :<http://frederikshavn.dk/Sider/SenhjernesgadeCenter-Nord-i-Frederikshavn.aspx> (Accessed: 12.02.2016)

Frederikshavn Kommune 2 (2015) *Living Lab*. Available at: <http://frederikshavn.dk/Sider/Living-Lab.aspx> (Accessed: 11.02.2016)

SCN Living Lab (2014), *SCN Living Lab Koncept Manual*, Frederikshavn kommune.

### Illustration list:

- III.1. Board with employees' schedule (Own illustration)
- III.2. Area for creative activities -play piano (Own illustration)
- III.3. Outdoor area (Own illustration)
- III.4. One of the common areas (Own illustration)
- III.5. Doorstep inside the building (Own illustration)
- III.6. Doorstep at an exit door (Own illustration)

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### Evaluation:

The SenhjernesgadeCenter in Frederikshavn is a complex facility that offers shelter for people that suffered from brain injury, passed the rehabilitation phase and their condition is stable. Its structure does not pose major impediments for robot or wheelchair mobility. The ambiance sets a cozy environment, making it as much as possible for the residents to feel like home. It could be challenging to make a robot that would fit multiple residents' needs.

### Reflection:

The visit and Online research regarding the SenhjernesgadeCenter in Frederikshavn helped on getting an idea of the center, the management, the residents and the site itself. The insight from the caretakers set us a starting point for further research that plays a crucial role in the current stage: make more investigations, by visiting, interviewing and desk research.

**Activity:****Visit no. 1 to Senhjerneskadecenter in Frederinkshavn****Objective:**

Make a group visit to Senhjerneskadecenter in Frederikshavn (SCN) together with Karl Damkjær (robot researcher at AAU) and one of his robots, the Double Telepresence Robot. The intension is to present the robot, observe their reaction to such technology and get insight on possible leading tracks. Live presentation, semi-structured interviews and observations are the methods used throughout the visit.

**Experiment/data:****The Robot**

The Double Telepresence Robot is manufactured by the Double Robot startup company and it offers the possibility of attending a meeting without being there in person. It has a platform for placing an I-pad, it is a battery powered engine, it has a camera kit and shock absorbent wheels. The I-pad is placed on the robot and, by a simple configuration, it creates a live platform for communicating between two entities, no matter the distance between them. The robot has to be turned on and set to the Double application manually, and afterwards, it is automatically controlled by the person behind the screen, with the use of Wi-Fi (Introducing Double 2, 2015).

**The Circumstances**

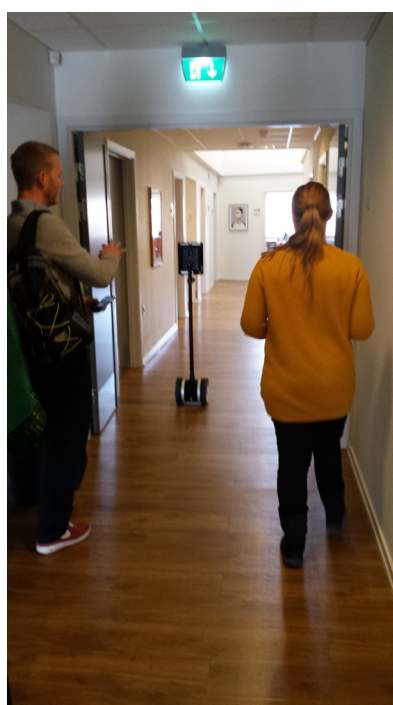
The team together with Karl Damkjær visited the SCN on the 9th of February to present the Double Telepresence Robot and to make a demonstration of its functionality. Arrangements were done with Anne Abildgaard, Project Manager at SCN living lab to visit the center and have a coffee meeting with people within the house. (Refer to Worksheet no. 08: Senhjerneskadecenter Nord in Frederikshavn for a better understanding about the center, people managing the activities and residents).



III. 1. Double Robotics Telepresence (2015)



III. 2. The Double Telepresence Robot in the Center, 1



III. 3. The Double Telepresence Robot in the Center, 2

**The Setting**

After a small introduction of each other's backgrounds and elaborating on the project with Anne Abildgaard, we proceeded to the coffee meeting that took place in one of the common areas of the center. Throughout the meeting, a number of approximately eight residents participated, most of them assisted by a caretaker or pedagogue.

When we entered the common room, there were already around five residents at the table, drinking coffee, tea or eating biscuits. They seemed used to having guests, since they did not react in any inappropriate way, just they looked at us with curiosity on their faces. Anne suggested that we should interact with them, not just stay and observe. We joined them at the coffee table and Karl started preparing the Robot for demonstration. The residents were already inspecting it curiously.

## The Presentation of the Robot

Karl presented the robot, showed its functionality by letting the robot drive around in the coffee room. He went into another room, from where he controlled the robot and had a video-conference with the residents and staff attending.

## Feedback from the residents

At first, the residents seemed a little shy, but also amused and made “car” sounds while the robot was moving around. It did not take much time until they got used to us being there and soon some of the residents started to talk, and having conversations with us, asking questions about the robot. They did not seem afraid of talking through the robot with Karl. One of the residents seemed very interested in the robot.

He had a car accident in the 70's when he got an injury on the Frontal lobe and most of his short term memory is gone. He remembers everything before the accident but now he is having a hard time differentiating between what he has said before and what not. He was sitting in a wheelchair.

Him and Karl were having conversations for most of the visit, due to the resident's interest in the technology and the mechanism behind the functionality. He was though also worried about the factor of privacy, since he was not interested in being monitored. The resident mentioned that some might be scared if the robot would keep following them, to try to get in touch with them. He also mentioned that he was very positively surprised about the robot.

One of the caretakers after getting to know the topic of research, proposed a robotic wheelchair with annex screen able to provide information to the patient and drive them around. Her argument was that the residents have more than enough electronics attached to them already.

## Feedback from Stine, pedagogue

When discussing the implementation with one of the staff members, Stine, she considered that having a robot in a center like this would not be very practical. She mentioned that a person would be able to interact much better and easier with the residents. When considering the Double Telepresence Robot, she mentioned that for instance, the camera can just visualize a small area (such as a person's face) and this would not allow to notice anomalies/movements in other parts of the body to be seen. For instance, if the resident would twitch his leg, known by her as a sign of nervousness and therefore not a good sign, it would not be visible by the robot in the camera spectrum. On the other hand, a person directly interacting with the resident would notice and react in a way to soothe the situation.

## Notes for the Robot

Along the visit, several ideas were generated by the caretakers, residents or were observed by us:

- It should keep a personal distance to people;
- It should not “stalk” people, keep following them if they don't want;
- When talking to somebody through the robot, it would be nice to have eye contact;
- It should look “cute”;
- Name suggestions for the Double Telepresence Robot: Roboto, Hr Skærm - Mr Screen;
- Some kind of body language would be preferable;
- It could help people finding their way on a hospital, or serve as a guide for people to find their way in the center;
- It should be able to move around by itself and remind the caretakers and residents of tasks and activities;
- It could have a divided screen or more screens: one screen with the video call and one with a keyboard to write on. This could be needed for the residents that are not able to talk, but that are able to type in a message. The second screen can also show a picture of a task the resident should do. E.g. “Taking a shower” will show a picture of the shower. It could also show a button with “yes” and “no”, where the resident is able the push to answer a question;
- It could need a function for non-verbal communication;
- It could help some of the residents to sort their laundry;
- It should be able to see the resident's entire body to notice the resident's body language.

## Reference list:

Introducing Double 2 (2015) Available at: <http://www.doublerobotics.com/> . (Accessed: 11 February 2016)

Illustration list:

- III.1. Double Robotics Telepresence (2015) [Online image] Available at: <http://www.gonnawannagetit.com/product/double-robotics-telepresence/> (Accessed: 11 February 2016)
- III.2. The Double Telepresence Robot in the Center, 1 [Own creation]
- III.3. The Double Telepresence Robot in the Center, 2 [Own creation]

## **Evaluation:**

The visit to the center in Frederikshavn has proved to be very helpful as the starting point for the project and our first visit on the field. The presentation of the robot went well, the residents seemed comfortable around it and some of them presented high interest in knowing more about it. The feedback received from the pedagogue interviewed, Stine, seemed not very promising in relation with this specific robot, but her insights are relevant and useful to keep into consideration. She told that when working with people suffering from brain injuries it is very important to see the Body Language of the resident. Likewise it was very important to know every person in the center's way of reacting in order to respond properly. This means that the robot should have a very detailed profile of each resident it is surrounding.

## **Reflection:**

Working with people that suffer from brain injuries is a very complex matter and in order for us to get a proper understanding of the area, further visits, interviews and research have to be made.

For the next visit to Senhjernesgade Center Nord in Frederikshavn, we plan to bring sketches or models of the solutions we would have by the time. This would hopefully offer a better understanding on the direction that our project is heading to.

**Activity:****Resident Categories****Objective:**

In order to understand the level of needs and abilities people with brain injuries are facing, we have been provided with a categorization based on the residents living at the Acquired Brain Injury Center in Frederikshavn (Senhjerneskade Center Nord - SCN). This Categorization has been translated into English with focus on what information we need to know. This information has afterwards been used to narrow down the focus-category / target-group.

**Experiment/data:**

At the acquired brain injury center in Frederikshavn (SCN) the residents are divided into 3 categories according to how much support and care they are receiving. On the graphs in the following chapters, 0 is reflecting self-reliant and 100 is reflecting constant need of help. The numbers represent the residents (Ill. 1, Ill. 2 and Ill. 3).

**Category 1**

The residents in this category are relatively active in relation to the support and care they are receiving (Ill. 1). They need moderate support for managing and structuring everyday life and activities. At SCN, there are four residents in this category in the age group: 30-60.

The cause of the residents' brain injury is traffic accidents.

**Mobility/physical functional difficulties**

The residents in this category vary from walking to being active wheelchair users.

They need a little to moderate verbal guidance in personal hygiene. Some of the residents are self-reliant while others need a little physical guidance/help.

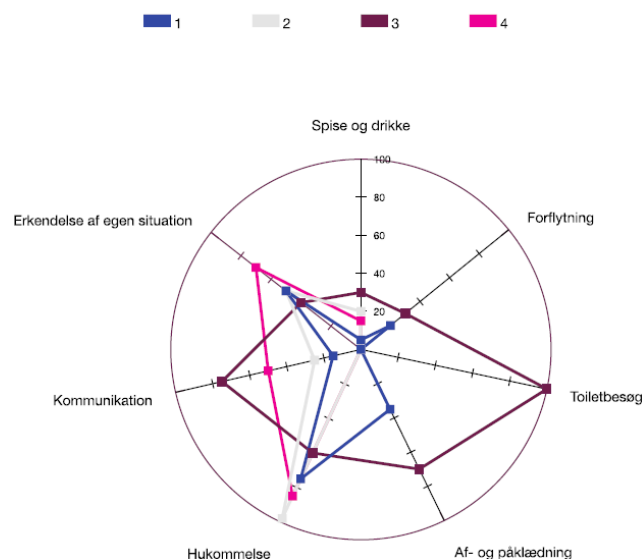
**Mental functional difficulties**

The residents vary from having a good memory to having challenges with their short term memory. They have preserved most of their language skills and need moderate guidance.

**Communication and cooperation**

These residents need clear and specific communication otherwise they might have a slightly choppy or aggressive reaction. Likewise, if they are exposed to too much stimuli, they will react in this way.

In general, this group is a very stable and resourceful group at SCN. They are able to be alone and without guidance in many situations.



Ill. 1 Graph reflecting the level of independence for residents in category 1 (Senhjerneskadecenter, 2015)

## Category 2

The residents in this category need extensive support when executing an activity or task (Ill. 2). Likewise, they need support when being together with other people. At SCN, there are 11 residents in this category in the age group 30-70. The cause of the residents brain injury are given by either a traffic accident, a clot in the brain or something else.

### Mobility/physical functional difficulties

The residents in this category vary from being walking to being active wheelchair users. They need a little to moderate verbal guidance in personal hygiene. Some of the residents need a little physical guidance/help, whereas others need a lot of physical guidance/help.

### Mental functional difficulties

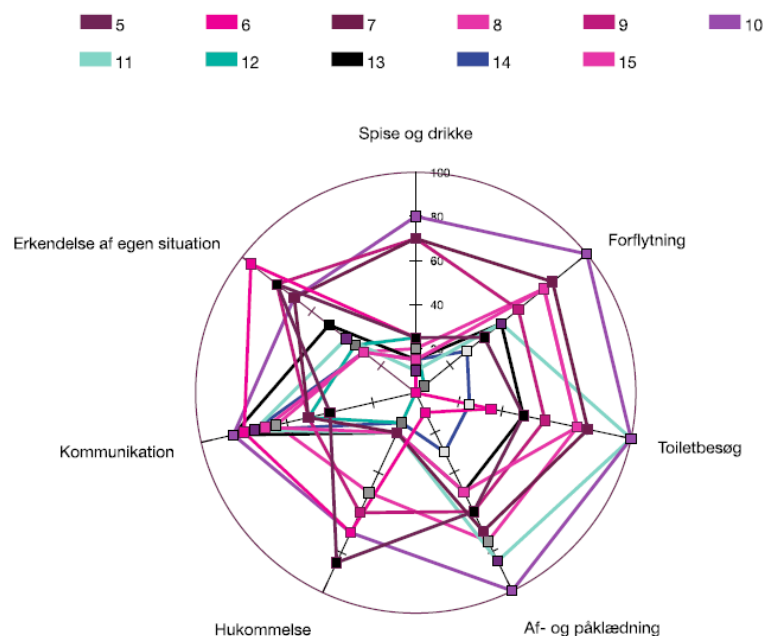
The residents vary from having a good memory to having challenges with their short term and long term memory. Some of the residents have preserved most of their language skills while others are not able of talking. In these cases the communication will be through signs and writing.

### Communication and cooperation

These residents need clear specific communication and repetitions. When communicating with these residents, a lot of patience and breaks are needed.

Several of them need rest through the day and if they are exposed to too much stimuli they will be frustrated.

They can be left alone for a shorter period of time but need a caretaker to provide support and safety when they have to execute a task.



Ill. 2 Graph reflecting the level of independence for residents in category 2 (Senhjerneskadecenter, 2015)

## Category 3

Residents in this category need a lot of support in order to perform an activity or task (Ill. 3). Some of these residents are not able to perform activities on their own.

There is a great variation in the skills of each resident and ability to perform physical activities, communicate, getting along with others, remember, organize everyday life, etc.

At SCN there are 5 residents in this category in the age group 20-60.

The cause of the residents brain injury are given by either an accident, illnesses or something else.

### Mobility/physical functional difficulties

The residents in this category vary from being able to walk to being wheelchair users. They need a lot of verbal guidance in personal hygiene or physical guidance/help.

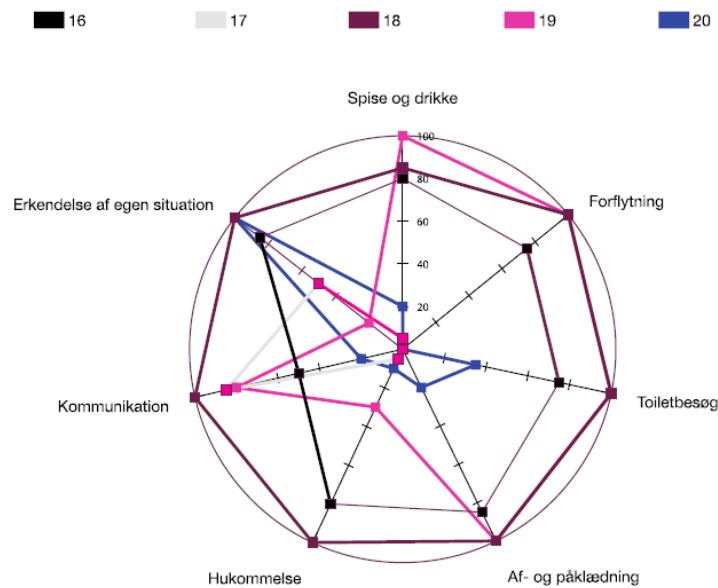
### Mental functional difficulties

The residents vary from having a good memory to having no memory about their previous or current life. Some of the residents have preserved a little of their language skills while others are not able of talking. In these cases, the communication will be through signs and writing.

## Communication and cooperation

These residents need clear specific communication and repetitions. When communicating with these residents, a lot of patience and breaks are needed.

Several of them need rest or naps throughout the day. Some of them need a lot of pedagogical support through the day while others need a lot of help to personal hygiene. A few are able to be alone for a short period of time.



III. 3 Graph reflecting the level of independence for residents in category 3 (Senhjerneskadecenter, 2015)

The information used for this worksheet can be found in the report by Senhjerneskadecenter Nord (2015), Likewise it can be found attached as Appendix 3 - SCN Living Lab Koncept.

## Reference list:

Senhjerneskadecenter (2015) *SCN living lab koncept manual*, Frederikshavn Kommune

## Evaluation:

From both the visits and the paper SCN Living Lab Koncept, it has been made clear that the target-group has to be narrowed down. So far, the target-group has been people with Traumatic Brain Injury (TBI).

The intension is to create a robot that is able to help, support and guide a person with TBI to perform a task or to remind to do a task. Likewise, it is the intension that the person with TBI should be able to do the tasks by him/her self without a caretaker. From this worksheet it is made clear that people which are placed in Category 3 need too much help and support from a caretaker to perform a task. People in category 3 will still need a caretaker in order to use the robot and might not even understand what is going on. Therefore we will not be focusing on this group of people. Since category 1 is able to do tasks by themselves, but still need verbal guidance to perform some tasks, this category will be our starting point. Some of the residents from Category 2 might also be able to understand to use the robot, but this has to be tested later when a prototype is made.

## Reflection:

From this categorization it is made clear that the residents are very different. Therefore, the next point will be to ask for permission to follow a resident for a day or to get a persona description of some of the residents.

**Activity:****Meeting with Matthias Rehm****Objective:**

Have a meeting with Matthias Rehm and discuss about our projects and a possible collaboration that could bring benefits for both parts. Face to face meeting at Create Building, Rendsburggade, Aalborg.

**Experiment/data:**

Matthias Rehm is an Associate Professor at the Faculty of Engineering and Science, Department of Architecture, Design and Media Technology, Aalborg University.

He has previously been working on a pilot project that spanned on a period between 7th and 10th semester. The project was about a robot lamp that had the tasks of reminding the residents at an elderly center of doing daily tasks like getting dressed. The lamp would use sounds and light to remind them of tasks. This was identified as very useful for the care-takers, because they were annoyed by the many repetitions and the time consuming task of reminding the residents that they have to get dressed.

The project stopped at the stage of testing, due to missing funds. One of the current robot manufacturers is releasing JIBO, a robot that will be able to perform these tasks.

Matthias is currently working on a project for SenhjernesgadeCenter Nord in Frederikshavn, together with Antonia Lina Krummheuer, Assistant Professor at Department of Communication and Psychology and one more researcher.

The project is planned to span over a long period of time because it is intended to exploit an approach that aims to concentrate on understanding the specific context, and afterwards develop a solution tailored to the specific identified issues. The project started two years ago, and they have started field research two weeks ago. The field tests they are doing is visiting the center every day, from 7:00 to 17:00, for continuous observation of the context. This includes participating in the work life, everyday life, socializing with the residents, observing daily tasks of the caregivers, blend within the team (filming, recording activities), etc. They have worked on creating a bond with the residents, winning their trust and getting very useful insight from a center with those settings. Creating this bond plays a crucial role.

After this stage ends, they are planning to make workshops with the staff that would align the project's solutions with the final user's needs.

He mentioned that the residents are very different one from another, and there are not two residents that have the same needs. It would be very hard to create a robot that would target more patients, since it seems very hard to find a common need for them.

In his opinion, the concept of transferability is not possible. His team develops a solution for a very specific context and user. Afterwards, they will see if the concept can be useful for other users.

We also discussed of our visit to Brønderslev (Worksheet no. 12): more structured schedule and more clear procedure. To this he said that Brønderslev would maybe be more suitable for a robot that can help more people. At Brønderslev, the patients might have more of the same issues.

**Evaluation:**

The meeting was very useful in order to obtain a different point of view on the project's context and scope. He made us realize that we might not have the time to understand the residents at the acquired brain injury center in Frederikshavn. Likewise, he said it would take a lot of time to build up the trust to go and observe the residents, time that we do not have. For his team it took around two years.

**Reflection:**

The interview was very useful and gave good insights. He knew a lot about the center and because of his feedback we realized that we either had to change direction or narrow down the scope of the project. If we were planning on extending the project, a collaboration might have been possible.

**Activity:****First visit to Brønderslev Rehabilitation Center****Objective:**

Get an understanding of how rehabilitation center works for people with TBI. Understand the system, what is the journey of the patient, etc.

**Experiment/data:**

The Team made a visit at Brønderslev Rehabilitation Center on the 17th of February, where a meeting with Nicky Møller was established.

Nicky Møller is a physiotherapist with 10 years experience at Brønderslev Rehabilitation Center.

He works with both patients who had suffered from stroke and from brain damage.

He also supervises physiotherapy students and students from UCN, which can also be nurses.

Besides the work at the Center, he has a collaboration with a company that is making a project about electrical stimulation for feet.

00:03:42 Patients stay in the center from a minimum of one month to a maximum of 4 / 5 months, depending on the severity of the damage.

00:05:16 **Patients** stay at the center during the week and if their condition is evaluated as good enough to be spending some time at home, then they can go home to spend the weekend. Prior to that, there is an inspection of the house from the center to ensure that the house is suitable and prepared to welcome the person suffering the injury e.g. are there stairs, is it easy to reach the bedroom. But if the patient is not evaluated as ready to spend time home, then he will not go home during the weekend. Often, to re-introduce the person in the environment of the house, at the beginning, the person is sent home just for few hours and the time spent home is progressively increased along time (reaching one night, then two and so on: from Friday to Monday morning).

00:06:25 The hospital in collaboration with the center and the relatives decide when the patient is ready to go back home. The time spent home by the patients is also good because then they can report to the professionals in the Center what are the difficulties that they encounter in their everyday life.

00:07:45 Many of the people suffering from Traumatic Brain Injury, from his experience, are not using the wheelchair for a long time, but rather are suffering from cognitive problems (which is the biggest issue). But this also depends on how severe the brain damage is.

00:08:23 **The Center** is made in 2 floors (2 groups of patients in each floor). There are 10 patients of Brain Injury and 37 in all the institute. The patients suffering from Brain Injury are clustered in the same area, in order to be able to provide them the specific care they need (more focused on cognitive problems).

00:09:23 **Daily routine:** the professionals at the center make a Weekly Schedule for the patient that he has to follow. The schedule is made in co-operation with the patient.

There are Goals Meeting set with the patient: 3 or 4 major goals are established (and some minor goals as well). The schedule can be very full or less intense. It very much depends on the patient's status.

00:11:11 It is **not possible to generalize** patients' issues and needs because, especially for people with brain damage, the issues can greatly vary (from problems with memory, to orientation, solving tasks, attention, etc.). It is not possible to outline some common issues for brain damage in different areas. But if we are speaking about a specific area of the brain, usually there are some common issues, but at the same time, since the different parts of the brain are very much connected, it is still not easy to generalize.

Frontal lobe issues usually are: controlling themselves, social behavior, etc.

00:13:40 Some of the patients are allowed to go out by themselves if they are able to orientate, traffic safe (patients are usually not violent, might be angry).

00:14:30 Patients arrive from the Hospital, then they stay at the Center. Sometimes they can go afterwards to another place if they do not get better (for example Hjernesgade center).

Phase 1 (acute phase), Phase 2 (is in the center) then they go to the community (home).

00:16:00 Can also go in a center in **Strandgården in Nykøbing Mors** (have their own apartment, make food together, they live there but they have professional supervision and training).

They can also go to Senhjerneskade Center but is sometimes a later stage maybe after they have been to Strandgården. It very much depends on which Municipality they are from (e.g. in North Jutland there are 9-10 Municipalities and every one of them has a different approach to patients) some of them think is good to go to Strandgården but some think that it is better if the patient goes back home in the community. Therefore, sometimes they go to the Hjernesgade center, but a factor that influences that is also that not all the Municipalities have the possibility to send patients there.

Normally, they go from Brønderslev to Strandgården, where they usually start with a 3 months stay, then they make a status seminar to decide if the patient needs to stay 3 months more. It is not a permanent place, only in rare cases they stay up to 1 year. Patients number: around 8/9.

#### 00:18:40 **Economic Issues**

There was a center in Sindhal which closed because if the patients go home is the community that pays for the rehabilitation, but if the patients stay for instance at Strandgården, the community will have to pay the center which is much more expensive.

That is why some communities want the patient at home in order to save money. But the problem is that often they don't have the skills to take proper care and give proper assistance to the people who are suffering from the injury (because is needed very specialized skills to work with this kind of patients). Sometimes, the decision of sending them to the more expensive rehabilitation centers depends on factors as: age (if a person is young and has many years in front in which he needs to work, or has a family to look after, then more effort will be given in trying to make him regain more skills so they will more likely send him to Strandgården; if the person is old, more likely it will be decided to send him home instead a very long time of rehabilitation).

00:20:04 Anyway, now is more and more difficult to be able to send the patients to centers as Strandgården because the **Kommune** prefers to send the patients home (after Brønderslev) and have the community taking care of them in order to reduce costs. The Kommune does not have the skills to take proper care of these patients but they are getting better and better because now almost in every community they have special teams with neurological skills so that they can manage those kind of patients better.

#### 00:21:00 **Age group**

He observed that an age group that he sees more often of people suffering from brain damage are younger people suffering from car accidents, working accident (falls), etc.

All patients are very different one from the other.

**Hammel** center is almost the same as Brønderslev but takes care of more severe injured patients (from Northern Region) because they have more resources.

In Brønderslev, the physiotherapists and occupational therapists are available in day time from approximately 7:00 to 16.30.

In Hammel, the physiotherapists and occupational therapists are available all day and also in the weekends, they also have more nurses and so on.

So if a patient is very severe, he will go first to Hammel and then to Brønderslev when he gets better.

Ulla explained the project and asked what are the tasks in which Nicky would imagine the robot to be useful for?

00:25:00 It already exists an app. that helps people with memory issues - to organize activities (help e.g. explain the steps to make coffee)

Occupational therapist is the one that takes care of daily living activities (washing, toilet, bath, laundry etc.)

It is not possible to put on a scale or define common issues for example to define what exactly are the issues for mild or severe injury. Because a severe injury could leave a person without good mobility skills but to another could just cause cognitive issues.

Not possible to generalize because there are different degrees and combination of physical problems and cognitive problems. Not possible to make such a scale. But you have some tests about cognitive and separately physical abilities but is not common to have them combined.

Is a mix, you have to look at different areas.

Many cognitive problems are difficult to notice that is why they also have a neuropsychologist.

00:31:21 **Professionals:** physiotherapist, occupational therapist, nurses, doctors, neuropsychologist

Also families and relationship with them is very important to obtain help for the injured person. It is different to be home few days a week then stay for a long period.

The first period back home is going to be very hard for the patient, he has to see if he is able to deal with all the issues related to everyday life.

00:31:37 Here he says is **“like a hotel”** the center make a schedule for the patient, they make food for them (usually they can not cook for hygiene reason)

The group of Traumatic Brain injured every 2nd Wednesday make dinner together with 2 therapists  
But otherwise the occupational therapists make everything for the patients.

00:32:25 **HAVING A STRATEGY OF REINTRODUCTION TO EVERYDAY TASKS** would be the best thing. Because there is kind of a trauma from being served and helped in everything and then from one day to another have to do everything by themselves. This is currently a big issue especially for patients with cognitive problems.  
The environment in the facility is not especially tailored for helping this kind of patients.

IT WOULD BE GOOD TO TRAIN THEM IN THEIR OWN HOMES but this is not possible for a question of **resources**.

Nicky says when he started in 2006 they were working much more on home training but now is not so often anymore because is very time consuming: you might have to drive 1h to reach the house and then train about 45min./1h and then drive home again. So it would be 3 h. When instead staying at the facility, in those 3 h he could treat 3 patients. Even though research says that would be better to work with the patient in their home.

In Hammel they have a unit where they can train independently better than here (cooking, make schedule etc). Sometimes in Brønderslev. they also try to reintroduce a little everyday life (e.g. grocery shopping) but not as much as it would be needed. Because they do not have to manage their own everyday life.

00:36:30 **After the patient goes back to the community**, he will still get professional help.  
Usually 2-3 times a week (around 1 h each time), depending on how severe the damage is. Depending on the case, they do the training either in a center or at home.  
But he says it is not enough because at the center they do training almost every day (around 20h a week).

Research says that the earlier you start rehabilitation after the injury, the better. The brain is more plastic within the 3 months after the injury. But recent studies say that you can get better even for a window of 6-9-12 months, even 2 years. But still the biggest progress is in the first months.

Every 3rd week there is a status meeting to see how the patient is improving (3 weeks at the time). Also the problem is that in the center they do specialized training to achieve goals, while out in the community they do generalized training. Intensity of the training is very important. RESEARCH on it from Netherlands: Gert Kwakkel (Intensity of practice after stroke: More is better Gert Kwakkel Professor in Neurorehabilitation, Department Rehabilitation Medicine, VU University Medical Centre Amsterdam, The Netherlands; and Rudolf Magnus Institute of Neuroscience, Department Rehabilitation Medicine, University Medical Centre Utrecht, The Netherlands).

During training some people are approached with verbal communication, but others, they can better understand gestures, and you have to show them with your body.

You can not generalize

Memory vs. Attention (focus) regarding understanding communication - RESEARCHER neuropsychologist Keit Meiler from England (5 different forms of attention)

In which area is the robot going to help the people?

00:44:00 Make solution or device that can help with cognitive problems in some manner. Because it is easy to see when there is a mobility problem, but the cognitive issues are not visible (hidden) and for this reason it is difficult to understand from people that are not suffering from the injury.  
It is a very difficult area because it variates so much depending on the importance of the damage, on age and many other factors (many parameters to take into consideration).

00:47:00 repetitive training is useful for brain plasticity, something that can help the person to perform the training exercises and also help him counting how many he has already done can be useful.

00:49:51 The robot should be intended as a tool to help the caretaker taking care of the patient. But it would not be a

substitution to the caretaker.

Training is usually made on the floor, it is usually not used a video. But usually it is just patient and physiotherapist.

Mitii Interactive System: shows what the patient has to do during the training

We can get in contact with Occupational therapist: Anja, to get more information.

00:56:27 Relatives here usually call each other by phone. They usually do not skype.

No place for relatives to stay at the center. Sometimes they stay in the patient room. But in general it is forbidden to do so.

00:57:00 Usually patients with TBI (Traumatic Brain Injury) have one room for themselves because their behavior and emotions are less stable.

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### **Evaluation:**

Has been collected useful material for a better understanding of how TBI is treated in rehabilitation centers also on a system level.

### **Reflection:**

The occupational therapist is the most qualified professional that can provide useful information for the project development.

Has been obtained further confirmation of the fact that is not possible to create patients categories with common issues because each patient is very different from another and consequently needs and issues can greatly variate.

**Activity:****Second meeting with Karl Damkjær Hansen****Objective:**

Discuss the current status of our project with Karl, introduce him to our group area and get his feedback on our direction.

**Experiment/data:**

The team had a meeting with Karl Damkjær Hansen on the 25th of February. The meeting took place at Create building from Rendsburggade 14. The team presented the group room and the present status of the project. Then, Karl gave his feedback and presented his ideas, through a presentation, which is summarized further in this worksheet.

The feedback received from Karl is summarized in the following points:

- NO OVERVIEW ON THE ENTIRE REHABILITATION PROCESS

Each professional involved in the rehabilitation process covers his own specific field but has no communication with professionals from other domains. (E.g. physiotherapist and neuropsychologist do not know one another's progresses with the patient). Creating Electronic Health care Journals has been considered as a solution, and there is a Swedish initiative in creating such a tool.

The robot could feed from this system.

- SMARTPHONE ANALOGY

We could take advantage of the current technology, by creating apps specific for the robot that can be downloaded from a robot-cloud. Inspiration can be found by looking at Apple Store, Android platform, similarities, differences, business cases, etc. (Karl made an app that can be used for the Double Telepresence Robot). In this way there would be a division of labor because hardware and software of the robot could be developed by different entities.

In this way the robot could also adapt to each specific need of different people suffering from consequences brought by TBI.

- Finding a purpose for making the robot is very important.

- Has no sense to make a robot for just one function. It could also be a platform that has a modular architecture that allows to perform different functions

- USE CASES 2.0

Use Case 2.0 are a good method for listing the need, users, the solution, the principle of the solution, by having base cases, special cases/alternatives (scenarios). (Water Model ??)

After identifying the user, you can identify his needs and consequently make proposals on how to solve them. This can be translated into a 'story' that enable to gain an understanding of how the system work. Several cases are identified: one basic case and some exceptional cases. The basic case, can be translated in different scenarios.

Using Use Cases allows to slice the most important issues (regarding the robot e.g. sort laundry).

By making a list of Use Cases and subsequently let stakeholders prioritize them (e.g. What are the most cost beneficial for municipality, most relevant for caretakers

(Use cases could be 10: 1 developed in very depth, 3 specific, the other in a rough way.

- Business aspect: the buyer can pay for the apps, not for the robot.

- Leasing seems like a good idea.

- BrainRobotics in Aarhus are making apps ; Bossa Nova Robotics: mObi ; Ballbot developed in Zurich (TED Talks)

- Søren Trombærg is a former Phd. in robotics - invest in Denmark project? - Karl said he will put us in contact???

- WHAT IS A ROBOT?

A robot is a programmable machine controllable by a computer.

It has joints, wheels, actuated / controlled by computer. Actuators are electric motors.

A robot comprises of: battery, wheel(s), computer, motor, sensors (encoder on the wheels - mount a disk and a sensor on the motor's shaft - Tacometer).

SENSORS: are used to locate a robot in the surrounding space. Can be used:

- Encoder on wheels (tacometer) it enables to know in which direction you are going. But it can not provide an accurate position of the robot in space.
- Laser scanners (infrared) are the most used ( SLAM - Simultaneous Localization and Mapping). They provide a distance measurements. But there is a blind spot because the scan can cover only 260°. Laser scanner can identify obstacle in space
- Cameras are an alternative to laser scanners. They are a cheaper option, but consume much more processing power compared to a laser scanner and they need a more powerful computer.
- Structure sensors, not so used. They function as a laser scanner but in 3D (developed by Microsoft Connect, they are not produced anymore because they have been bought by Apple ; Intel is making a new version)

Microsoft Kinect is a sensor created by Intel. It is expensive. The manufacturing of a cheaper version is in process.

A navigation application is needed,for knowing where to go, when, do what.

#### WHEELS

- Mecanum wheels (the one used by Karl in the robot he made) they need a very flat surface because they are not very stable (larger the wheel, more the stability because there is less distorsion).
- ball with Mecanum wheels on it. The ball gives more stability because has a bigger surface.

Artificial Intelligence (used to navigate) is used to get from one point to another (global and local planning). It says where to go, when and how to reach the destination.

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#### Evaluation:

The meeting allowed an exchange of ideas regarding the status of the project and gain a better understanding of the point of view of Karl regarding the project.

#### Reflection:

In what specific tasks the robot is going to be relevant? Might be good to define some specific Use Cases in order to gain an ever better understanding of the system and of the advantages that the user would experience with the use of this robot. What about the technological aspect?

**Activity:****Traumatic Brain Injuries****Objective:**

Investigate the field of Traumatic Brain injuries, the circumstances for appearing and the consequences. Online research.

**Experiment/data:**

Trauma = a severe injury, usually caused by a violent attack or an accident (Cambridge Dictionaries Online, 2016).

Traumatic Brain Injury (TBI) is an acute injury that has very different consequences, depending on the level of damage to the brain. It can affect all aspects of life. The healing process is very different from individual to individual, since there are no two brain injuries that are alike and the healing process can differ greatly. The symptoms may appear immediately (primary brain damage) or after days or even weeks from the accident (secondary brain damage). There is the possibility for the person not even to realize that a brain injury has occurred (Traumatic brain injury.com 1, 2004).

According to Traumatic Brain Injury (TBI) (American Speech-Language-Hearing Association, 2016) TBIs can be:

- Open Head Injuries or Penetrating Injuries, which occur at the moment of an object entering the brain, causing damage to specific parts of it and therefore different consequences.
- Closed Head Injuries, as the result of a blow to the head.

TBIs can be classified according to the gravity of the injury into mild or moderate to severe injuries.

**Mild Traumatic Brain Injury**

A TBI is classified as mild when the loss of consciousness and/or confusion lasts less than 30 minutes. Despite its classification as “mild” injury, the impact on the patient and family can be overwhelming. It can be found also under the names of concussion, minor head trauma, minor TBI or minor brain/head injury. (Traumatic brain injury 2, 2004)

Such injuries can present physical, sensory, cognitive or mental symptoms, which might appear immediately after the accident or in few days or even weeks.

According to Mayo Clinic Staff (2014), the symptoms after a mild TBI are the following:

“Physical symptoms:

- Loss of consciousness for a few seconds to a few minutes
- No loss of consciousness, but a state of being dazed, confused or disoriented
- Headache
- Nausea or vomiting
- Fatigue or drowsiness
- Difficulty sleeping
- Sleeping more than usual
- Dizziness or loss of balance

Sensory symptoms:

- Sensory problems, such as blurred vision, ringing in the ears, a bad taste in the mouth or changes in the ability to smell
- Sensitivity to light or sound

Cognitive or mental symptoms:

- Memory or concentration problems
- Mood changes or mood swings
- Feeling depressed or anxious”

**Moderate to severe Traumatic Brain Injury**

The difference between moderate and severe TBIs is in the time span of loss of consciousness. Glasgow Coma Scale can be used to assess the “impairment of conscious level in response to defined stimuli” (Glasgow Coma Scale, 2014).

The moderate TBI presents a loss of consciousness ranging from 20 minutes to 6 hours, with a Glasgow Coma Scale of 9 to 12.

The severe TBIs are characterized by a loss of consciousness longer than 6 hours, with a Glasgow Coma Scale from 3 to 8. (Traumatic brain injury.com 3, 2004).

Moderate to severe brain injuries can lead to the following symptoms:

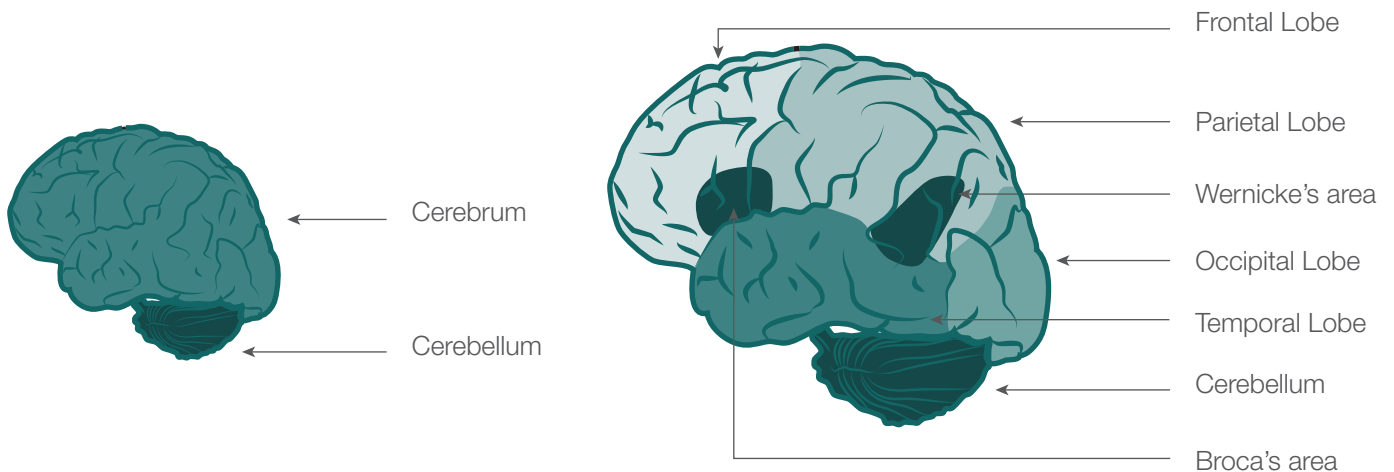
“ Physical symptoms:

- Loss of consciousness from several minutes to hours
- Persistent headache or headache that worsens
- Repeated vomiting or nausea
- Convulsions or seizures
- Dilation of one or both pupils of the eyes
- Clear fluids draining from the nose or ears
- Inability to awaken from sleep
- Weakness or numbness in fingers and toes
- Loss of coordination

Cognitive or mental symptoms:

- Profound confusion
- Agitation, combativeness or other unusual behavior
- Slurred speech
- Coma and other disorders of consciousness.” (Mayo Clinic Staff, 2014)

According to the area of the brain where the injury took place, the consequences differ greatly. The brain consists of the Cerebellum and the Cerebrum (III. 1). The Cerebrum is divided into four Lobes, the Frontal Lobe, the Parietal Lobe, the Occipital Lobe and the Temporal Lobe, together with Broca and Wernicke’s areas. (III. 2)



III. 1. The Brain

III. 2. Cerebrum division

Area	Functions	Result of injury
Frontal Lobe	<ul style="list-style-type: none"> <li>- Reasoning</li> <li>- Planning</li> <li>- Parts of speech</li> <li>- Movement</li> <li>- Emotions</li> <li>- Problem solving</li> </ul>	<ul style="list-style-type: none"> <li>- Loss of inhibition</li> <li>- Impaired mental flexibility</li> <li>- Difficulties in prioritizing tasks</li> <li>- Diminished motivation</li> <li>- Increased or decreased talking</li> <li>- Impaired perception about taking risks and following rules</li> <li>- Increased or diminished socialization</li> <li>- Affected sexual interest and habits</li> <li>- Impaired short-term memory</li> </ul>

<b>Parietal Lobe</b>	<ul style="list-style-type: none"> <li>- Movement</li> <li>- Orientation</li> <li>- Recognition</li> <li>- Perception of stimuli</li> <li>- Sense of touch</li> <li>- Interchange of information for most of the other senses (Serendip Studio, 2012)</li> </ul>	<ul style="list-style-type: none"> <li>- Agnozia: inability to recognizing an object by using a specific sense, no matter if the sense is damaged or not.</li> <li>- Apraxia: inability to move in a specific way, even though the muscles are not affected and they are able to do the task involuntarily</li> <li>- Alexia: word blindness</li> <li>- Agraphia: writing impairments</li> <li>- Damage to the Right Parietal Lobe can lead to impairment in skills as washing, making things, denial of deficits and loss of drawing ability.</li> <li>- Neglection of the opposite side of the body, up to the point of not recognizing them</li> </ul>
<b>Wernicke's area</b>	<ul style="list-style-type: none"> <li>- Understanding the language: processing and comprehension</li> </ul>	<ul style="list-style-type: none"> <li>- Wernicke's aphasia: affected ability to comprehend language, to read, to speak with meaning</li> </ul>
<b>Occipital Lobe</b>	<ul style="list-style-type: none"> <li>- Visual processing</li> </ul>	<ul style="list-style-type: none"> <li>- Damage to the Right Occipital Lobe can affect the left visibility of both eyes, and vice-versa.</li> <li>- Cortical blindness: complete blindness if both of the Lobes are damaged, no matter of the condition of the eyes.</li> <li>- Damage at the frontal part of the Lobe leads to difficulties in recognizing familiar objects and persons and correct interpretation of what they see.</li> </ul>
<b>Temporal Lobe</b>	<ul style="list-style-type: none"> <li>- Speech</li> <li>- Memory - Long term memories</li> <li>- Hearing</li> <li>- Part of the vision, sexual behavior and personality</li> </ul>	<ul style="list-style-type: none"> <li>- Difficulties of correlating and recognizing pictures and words, which can lead to impaired memory for verbal material.</li> <li>- Impaired language skills</li> <li>- Impaired long-term memory</li> </ul>
<b>Cerebellum</b>	<ul style="list-style-type: none"> <li>- Coordination of movement</li> </ul>	<ul style="list-style-type: none"> <li>- Impaired gait: standing or walking problems</li> <li>- Ataxia: Fluctuations or mis-coordination of limbs, posture and gait.</li> <li>- Hypotonia: diminished muscle condition</li> <li>- Tremor</li> <li>- Abnormal eye tracking</li> </ul>
<b>Broca's area</b>	<ul style="list-style-type: none"> <li>- Written and spoken language (CEMM Virtual Library, 2015)</li> </ul>	<ul style="list-style-type: none"> <li>- Broca's aphasia: difficulties in expressing complex sentences, finding the right words.</li> </ul>

Table 1. Functions and result of injury of the brain

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Serendip Studio (2012) Brain Structures and their Functions [Online]. Available at: <http://serendip.brynmawr.edu/bb/kins-er/Structure1.html> (Accessed: 24 February 2016)

## Illustrations:

III. 1. The Brain (Own illustration)

III. 2. Cerebrum division (Own illustration)

Table 1. Functions and result of injury of the brain (Own table)

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## Evaluation:

Traumatic Brain Injury is a complex damage that can occur to the brain and it can lead to dramatic changes in the individual's life.

## Reflection:

TBI is a very broad topic, and in order to get a better understanding, the Team has to focus on one specific area of the brain. Future steps could include to investigate the most relevant direction for the project and search in more details the impact of such injury.

**Activity:** Defining degree of interaction for the assistive technology

**Objective:**

In order to define the degree of interaction intended for the assistive technology a market position map has been made. In this map the degree of interaction will be compared to similar devices. The map consists of existing robots and smart-devices that can be found in most households or within the healthcare sector.

**Experiment/data:**

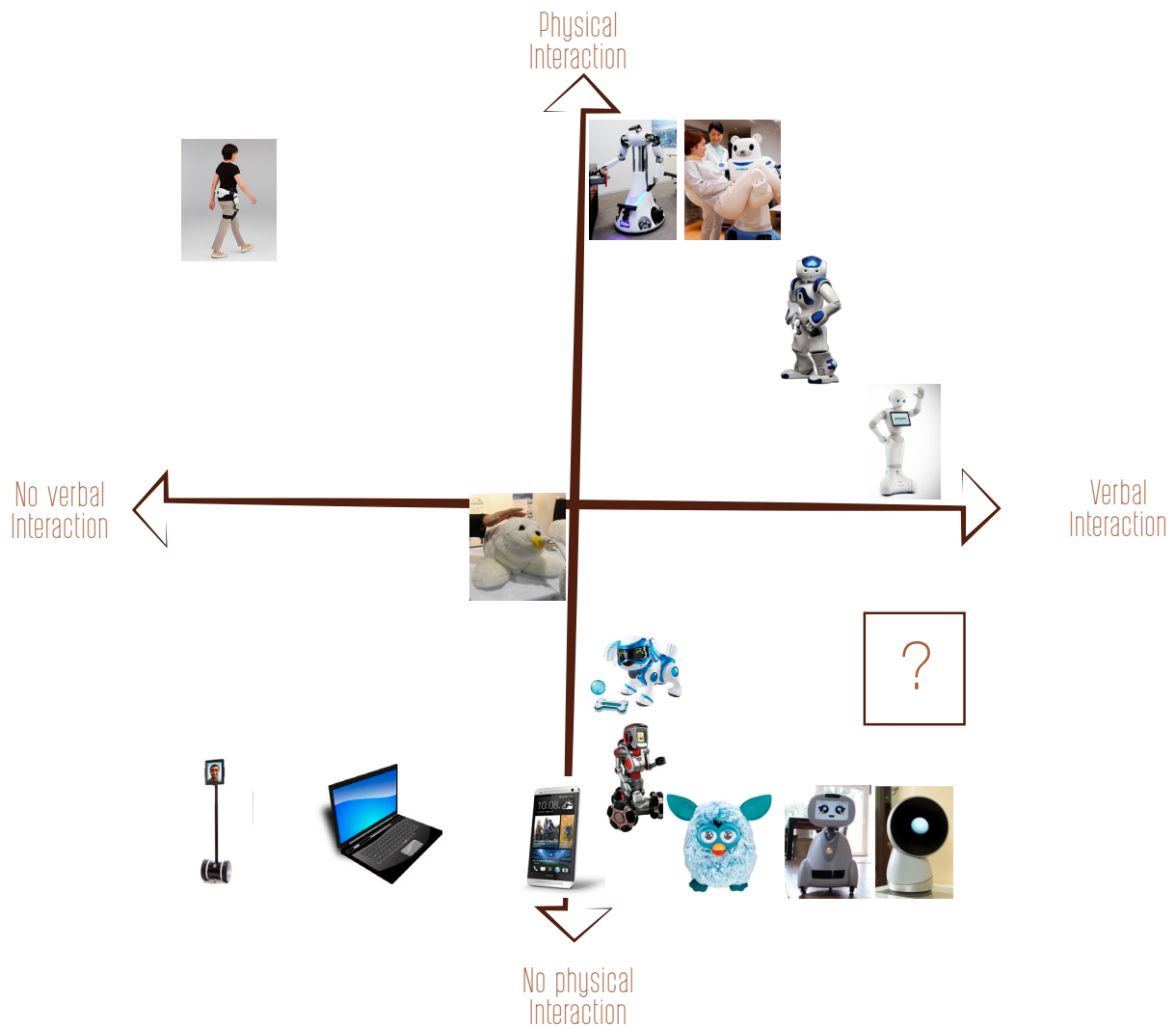
The following words define the words used for the axis in the coordinate

**Verbal Interaction (Y-axis):**

The user and device use verbal interaction. The device use verbal assisting to make the user perform a task and the user use verbal interaction in order to let the system of objects know what to do next.

**Physical Interaction (Y-axis):**

The user and device use physical interaction. The device use physical assistance to take over a physical task and the user must physically make the device perform a task.



III. 1 - This illustration is based on information found in the following references:  
 CST group (2014), Mr. Personality by Wow-Wee (2016), Mogg T. (2015), Power products (2015) , A  
 Chronology of Computer History (no date), Patel, R. (2013), Garcia, D. (2010), Worksheet 002 and  
 worksheet 005.

### Illustration list:

Ill. 1. Own illustration - consisting of:

CST group (2014) AMIGO Available at: <http://www.roboticopenplatform.org/wiki/AMIGO#Overview> (Accessed: 22 February 2016).

Mr. Personality by Wow-Wee (2016). Available at: <http://www.theoldrobots.com/MrPersonality.html> (Accessed: 22 February 2016).

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Garcia, D. (2010) Bandit, Little Dog, and More: University of Southern California Shows Off Its Robots Available at: <http://spectrum.ieee.org/automaton/robotics/medical-robots/041910-bandit-little-dog-and-more-usc-shows-off-its-robots> [Online image] (Accessed: 23 February 2016).

Worksheet 002

Worksheet 005

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### Evaluation:

This mapping gives an understanding of the degree of interaction intended for the assistive technology in relation to other products on the market.

### Reflection:

This map is mostly based on robots and it would therefore be interesting to make a mapping to reflect on the tasks the assistive technology take over also.

**Activity:****Man-Machine relation****Objective:**

The objective is to define a man-machine relation that can help in the understanding of what and how our product should help. How do people consider machines now, what do they use them for, how does people rely on that what the machine is doing is right?

**Experiment/data:**

Relevant literature, movies and documentaries have been reviewed and an observation on a helping tool called Melvin has been made to define what kind of relation the product will have.

**Movies:**

A movie called Chappie has been watched and a resume has been made of the movie with focus on the relationship between man and machine. In this case, the relationship that occurs between a robot with artificial intelligence and the people surrounding it. Furthermore a reflection about artificial intelligence in relation to the system of objects will be made.

**Resume of the first 45 min. of Chappie (See Ill 1.):**

This movie is about a future where there is a lot of violence and therefore a lot of policemen have been killed. Robot developers have therefore developed police-robots to takeover fighting the violence.

A gangs of criminals, consisting of two men and one woman, think that these police-robots can be turned off. In order to get a remote, to control the police-robots, they kidnap one of the robot developers named Deon. They take Deon and his car to their hiding where they force him to help them. While searching his car they find a lot of robot-parts from police-robots and decide to force Deon to create a police-robot to work for them instead. He agrees to create a robot for them if they spare his life. He tells that the police-robot-parts in his car is a part of a project where he has been working on with intelligent technology, meaning that the robot will get the mind of a human. He explains that the robot in the beginning will be like a human baby and develop like a human. The robot will learn much faster than any living creature, but still need time to develop.

The gang force Deon to put together the robot and install the software needed. The robot turns on and the first thing it does is to run away and hide. One of the male gang-members gets angry and tries to make the robot come out by scold-



Ill. 1 Chappie (Olds J., 2015)

ing. The female gang-member on the other hand, quickly understands the situation and asks them to go away. *"It is just a child"* she shouts. She reacts as it was her own child and steps in as the protector of the robot. Together with Deon, she takes the time to talk slowly to the robot to make it come out from its hiding. Deon and the woman act as they are the parents of the robot and get all excited when the robot repeats what they are saying. The woman names the robot Chappie. Throughout the movie, Chappie develops his mind and acts as a human. The development is going extremely fast and he is therefore influenced a lot from his experiences. He needs to go through his childhood stage before he can become the gangster-robot they want him to be. The female-gang member and Deon understand that Chappie has feelings and needs time to "grow up". The male-gangs, on the other hand, treat him as he was just a tool for them. Already on the second day of Chappie's "life", they try to make him shoot with guns, but Chappie gets afraid because of the loud sounds. While the male-gangsters are trying to make Chappie shout, the female-gangster steps in and protects Chappie. She explains that Chappie is still just a child that needs to "grow up" before he will be able to shoot with guns. Afterwards she takes the time to teach him to talk and ask him to call her mom.

Deon, who had to leave the day before, is coming back and also trying to teach Chappie to talk, paint and make decisions on his own, without being influenced by the gangsters. Because of this, the leader of the gang gets angry and chases Deon away. He tells Chappie that he is the father and he make the decisions. In order to punish Chappie, the male-gangsters tell him to go into their car and drive him away to another gang-area where they leave him. As soon as a group of gangsters see Chappie, they start throwing stuff at him and hitting him with metal pipes, because they think he is a police-robot. Chappie gets afraid and asks them to stop, which just makes them laugh. Thankfully, Chappie manages to escape and to get back. When he gets back, the female gangster is sitting and waiting for him and has been worrying for him. She asks if he is okay and if he is hurt. She starts yelling at the gang-leader and asks how he could just leave him out there. She keeps saying that he is just a child. She goes to get a wet cloth and while washing Chappie she asks if he is okay and if he is hurt.

After this, the female gangster takes Chappie to her bed and finds a book that she reads to him. She tries to explain why the world is cruel sometimes and she makes him happy again.

Throughout the movie the child-parent-relationship develops between the female-gangster and Chappie. She is teaching Chappie fundamental behavior and giving him love. Deon is trying to make Chappie a "good" robot and teaching him different skills such as reading, painting and make his own decisions. At the same time the male-gangsters are trying to make him into a killing-machine. Because Chappie see the gangster-leader as his dad he also want to do as he say and get recognition. This is very confusing for Chappie since he is developing so fast and he ends up with a very divided mind (Chappie, 2015).

### **Chappie - reflection/evaluation**

This movie shows a very extreme side of what artificial intelligence in robotics could be like. Some of the main points highlighted in this movie are: in order to give artificial intelligence to a robot or system, someone will need to teach it what is right and what is wrong. Depending on the person that does so, the understanding of right and wrong will vary.

Chappie in this movie has a very high level of artificial intelligence and is exactly as a human child that needs to be taught how to behave. Therefore, this movie also challenges the idea of what happens when a robot becomes as a human and what kind of relationships will arise. Chappie needs a mother figure to teach him how to behave, which ends up being the female-gangster. His father-figure is the gangster-leader, but since the leader sees him as a tool, he does not get the same close relation as between the female-gangster and Chappie.

Most of the police-robots in this movie are just seen as tools and people are also treating them as tools. Their value is much lower than humans and therefore it does not matter if they break. The police-robots have no feelings and it does not really matter what happens to them. They are created to fulfill a human task that nobody else wants.

Suddenly, when one of these police-robots gets feelings and goes to a childhood-stage, some people do not really understand it. They still treat him as a machine and does not care about how he feels.

The people surrounding Chappie are treating him very differently and since he is developing very fast, he is affected a lot by the impressions he gets. The female-gangster in the movie understand that he has feelings and is treating him as a child and comforting him when needed. Other people that see him as a machine does not understand his reactions when they try to make him be violent. This mix between behavior patterns are affecting his sense of right and wrong a lot. This is making him very dangerous for his surroundings and the people close to him.

In reflection to artificial intelligence, the system of objects will, to some extent, need to know what is right and wrong. Since people are cooking very differently and have different habits regarding cooking, it will be difficult to cover all the different cooking styles and preferences. Therefore, when testing the system of objects one focus point will be to see if people with TBI remember old cooking-habits and are affected by them when the system tells them to do a task in a different way.

Also, the degree of right and wrong has to be decided. How much will the system of objects decide and will it be able to adapt if a person is doing a task differently than shown.

### **Book:**

#### **The future of business**

##### **Resume of the chapter: Redefining the relationship of man and machine by futurist: Gerd Leonhard**

In the very soon future, more or less everything will be possible with technology. This means the focus will move away from whether "something is possible" to if a technology "truly adds human value".

Humans are slowly getting used to having digitization, automation, and robotics in all aspects of their life. It is expected

that the world in 2020 will have six billion Internet users and more than 100 billion connected devices in the Internet of things, such as sensors, wearables and trackers.

Intelligent machines of all kind will play an important role in the future and this will impact the way we, as humans, live our life. Humans are nearing a pivot point where anything will be possible with technology. For example real time translation is already possible with; "Sayhi", "Google translate" and "Skypetranslate". Likewise, self-driving cars such as "tesla" are getting on the market and intelligent personal agents such as "Cortana", "Siri" and "Google now" are developed. All these examples and any other systems are already affecting how people are living their life. Every time a new system becomes common use, a pattern has been changed. The world and human life are being reshaped by the developers behind these systems.

Technology is no longer about if or how, but about why? The question is no longer whether something is possible with technology, but more about if it should be possible. What will be the limit? How much do we, as humans, want the future intelligent robots to take over?

If robots are given artificial intelligent that allow them to adapt to changes, what kind of reasoning would they need? Furthermore, would they need some kind of moral agency also? Would they need some kind of human-like capacity to decide whether something is right or wrong even if the facts are not clear?.

It is often said that technology is not good or evil - "it just is", but if robots start to get human like intelligence, somebody will need to decide whether or not the machine will be good or evil.

It is assumed that intelligent machines of all kinds will play a bigger role in the future. Therefore it is up to us as humans to decide both what we want them to be and maybe more important who we want to be.

Many big companies are working on developing artificial intelligence of all kind. IBM is developing neuromorphic chips and cognitive computing that tempt to mirror humans own neural networks and Google is working on a global brain project.

Companies around the world are striking to make every single machine and device truly functional and intelligent. They have though not reached a human like intelligence with social and emotional skills yet. This lead to another question which is not about "when" machines will have a human like mind but rather if machines should be human like.

Imagen what artificial intelligence will do to people. Imagen a future where a system has every single information stored about you. It knows everything about you, your schedule, your location, your likes, your connections, your transactions etc. When you search on the web it will already know what you need and are looking for before you even know it yourself. Facebook as an example already know a lot about your social life, Google knows what you are looking for and through ads it suggests you to look at similar topics. Goolge maps know where you live and your traveling preferences and lastly Linke-din know your current job-situation and are able to suggest you relevant work. This is just the starting point. In the soon future this might become a external brain stored in the cloud that know everything about you even know it before you think of it yourself. This way it will be able to propose desirable actions as easily as todays walking directions in google maps.

Then a new question arise: Who is serving who?

Today almost everybody are using smart-devices on a daily basis for everything and most people are so attached to their smart-devices that they will not feel complete without them. It has become normal to have a smart-device that quickly are able to help in any given situation.

People are doing tasks faster and faster and without a smart-device you will simply not be able to keep up with the rest. This arise another question about how depended we want to be of smart-devices and how much they are allowed to change our way of living.

Human kind has changed a lot of pattern after the arrival of the smart-devices and this lead to the next question: How can we remain truly human in a world where the smart-devices are starting to define the way we live? (Leonhard, G., 2015).

### **The future of business - reflection/evaluation**

Gerd Leonhard has some really interesting points regarding human-machine relationship. He state that the future is about making machines that truly add human value. Intelligent robots will without doubt play a big role in our future and thereby have a big impact on the way we life our life. The question is no longer weather something is possible with technology, but about if it should be possible! How much do human kind want intelligent robotics to take over? In relation to the system of objects how much do the user want the system of objects to take over the task and in which parts of the task?.

In earlier concepts and ideas for this project (See worksheet 31) the intension was for the system of objects to take over a physical task. By setting up criteria it was decided that the system of objects should not take over a physical task, but only guide in physical tasks.

In relation to the guidance-part the question is still; how much is needed for the system of objects to take over and in relation to what?. Which parts of the task should be decided by the system of objects and which should be decided by the user?.

Gerd further state: Technology is no longer about if or how, but about why? In relation to this the system of objects has to be clarified in order to truly understand the purpose of the overall system and in every single step. Why does the system take over in the specific steps.

He further ask; how much should be possible in the future in relation to artificial intelligence and the development of human like technology. What will be the limit?. If the system of objects in the future would have a human-like mind it might be able to give the users some of the lost skills back. When this said it is still a question weather the person would listen to the system of objects if it is still only a machine and not a individual creature.

It is often said that technology is not good or evil - "it just is", but if robots start to get human like intelligence somebody will need to decide weather the machine will be good or evil. If the system of objects in the future will become a individual creature that mean someone has to teach the system right and wrong. Even if there are many answers it will need to know the right one in the given situation.

This arise another question about how depended we want to be of the smart-devices we are using and how much they are allowed to change our way of living. In this given situation with a user that deal with cognitive difficulties they will without doubt be depended on a smart-device to help them i their daily life, but with a understandable reason. They have already needed to change their life to deal with the difficulties they face and if the system of objects can make the changes easier then it will add human value.

### **Conversation with Helene Høyer - Sales manager at Melvin ApS**

At Melvin Aps they are developing a helping tool to help elderly suffering from arthritis to pull up and down the pants when using the toilet. From previous conversation with Helene Høyer a basic knowledge was gained about Melvin (see work-sheet 27).

Through this conversation Melvin was both seen and tested. Melvin is a wall mounted tool that has two armrests and two arms with hooks that is meant to pull down the pants of a person (see ill. 2).



Ill. 2 Melvin



Ill. 3 Close up of hooks on Melvin

#### **Told by Helene:**

In order for the hooks to go into the pants the right way, the machine and elderly has to collaborate. The person has to stand in the right position and has to remove lose clothing that is covering the top edge of the pants (Long cardigans, shirts or similar). When the elderly are standing right the 4 hooks starts to move down between the skin and underpants. Hooks are shown in ill 3. Next the two inner hooks starts to move outwards, likewise the two outer hooks start moving away from the body until the 4 hooks are forming a rectangle. Then the arms with the hooks start moving down while pulling down the pants. Next the armrests also moves down allowing the elderly to sit down. When elderly are done using the toilet (wash and dry toilet) the armrests moves up again and support the elderly to get up again. Next the arms with the hooks start moving up and pulling the pants up again. The hooks moved back into the body and go back to starting position.

It is the elderly that control the machines up and down movements. Form the test made so far it was discovered that the elderly wanted more control. The wanted to not only control the up and down movements, but also the movements of the hooks.

When the test subjects felt the hooks going down between the skin and underpants the first time is was a little unpleasant, but second and third time they said it was fine since they knew what was going to happen.

It was also discovered through the tests that Melvin had a hard time pulling down the pants of a person that was to fat. If the rubber band and fabric of the pants was stretched to the limit Melvin would simply not be able to pull down the pants.

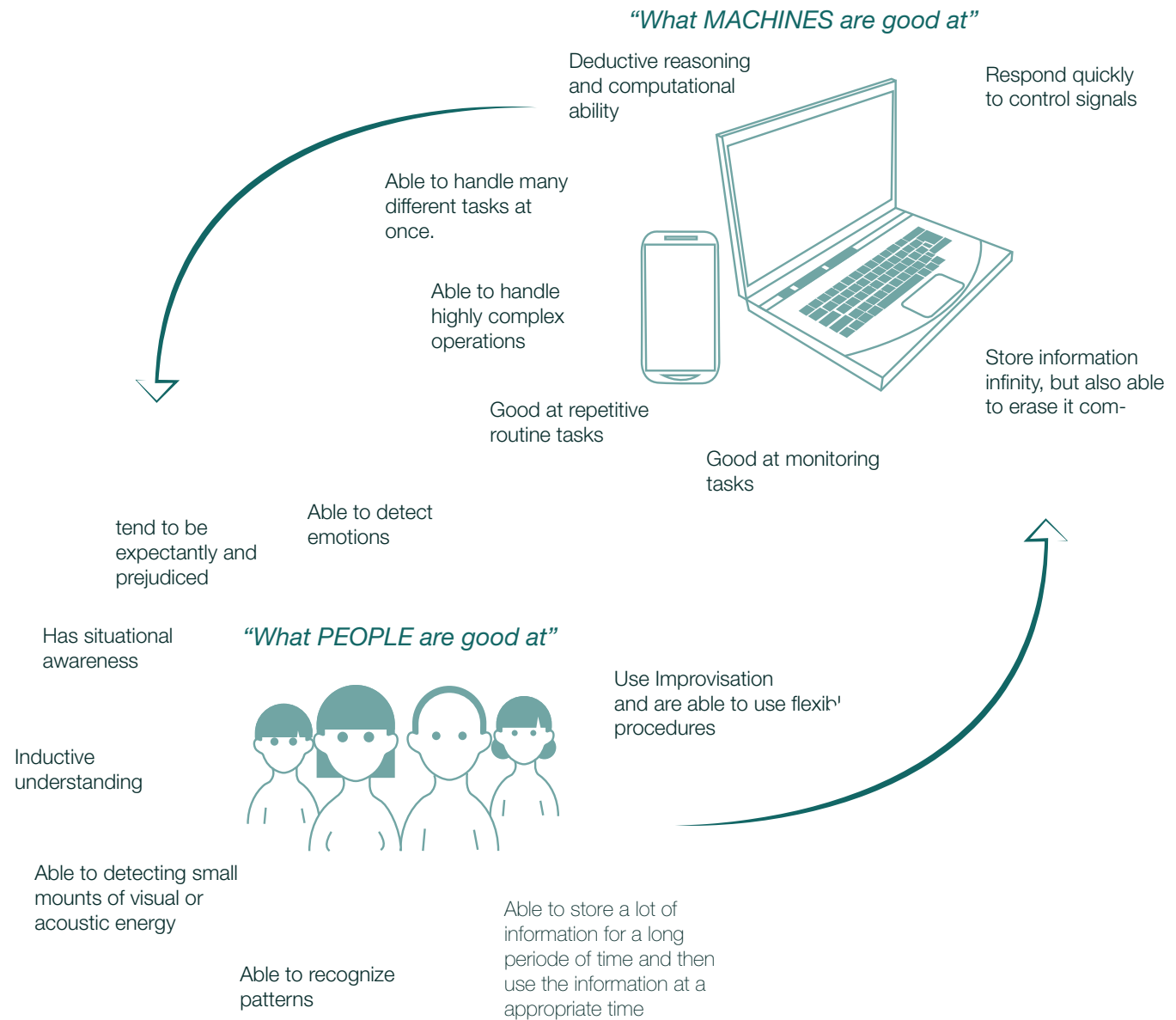
#### **Conversation reflection/evaluation**

Melvin is a helping tool that help a person with a very personal task. It is only a helping tool meaning that the person should only expect help and not a complete takeover of the task which might be the case with a caretaker. Therefore the user has to collaborate with Melvin to get the task done. This collaboration requires the user to trust and give responsibility to the Melvin otherwise the task will never be done. For example if the user do not trust Melvin to put the hooks down in the pants without hurting the user the task will not succeed.

## Scientific articles

### THE HUMAN AND COMPUTER AS A TEAM in Emergency Management Information Systems

From this article a Illustration (see ill. 4) with “what people are good at” and “what machines are good at” has been made. It gives a overview that will be used to also define a similar relationship between user and system of objects.



Ill. 4 “What people are good at” and “what machines are good at” - CARVER, L. & TUROFF, M. (2007)

### What people are good at - reflection/evaluation

This illustration give a good offset to understand what people are good at in relation to machines. This is though based on people that has a normal functioning brain. Therefore a similar illustration has to be made to clarify the relationship when the person has cognitive challenges.

## Brain storm on relations with the system of objects.

Based on the knowledge obtained through this worksheet (Worksheet 16), Radio-interviews (Worksheet 20), Interviews with caretakers (Worksheet 17, 18, 21, 23, 39) and user interviews (Worksheet 22, 26, 32 and 40) the following brainstorm has been made to finally define the intended relations. These words has then been narrowed down to a specific relationship that is desired to be obtained with the system of objects.



### Relationship definition:

The system should be as the friend that you trust and take advices from, that does not underline your mistakes and does not judge you

#### III. 5 Relations with the system of objects

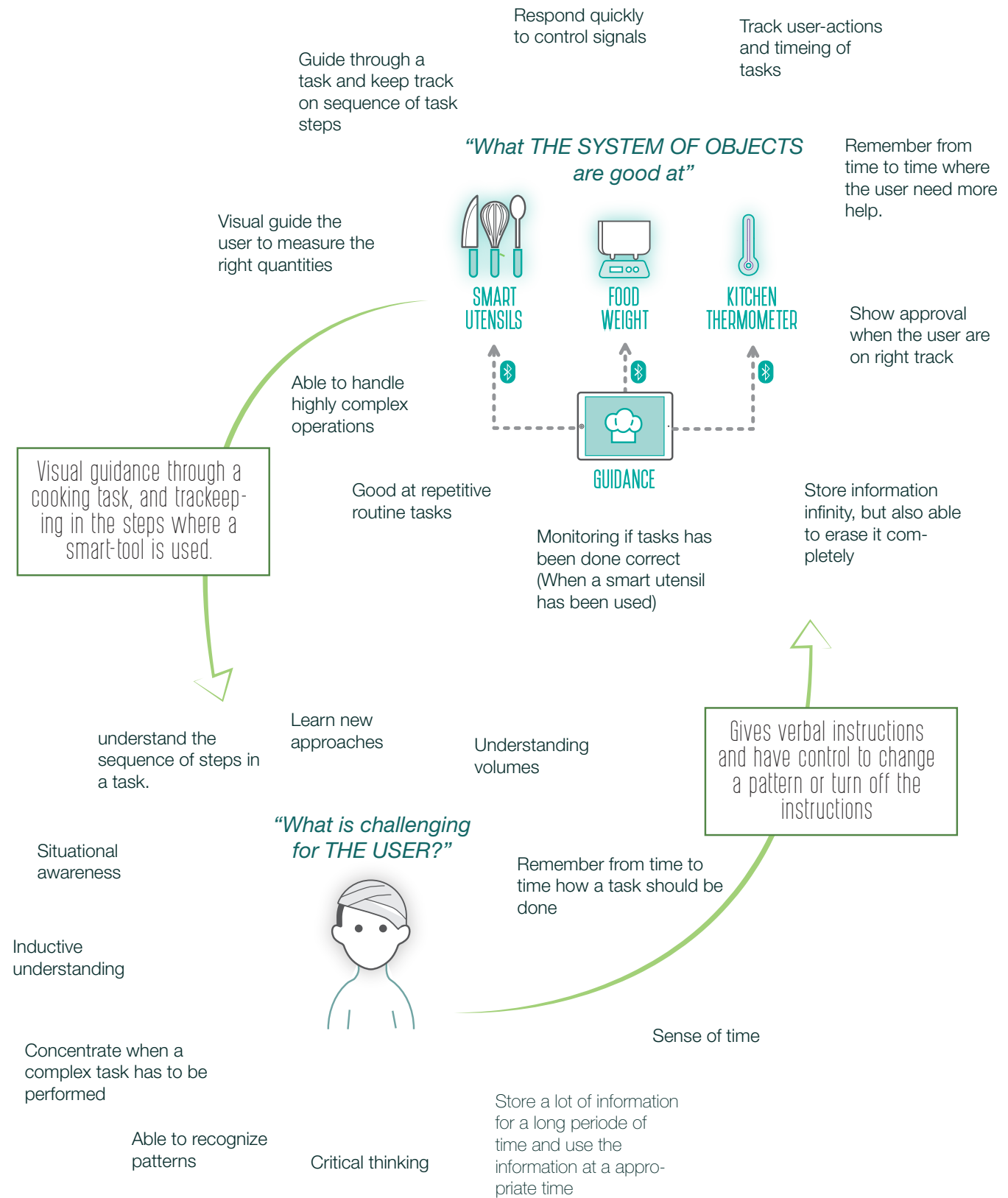
### Brain reflection/evaluation

This brainstorm has given a good understanding of the intended relationship between user and system of objects. It will though be hard to fulfill this role fully and a clear description of how the and when the system of objects are in this role and when it is not.

## Illustration of strengths and weaknesses.

### Defining the relationship between user and system of objects

In order to get an overview and understanding of what the system of objects are able to offer the user in reflection to the user challenges the following illustration has been made (See ill. 6).



III. 6 “what people are good at” and “what machines are good at”

### Reference list:

Leonhard, G. (2015) 'Redefining the relationship of man and machine' in Talwar, R. (ed.) *The future of business*. Fast future.  
*Chappie* (2015) Directed by Neill Blomkamp [Movie] Mexico, USA: Metascore  
CARVER, L. & TUROFF, M. (2007) 'THE HUMAN AND COMPUTER AS A TEAM in Emergency Management Information Systems' *COMMUNICATIONS OF THE ACM*, 50 (3), pp. 33-38

### Illustration list:

III. 1 Olds J. (2015) *Chappie* [Online image] Available at: <http://www.lifeisstory.com/dvd/chappie/> (Accessed: 1 Maj 2016).

III. 2 Own Illustration

III. 3 Own Illustration

III. 4 Own Illustration based on:

CARVER, L. & TUROFF, M. (2007) 'THE HUMAN AND COMPUTER AS A TEAM in Emergency Management Information Systems' *COMMUNICATIONS OF THE ACM*, 50 (3), pp. 33-38

III. 5 Own Illustration

III. 6 Own Illustration

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### Evaluation:

In the movie *Chappie* the relationship defined is a parent-child relationship. A relationship where the female-gangster (*Chappie's* mother) care for *Chappie* and help him to perform tasks. *Chappie* trust her and take advices from her. A similar relationship is wanted for the system of objects, but in this case it is the system of objects that need to be the "parent". Through a brain-storm the relationship between user and system of objects has though been clarified to be a friendship-relation and is defined as follows: The system should be as the friend that you trust and take advices from, that does not underline your mistakes and does not judge you.

The reason for not letting the system being the parent fully is because it should not be above the user. The user and system of objects has to be at the same level and need to collaborate in order to do the task and it will always be the user that is control. For the same reason should the system of objects not take over any physical parts of the task as for example dispensing the right amounts of ingredients.

This kind of relationship is also similar to the relationship between user and *Melvin*. In order for *Melvin* to do the task it is meant for the user has to collaborate with it. If the user is not standing correct and allowing *Melvin* to pull down the pants it will simply not succeed. The user has to trust that *Melvin* are not hurting him/her and has to let *Melvin* help in a task that crosses personal boundaries. *Melvin* will not underline the user nor judge the user. It will simply help in a task the user cannot do alone anymore.

The user in this case can not cook anymore because the understanding of the system and structure in cooking has been lost. Not being able to cook anymore, which the user feel he should be able to do, is a very frustrating feeling. It is a personal challenge that is both embracing and condescendingly. Therefore it is a task that the user will not allow anybody to help with.

The primary reason for the user to use the system of objects is simply because he/she can not cook without it. Secondly the system of objects needs to truly add human value by making the experience of cooking not just a duty but a feeling of success by overcoming a challenge. It should not be underlining in any way and all the difficulties and small mistakes will become a secret between user and system of objects.

### Reflection:

Through this research different media and methods has been taken into use which has given a very broad and extensive basis for defining the relationship between man and machine. All both the literature and movie are defining a relationship between normal people and machines. Therefore the interview about *Melvin* has been of great importance to get the understanding about the relation that might occur when a machine is helping in a task that the user can not do anymore. Together the reviewed material has given a broad basis.

**Activity:****Second visit to Frederikshavn Center****Objective:**

Make a visit at the Senhjerneskadecenter Nord in Frederikshavn to find more needs from users, get to know more about the users and validate the needs found from previous meetings.

**Experiment/data:**

One of the members of the Team went together with Karl Damkjær at the Senhjerneskadecenter Nord in Frederikshavn to meet with Anne Abildgaard, Tina - SOSU assistant education - and one more person.

From the perspective of the caretakers, the following users have been identified as fitted for the project. The identity of the users is kept anonymous, due to personal regulations. The highlighted text represents key notes for the Team.

**User 1: Andreas**

- He is around 35 years old.
- He was in a traffic accident at the age of 16.
- He is walking and able to do a lot of activities by himself.
- He is living in a more independent part of the Center.
- He has cognitive problems: he has a very bad short term memory, e.g. he can drink a cup of coffee and two seconds later he will not remember that he got the coffee.
- He is one of the more independent residents at the Center and can go to a lot of places by himself, as long as the places are not new for him.
- He has a Puls watch that he is very fond of. He could have a smart watch on the other hand.
- When he was younger he did archery and one time he hit an arrow exactly on top of another arrow. This arrow is hanging on his wall.
- He has some plates with motives that his grandmother painted, e.g. motives of H. C. Andersen.
- He has a lot of pictures hanging on the wall of his family and was very proud of his family.
- When the Team member entered his apartment, he joked of having a picture of a gorilla hanging on the wall – it was a mirror. Two seconds later he told the same joke.
- He has a smart-phone which he likes to use - He started using it not too long ago and it would therefore be a good idea to continue using a similar technology in our product. It took time for him to learn how to use a smart-phone, but he is able to use it now.
- He is very structured and is doing exactly the same things every week at the same time.
  - Every Monday at 13:00 he will come and ask for help with his laundry.
  - Every Friday he will go grocery shopping and will then come and ask about how to do it.
- Since everything he does is planned in a system – maybe this system can be “Installed” in our solution.
- He can go grocery shopping by himself, but will forget what he wanted to buy by the moment he will arrive at the shop. E.g. he went to Rema 1000 24 times last week to get coffee. When he got there, he did not remember what he has to buy. Then some might ask why he did not bring a note, but then he would forget that he brought a note.
- If the plan of the day is interrupted by something, he will be frustrated and walk around until he gets to the next task of the day.
- He knows how to do most tasks, but still needs approval when performing a task.
- The robot can follow Andreas all the time and e.g. at 13:00 the Robot and Andreas are both agreeing on the time and task that needs to be done.
- The robot can follow him to the bathroom, like the caretaker and tell him that he is doing the laundry the right way. – The robot takes over a task. In this case the Robot does not need to think, It just need to say the right things at the right time.
- He is able of sorting the clothes in the right colors, but needs approval that the clothes are divided right. The robot could scan the piles with clothes and see if there are any clothes that are wrongly placed. Or it could in his case just state that it is right when he asks, because it is right.
- He would like to have a tool that is as precise and structured as him.
- He needs a product that he can rely on and feel comfortable to use.
- A robot would be ideal for Andreas, because he is so systematic whereas all the other residents are very different.
- He should not have a robot that is following him outside of the department because it would be too stigmatizing - Handicap-alarm - A more neutral product would be better e.g. an app that can go on a smart-phone or smart-watch.
- His biggest wish is to become more independent, which he could be if he had a device to help him.
- Entertainment is of great importance if people are going to use the product. It needs to be attractive.

- He does not remember what he has been doing during the day, which brings a great deal of frustration for his parents. At the moment, the caretakers are taking the pictures of activities, but if a robot is standing, ready at any moment, it would be faster and easier to take the pictures.

- The caretakers could then record what is going on in the picture.

- The robot could also remind him of writing down what he is doing.

- If he had a smart-watch or app on his phone the GPS tracking could register that he went to Rema 1000. Then, when the GPS tracking tool would notice that he is not at the center, the watch or phone could make a sound and the shopping list will appear.

If he could get a tool that can guide him around, he might be able to go to new places by himself and find his way home again. It would provide the comfort of not getting lost.

- If he had a bad experience using a product once he will remember that there was something he did not like about the product last time.

### **User 2: Susan**

She is not able to talk, and therefore, not able of telling what she has been doing during a day. In this case, a reminder of her actions would be useful, by taking pictures, etc.

She has very different activities from day to day, but also some of them repeat.

### **User 3: Per:**

He has some very bad days and it can be challenging to go talk with him face to face. In this case, a robot could create the missing link, that would lead to having a conversation with him.

If the robot would allow to have skype conversations with his wife, he would always want to talk with her, because he misses her very much. In this case, his wife might no be very happy.

### **General considerations**

As a sum-up of the discussion between the parties involved at the meeting, the following considerations have been covered:

- GPS would not be a feasible solution due to the fact that it does not work inside buildings.

- The apartments at the Center are very small - this needs to be taken into consideration.

- It is needed to have different Apps for different cases.

- Almost all people have smart-phones, they might all have 100 apps, use 20 of them, which could mean that they might have 5 apps in common.

- When comparing the advantages of having a robot with the advantages that a smartphone offer, some apps might be more suitable to be performed by the robot, while some of them might be more in handy when used from a smartphone. E.g. computers are the best tool to write e-mails on, but a smart-phone offers this possibility as well, it just depends on the complexity of the activity.

- The robot should be able to navigate and "think" independently.

- The robot needs to be tested in relation with the reaction of the users when using it. For some of the residents it might not be enough to have a robot. They might need a person instead.

- The Apps and robot must not give the signals of being a handicap tool. Otherwise they will not use it.

- The Center has four residents that are trying to use tablets to communicate.

- Three residents have their own computer/tablet.

- They get I-pads from Syn og Hør because they are considered a communication tool. In case the Center would desire for the I-pad to perform other activities related to communication, they would not provide with such a tool. Their rules are very strict in relation with what they want to provide.

- Phase 3 centers are almost not existing anymore and therefore the patients will either go directly from Phase 2 to Phase 4. Phase 3 is a center that is meant to prepare the patients to return to the home after rehabilitation. They are closing one in Horsens soon.

- When the patients are done with rehabilitation, they are not aware of what challenges they will come across when they come home, and some people will not accept that they need a tool / handicap alarm.

- There is a center called Østerskoven close to Hobro that is partly a Phase 3 Center.

- A robot that can follow the patient could really make a difference.

- The Occupational Therapists are only helping the patient for a very short period of time and then the patient is on his own.

- When the patient arrives home after Phase 2, nobody will know what the patient needs.

- The platform with different apps that can be added to the robot is good. In the future, the robot will be able to recognize the need of a specific app, but right now it is the relatives and caretakers that have to install the apps needed.

- They do not discover the effects of the brain damage before they get at the Center or home. Likewise, the affect of the brain damage will change a little all the time.

- It is not possible to create personas with brain injured people because the effects are very different from person to person. in Frederikshavn, they have 24 residents - 24 cases. It is impossible to put the people into boxes.

## Use cases

Three use cases have been identified as having the highest priority, due to their possibilities of making the residents more independent. They are considered as apps, each one of them covering one need. They have been discussed during the meeting, and the general comments are presented below.

### 1. Reminder of daily schedule

- It would be beneficial if the robot could notice when the person is ready to get a reminder, instead of repeating or giving a reminder at a bad time. This is what robots are good at.
- Is the robot able to recognize when a person is busy or not and able to take a reminder?
- Which reminders are important right now and which ones can wait?
- The robot could notice that the person is looking at him and then give the notice. This is not as accurate as a person observing the person. This idea has been well perceived by the caretakers.

### 2. Record important moments

- The robot will not be able of knowing what is important and what is not, but, in time, it might be able to sort the relevant pictures and videos. Afterwards, a caretaker or relative would need to go through the images to select what is important.
- The robot could ask if it should take a picture.
- The robot could know when something important might happen and then be ready to take pictures.
- The robot should not ask the residents if the pictures are relevant because they might say no to all of them or be frustrated because they have to decide something.
- Jibo, one of the SARs, has the possibility of following the face of a specific person. It can offer the possibility for the person from the other end to click on the face of a specific person from the screen and the robot will focus his attention on the person selected. This idea has been well perceived by the caretakers.

### 3. Medication reminder

- Medication is useful at home, but at the center it is not as important. At the Center, the caretakers are responsible for the medication.

## Other devices

- A system in the entire house might end up being more complex and expensive.
- There is a program that already is able to guide a person to do everyday tasks. It is a very good idea to show a video or images of the tasks to be done.
- Before, when Phase 3 was more common, they planned strategies to help people the best way and had pictures all over the bathroom to show how to do a task.
- The outreaching function is very important. E.g. If the robot is able to recognize the time in the day and the situation/location, the robot would notice the person going to the bathroom in the morning at 7 am. Then the robot knows that it is around the time where the person should brush his teeth and it remind him of doing it. It might even film it to notice if he is doing it right.
- Some of the people need help to take the initiative to do something.
- Repetition is the key to learn again. E.g. a person will only know how to take a shower because he has done it many times, but is still in doubt once in a while. The body / subconscious will start taking over the tasks.
  
- Should the robot be able to move around with the person or just be in corner? The feature needs to be tested.
  
- By using a tablet or smart-phone the person needs to use hands.
- A smart-watch has the screen too small to show a video of a task.
- If you watch a video on a smart-phone or tablet, the person needs to have it in the hands.
- The video can also be shown on the TV.

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## Evaluation:

Since the residents are so different and have very different needs, there is not one case that is more important than another.

This meeting expanded our knowledge about some of the residents and some of the challenges they are dealing with.

## Reflection:

The cases are still only from the caretakers' perspective, but since in Frederikshavn they are used to work on development projects, they are used to notice where they are able to come with an input. In order to follow a patient at this place, it takes a long time of getting to know each other, time that the Team doesn't have. Therefore, the team will not be able to talk with the residents about their challenges because they will simply not remember. For now it is relevant to rely on the caretakers inputs.

**Activity:****Visit to Brønderslev - Meeting with Anja****Objective:**

Have a visit at the rehabilitation center and discuss with Anja Børkild Nielsen, an occupational therapist to find out more about the patients' activities, the processes behind the rehabilitation and possibilities for implementing the technology.

**Experiment/data:**

The team made a visit at the Rehabilitation Center in Brønderslev on the 3rd of March, with the purpose of meeting with Anja Børkild Nielsen, occupational therapist. She has been working at the Center for 11 years, and this is her first job. She also works as a teacher for occupational therapist students, and her primary work is to guide them through education and help them training with the patients. Sometimes, she also has some patients of her own, for which she has to take care of.

During the training, they focus on the motor skills, similar to the physiotherapist, while trying to take an angle on the daily life. They train a lot in their daily lives, doing many of the things they have to perform when returning home, e.g. shopping, cooking, dressing, house cleaning, but also general activities, in case they have some kind of interest like painting, knitting, sewing, etc. Those activities differ from patient to patient.



Ill. 1. Brønderslev Neurorehabiliteringscenter (Regionshospital Nordjylland, 2015)

The patient's motor skills and process skills are analyzed to detect what kind of disability they have and then they observe the patient in the daily life to see which activities cause problems in performing. They try to make the environment as close to the home as possible, but it is still a health center where, for example, the toilets are bigger than at home.

Since she is working in this center for 11 years, she can see the changes along the time span. For example, the time available for spending with the patients has been cut down in the last years. Before, they would have had time to go to the patient's home and train in their home environment 4, 5 times during their stay at the center, and they would have the time to go and visit them after they would be sent home, to see their condition. Now, they don't have so much time left for those activities. The only things that they do is to make one or two visits at the patient's homes and check if the house's setting is suitable for the patient's condition (in case the patient is in a wheelchair, are there stairs, a lot of furniture, is it easy or hard to come around the house?).

When the patient is sent home, the Community assigns an occupational therapist that will take care of the person.

At the center, they have Status Møde every three weeks, as Nicky explained at the first meeting (Worksheet no. 012), where they discuss about the evolution of the condition since last meeting. For example, if they take a patient that is going to be at the Center for three months, the first meeting is about three weeks after patient's arrival, after which they send a standard form to the nurses and therapists. They also send a standard form to the occupational therapist in the Community, where they state that one of the persons from their Community is at the Rehabilitation Center and then they can decide if they want to come for the Status Møde. The decision depends on the condition of the patient: in severe cases, where many changes can occur along the rehabilitation process, they decide to attend the meetings; in more light cases, they decide not to join. At the last Status Møde, before they can go home, the therapist and other people from the Community (e.g. nurses) come to the meeting. The Center writes a training plan (Genoptræningsplan - GOP) for the patient, which is a standard plan that, in this specific center, it is completed only by therapists. In Phase 1, it can also be completed by doctors. The paper contains description of the patient's condition before and after the rehabilitation program, together with suggestions with what should the next steps be, what kind of training would the patient need in the future. This list is given to the Community and is up to them if they want to follow the advices or not.

Related to daily activities:

Most of the patients want to be independent, to do the daily activities by themselves. It is very different from patient to patient. The patients that have the motor skills affected, have ADL problems, such as dressing up. They are trying to teach the patients to do the things as they used to do before, because the goal is to gain the motor skills back (e.g. use the affected hand again). If this method does not show results (e.g. the hand performance does not show any improvements), then they use new methods, offsetting and compensative strategies. This method is not the first choice when starting with the training and it is generally avoided, but it is most relevant when the patient has to go home. A robot could help in this situation but not in the case of physiotherapy, when the patient has to train but maybe he is not staying in the correct position. In this case, a person is needed to position the patient correctly.

For patients with process skills, the robot could give information in compensatory actions, such as: how can I take the cup on the upper cupboard, if I am in a wheelchair? How will the wheelchair have to be placed?

There is a project in Aalborg University Hospital related to young people with brain injuries (18 to 32). They follow the patients for a year. In the Phase 2, they are not very involved, but when the patients are sent home, the people working at the project have meetings with the former patients and discuss about their problems, difficulties. They know very well the problems of this age group are struggling with, even months after the rehabilitation phase is finished. Contact neuropsychologist Trine Ryttersgaard for more information. The reason for starting the project was that in some cases, the patients are sent home immediately after Phase 1, because they have suffered minor injuries that seem not to have damaged the person but in time (one year) the consequences become visible (have headache or problems in everyday life because they are very tired).

*"It could be interesting for you to go and discuss with this group"*

At the Center in Brønderslev, their every day life is very structured, with schedule around the clock. Therefore, their cognitive problems will have a greater impact when they will go home, because they have to do their own schedule, go back to their jobs or their education.

EADL = education, job, interests, social activities (e.g. be with friends, take the phone, make an appointment)

PADL= cooking, cleaning, dressing.

The needs of patients in verbal guiding differs from patient to patient.

**MOBI:DO** is an app that is designed for people that have difficulties in performing tasks, such as making coffee, doing laundry, taking the trash out, etc. She thinks that our project is similar with this one. She has been a part only at the beginning of the development of the app, therefore she doesn't know what is the current stage, why is it not used by everyone now. It would be useful to investigate and discover their struggles.

The problem that she identifies with the MOBI:DO principle is that it must be personalized, otherwise the patients might not recognize the objects. E.g. the app has to show the exact color and type of towel that the patient has to use, otherwise there is a big chance that he will not recognize it. In this case, the occupational therapist could preset the device with the specific objects that the patients uses.

She finds our project relevant.

"The apps and smartphones and everything like that is the new black in this way."

Apoplexy app is an under-development app that serves as the patients' diary. It offers the possibility for the patient to write the journey that he is having, e.g. what am I doing here, why am I here, because some of them don't know what has happened with them until that point. It also works as a platform for videos with exercises for rehabilitation.

The patients learn very fast to use the smartphone much faster than to use a washing machine.

It would be a good idea to have combined verbal communication with visual information, because the patients have different needs and impairments.

She doesn't have right now a patient that we could follow in the daily routine, but if in the near future, an occasion emerges, she would gladly allow us to observe.

When discussing about monitoring the patient, if he does the tasks correctly or at the right time, Anja mentioned that this would lead to ethical problems, both because they wouldn't like to be monitored, but also that some patients of TBI don't even know or recognize that they have a problem.

When they want to cook, they are either discussing what they would like to cook or they would be shown a cooking book and they would choose. Then, they would go through the cupboards and check what they have and what they need to buy. This is done through verbal guidance. The shopping is done always with assistance. If a device would be used for helping with the grocery, it would be better to have visual information, rather than written text, since it might be more diffi-

cult to understand and associate it with reality. This still brings the problem of the large variety of products on the market, and in case the same one as in the picture can't be found, confusion would emerge. Anja considered that having an app or something to solve this problem is a good idea.

She considered that the topic of having a schedule for the caretakers is also interesting. They have problems with ensuring that they are helping the patients with physical injuries in the correct way. Now, they have patients that need special ways when moving, specific positions for the legs. For ensuring that the task is done correctly, they take pictures. It would be nice to have a video on how to help the patients from the chair to the bed, that would help in a more structured visual way to show the steps, especially because there are many people that come in their room and that helps them move.

They have discussed the possibility for every patient to have a tablet. In this case, the idea of having a video that can easily be accessed by any caretaker that comes to help would save a lot of time and would transmit the necessary information rapidly and efficiently.

00:42:25 When discussing the possibility for the device to record daily moments for the patient, such as improvements of the patient, Anja considered that it would be a nice idea to have a robot recording what they are doing. The team suggested that the device could have the possibility of sending videos to the family of the patient. In this case, Anja mentioned the privacy issues, that the online exchange of information might not be very safe, which could affect both the patient's privacy but also the caretakers' work.

00:43:56 The medication reminder is not that relevant for the Center, it would be more suitable for the home.

00:44: 42 Some of the features can be made also for the smartphone, since they already use it, and some of them already exist: e.g. the calendar for daily schedule. Making another application for the same purpose would not be used.

00:46:50 Following a patient at this Center would not give us the exact problem we are looking for, since it seems that we want to make a product that can be used at home by the patient. It makes sense to present the product to the patient at the center, since he is always surrounded by people, and it would be easy to make him understand and teach how to use it. But they will need it when they will be at home, and therefore the needs we are looking for are to be found at their home. It would be most relevant to contact occupational therapists that are assigned to go to the patients' homes. Anja suggested to contact Udviklingsteamet from Aalborg Community, where there are many patients and students from other countries.

00:49:00 They have just discharged a young man, of 33 years old which would have been relevant for us to see. We could also contact the Østerskoven, a center where patients have their own apartments, where they have mostly young patients. This is similar with Strandgården in Nykøbing Mors. The activities from the Center at Brønderslev are mostly for understanding what the patient needs to do, since it is in the very early stage of the process. It can take many years for the persons to rehabilitate.

00:52:20 When the patients are finished with the rehabilitation at the Center, the situation of the patient is presented to the Community from which the patient belongs and the specialists from Brønderslev "fight a lot to make them understand what we suggest and for the most times, the Community follows what we suggest, but is different from each Community". This depends if there is a center in the specific Community. In the case of the patient that they have just discharged, they really insist on sending him to Østerskoven, because the environment is much more suitable for him to recover, due to the age of the patients there.

00:54:01 There has been a lot of reorganization in Nordjylland, which makes the system not work:

- There are 10 -15 less beds for neuro rehabilitation in hospitals.
- There is also a change in the period of the Phases: approximately 5 years ago, they would have kept the patients one or two weeks in Phase 1, but now they discharge them earlier than 72 hours after the stroke. Therefore, Centers like Brønderslev receive the patients much earlier. On top of this, the period of stay in the center is shorter than it used to be. Therefore, the patients are received earlier and sent to the next stage earlier. And since some of the patients, at the beginning, cannot even perform more than one hour per day of training, the process of rehabilitation goes slower.
- The Community is getting the patients earlier, and they don't have the resources needed for them, nor for placing them at Centers of Phase 3. In the last seven years, 10 of the Centers for Phase 3 have been shut down in the whole country, and now the Community cannot manage those patients. It has been noticed that this idea of shutting down the centers was not good, because the young patients were placed in Center with older patients, and this didn't offer the suitable environment for them. It also led to having waiting lists for the remaining centers.

00:58:54 They have built a totally new Center in Syndal, with 10 more places at the Center, and after one year they shut it down.

When the patient is discharged to the Community, they can suggest what kind of devices would the patient need, e.g. wheelchair, walking devices, elevator, new car, etc. They write them in the form, and then it is up to the Community to decide, since they are the one to pay. For patients with visual impairments, a talking watch from Syn og Hør Institute is used, and in this case the patient is put in contact with the Institute and then they take over.

01:04:15 They will start using animal therapy, with dogs, from the fall. One of the staff personnel has a dog that can be used to see what is the result, from the motivational point of view for patients that are not very active.

01:06:10 Four years ago they had a project about home rehabilitation, when they were told that the patients will get a computer to take home and they would have a screen at the Center for making video exercises. They accepted the project and the tool was sent to the center, but it was very big, weighting around 500-600 kilograms. The tool would have had to be placed in the house of the patient, but since it was too voluminous and it would have required renting a moving truck every time they would need to move it, the project was postponed and the current status is unknown.

01:08:38 There is another engineer student from AAU that is making a project related with an arm exercising program and that is also not in the optimal version.

01:11:27 They had a patient yesterday that had to clean the floor in the room where the meeting took place. The patient is 63 years old and he had a stroke, he had a hemiparetic stroke but is able to walk. He has problems with organizing and planning. He has to be asked what does he have to do: "For example he should vacuum this floor and afterwards clean it and we were talking before, what do you want to do. Oh, I have to take the vacuum cleaner, and then I have to place the vacuum cleaner somewhere in the plug and where does he starts." He did the task well and afterwards he wanted to wipe the floor. Again, he was asked what does he need and he knew what is needed, but he still forgot that the water has to be warm. He did not wipe the entire floor but he did finish. He had to be fold also to remove the chairs.

They have the necessary tools for ironing clothes, shining shoes, cleaning the car. They are doing some of the activities. Some of the patients didn't do activities such as cleaning or cooking because the wife is doing those, but activities such as gardening are also trained at the Center, since they have specially arranged place for this.

01:14:48 The patients are asked what they would like to do.

They wash their clothes at home, when the family comes to visit, they take the clothes and wash them. Some of the patients don't have family members that come and visit, so the cleaning of the clothes is included in the program spent with the occupational therapist, where the patient is taught how to do it (Ill. 2).

01:16:30 The bathroom that they have is bigger than how is at home (Ill. 3 and 4). When the patients are ready to use the smaller bathrooms, they are using those.

01:18:15 All the patients from the four groups are eating together in the dining room , which is different from an ordinary hospital, where they are eating at their living room.

01:19:30 They have two workshops, one smaller, inside the building, and one outside, which is used just in the warmer season, since it has no heating system (Ill. 5).

01:21:05 They have creativity room where activities such as sewing, painting, boardgames etc. are available (Ill. 10, 11, 12). They take walks in the park, go at a farm for collecting strawberry, etc (Ill. 13, 14).

01:27:20 They have a package of pieces of furniture (black leather sofa, black big chair, small table, shelf, WEE, Playstation) that they can transport and place in a big room for when the patients receive visits from their children, they are found in a more cozy environment, more like home.



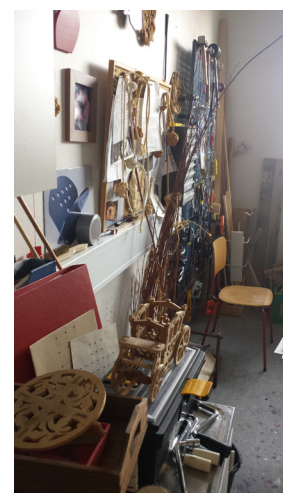
Ill. 2. Washing machine



Ill. 3. Shower in the big bathroom



Ill. 4. Sink in the big bathroom



Ill. 5. Workshop inside the building



III. 6. Eating area



III. 7. Kitchen area 1



III. 8. Kitchen area 2



III. 9. Relaxing area



III. 10. Creativity room 1



III. 11. Creativity room 2



III. 12. Creations of the patients



III. 13. Pictures from trips



III. 14. View of the garden

#### Illustrations:

- III. 1. Regionshospitalet Nordjylland (2015), Region Nordjyllands genoptræning samles på Brønderslev Neurorehabiliteringscenter [Online image] Available at: <http://www.sygehusvendssyssel.rn.dk/Service/Nyhedsliste-Sygehus-Vendssyssel/Nyhed?id=9bd2a153-3085-4cd7-9d3d-5da8772d7fe0> (Accessed: 03.03.2016)
- III. 2. Own illustration
- III. 3. Own illustration
- III. 4. Own illustration
- III. 5. Own illustration
- III. 6. Own illustration
- III. 7. Own illustration
- III. 8. Own illustration
- III. 9. Own illustration
- III. 10. Own illustration
- III. 11. Own illustration
- III. 12. Own illustration
- III. 13. Own illustration
- III. 14. Own illustration
- III. 15. Own illustration
- III. 16. Own illustration
- III. 17. Own illustration

**Evaluation:**

The interview with Anja helped in understanding better the actions that take place at the Center, the activities that they are covering during their stay. The Team also got a better understanding of the health care system regarding the four Phases that the patient goes through.

**Reflection:**

The Team discovered that is most relevant to introduce the product from the rehabilitation phase, in order for the patient to get used with it. The product is most relevant to be placed for use at the patient's home, where there is least help he gets from professionals. The next step consists of contacting occupational therapists that make home visits to the patients and also patients willing to share their story, in order to find more needs and test our ideas.

**Activity:****Assistive Technology for Individuals with TBI****Objective:**

Obtain an overview on currently available Assistive Technology for people suffering from TBI consequences. What are the areas covered by these products applications, are there any related issues?

**Experiment/data:****ASSISTIVE TECHNOLOGY**

The term Assistive technology technically refers to any item used by a person with a disability to increase independence and to make the tasks of daily living easier (referring to TBI: tackling cognitive, emotional, sensory, and motor impairments). Assistive technology in relation to traumatic brain injury, can therefore be, in the most basic case, as simple and low-tech as a spiral notebook (to help with organization and memory), arriving to the most extreme case of a very sophisticated computer-powered vocal assistant to aid with communication.

Assistive technology can provide people with TBI a way to more fully engage in life's activities. It is possible to use assistive technology to travel, participate in recreational and social activities, learn, work, and communicate with others.

Some examples of assistive technology are:

- Wheelchairs, scooters, and walkers which help with mobility and increase independence.
- Special computer hardware and software, such as voice recognition programs and screen enlargement programs, that enable people with mobility and vision problems to carry out educational or work-related tasks.
- Education and work aids can be: automatic page turners, book holders, adapted pencil grips that enable adults and children to participate in work or classroom activities.
- Bowling balls with hand grips (instead of finger grips) and one-handed fishing reels are examples of how technology can be adapted for sporting activities.

Light-weight wheelchairs have been designed for organized sports, such as basketball, tennis, and racing.

Bigger or easier-to-use on/off switches on electronic toys make it possible for children with limited motor skills to play with certain toys and games.

Devices to assist a person with daily living tasks, such as cooking, dressing, and grooming are available for people with special needs. For example, a medication dispenser with an alarm can be set to remind a person with memory issues to take daily medication. A person with use of only one hand can use a one-handed cutting board and a cabinet-mounted can opener to cook meals with improved independence and safety.

**APPS****- Behavior Tracker Pro**

Application that allows caregivers, behavioral therapists, aides, or teachers to track behaviors and automatically graph them. Option to record video of behaviors or interventions to later review with doctors, parents, teachers or therapists.

Helps With: Behavior, PTSD; Device: iOS; Price: \$29.99

**- Answers:YesNo**

Easy to use, affordable way for you to communicate with those around you if you are nonverbal. The app has two, large, color-coordinated buttons--one for yes, and one for no. Press either of them, and a voice will read you selection.

Helps With: Communication; Device: iOS; Price: \$1.99

**- Naming TherAppy**

Word-finding app to help people with aphasia and children with special needs practice important naming and description skills. Allows users to add their own images.

Helps With: Communication, Speech; Device: iOS; Price: \$24.99

**- Proloquo2Go**

An alternative communication solution to help you if you have difficulty speaking. Natural sounding text-to-speech voices, high-resolution, up-to-date symbols, powerful automatic conjugations, a vocabulary of more than 7,000 items, and advanced word prediction.

Helps With: Communication; Device: iOS; Price: \$219.99

#### - **Proloquo 4 Text:**

Text-based communication app that gives a voice to people who cannot speak. It offers a customizable single screen layout for easy conversation, free natural-sounding voices in 15 languages, word and sentence prediction and social media.

Helps With: Communication; Device: iOS; Price: \$64.99

#### - **Quick Talk AAC:**

This app gives a voice to those who cannot speak for themselves. Quick and flexible app designed to help you talk as quickly as possible.

Helps With: Communication; Device: iOS, Android; Price: \$0.99

#### - **Verbally:**

Comprehensive Augmentative and Alternative Communication (AAC) app for the iPad. This app enables real conversation for those who have challenges speaking. Just tap in what you want to say and Verbally speaks for you.

Helps With: Communication, Speech; Device: iPad; Price: Free\*

#### - **Voice4U:**

Picture-based, augmentative and alternative communication (AAC) application that helps you express your feelings, thoughts, actions, and needs.

Helps With: Speech, Communication; Device: iOS, Android; Price: \$59.99

#### - **Spaced Retrieval TherAppy:**

Facilitates recalling an answer over expanding intervals of time (1 minute, 2 minutes, 4 minutes, 8 minutes...) Helps to cement the information in memory, even for those with impaired memory.

Helps With: Memory; Device: iOS; Price: \$3.99

#### - **Unus Tactus:**

Developed to assist people of all ages with mild cognitive and/or motor deficits by allowing you to have an easy to use cell phone, with a simple set up. It utilizes a one-touch photo dialing system to generate phone calls using phone numbers from your existing contacts or those that you import directly.

Helps With: Communication; Device: iOS; Price: \$9.99

#### - **Visual Schedule Planner:**

Customizable visual schedule iPad app that is designed to give you an audio/visual representation of the events in your day. In addition, events that require more support can be linked to an activity schedule or video clip.

Helps With: Reminders; Device: iPad; Price: \$14.99

#### **10 apps to support brain injury:**

(behavior) - **Behavior Tracket Pro** is an app that allows caretakers, behavioral therapists and clinicians to track behaviors and automatically graph them.

(stress) - **Breath2Relax** is a portable stress management tool that has breathing exercises to help with mood stabilization, anger control, and anxiety management.

(life-skills) - **MakeChange** is a practical app that will show the best way to count change using the least number of coins, it can stack coins on a register display and check answers.

(poor memory) - **Awesome Memory** is a card game to help improve memory; a simple fun tool to stimulate brain activity.

(concentration) - **Audible** is useful for those who have trouble reading or find remembering easier through listening.

(low tolerance of noise) - **Clear Record Premium** is an audio recording app that suppresses ambient, background noise allowing the user to record conversations in noisy environments while maintaining clear voices.

(reading) - **iBooks with voice over** allows the user to search and instantly download thousands of books and magazines; it will also read the contents of the pages out loud.

(communication) - **Dragon Dictation** is a voice recognition app that allows users to easily speak and instantly see their words on the screen. It can also send short text messages, emails and update Facebook and Twitter statuses without typing a word.

(organization) - **Corkulous Pro** enables patients to collect, organize, and share ideas on virtual cork boards. They can pin: labels, photos contacts, and tasks.

(speech) - **Yes/No** is an easy to use app to help communicate with others in a simple way if the patient has difficulty in speaking

#### **Technologically Advanced Products**

- Memo recorders:

**Voice Cue** have clocks and alarms that can be programmed to make specific announcements, some at the same times each day of the week.

**Watch Minder®** When set ahead of time, can remind a person to do specific tasks like “call home” or “go to work”.

- Handheld microcomputers:

**Palm Pilot ®** uses touch screen capability and allows an individual to easily input, save, and retrieve notes, telephone numbers, dates and daily reminders, and to do lists. A built in calendar displays the entire month at a glance while cursor controls allow scrolling from day to day or month to month.

**Visual Assistant** is a hand held microcomputer that provides task prompting support by providing digital pictures, along with custom recorded audio messages that provide step by step instructions.

**Ultra Key Seeker** beeps and flashes to assist in locating lost keys.

**Shake Awake®** a vibrating alarm clock can be placed inside a pillowcase or under the mattress to assist with varied sleep patterns, such as insomnia and reversed sleep wake schedules.

**Pill Alert** provides an alarm feature that can be set to ring at the time or times medication needs to be taken. Some reminders automatically reset to repeat at the same countdown interval, or have lights that identify the compartment that should be opened. Medication alert devices may be pocket sized or housed in a wristwatch.

**Boil Alert** is a round, 3.5” heat resistant glass disk that is placed at the bottom of a pot or kettle to assist those individuals who may enjoy cooking but become distracted. The device alerts the individual by rattling when liquid starts to boil inside the pot or kettle. A Stove Power Controller is equipped with an alarm that may be set for 15, 30, or 60minute intervals before the automatic shutoff occurs. This device may be helpful to those who may forget that the electric stove is on.

**Talking Microwave II** provides voice prompts, including announcements for setting or running cook times, current power level, status of the microwave and reminders to attend to the food.

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IPAT North Dakota Assistive Technology <http://ndipat.org/learning>

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## Evaluation:

The data collected aimed to give a general overview on the Assistive Technology currently available for people suffering from consequences of TBI.

## Reflection:

Every product aims to cover a very specific and well defined need. For the types of cognitive impairments similar to the ones that the project is considering, the most relevant part is usually the software rather than hardware. In fact, most of them are applications (e.g. calendar, scheduling etc). For this reason, a very important topic that will need to be faced will be interface interaction and relationship of impaired individuals with technology.

**Activity:****Radio interview****Objective:**

Listen to a radio interview from HjerneKassen P1(2016) to get more knowledge about the Danish system dealing with brain injured people and how it is to live with a brain injury.

**Experiment/data:**

**Interviewer: Peter Lund Madsen**

**Interviewed person: Aase Engberg Special doctor, Neurologist and consultant for the Brain Injury Center Association.**

In Denmark, 120.000 people live with a sudden acquired brain damage, caused by either a traffic accident, a blow to the head, a clot or bleeding in the brain, inflammation of the brain or lack of oxygen because of heart stop.

For people between 15 and 24, the most frequent cause of brain damage is if they bike without a biking helmet or they are in an accident with a motorbike (this is also the case for people that have been biking without a biking helmet). If these people get into an accident and knock their head on something, it is always the front of the brain that is damaged either because the person falls on the forehead or because the brain is sliding forth and back and therefore being damaged by the inner side of the cranium.

The front of the brain is the part that is used to plan your life and execute tasks.

When this part of the brain is damaged, the first impact is the ability to plan, think and be able to “control your home”. You are not able to get through daily life to make sense and work. Likewise, the person’s behavior and personality will be affected and in very severe cases the person will lose situational awareness and the ability to behave in a decent way. This has a big impact on the ability of the person to carry out an education or a job, because the person has difficulties to know how to behave in relation to other people and how to structure and plan daily tasks.

Sometimes it happens that a person falls and breaks a leg in the traffic and, because the broken leg is more “visible”, the patient will end up in orthopedic surgery department where there are no specialists in brain injuries. Then the brain injury will not be discovered. When the person returns home, the relatives will notice a change in the person’s behavior.

When a person had a brain injury, the cure is to stimulate the brain either by talking to the person or to train body parts.

Training and the physical part of rehabilitation has had a lot of focus lately, but the mental aspect is still the most important aspect of rehabilitation in most cases. The physical movement has a big impact because when training the body, a growth substance will be produced in the brain called the brain derived neurotrophic factor. This training promotes the regeneration of brain cells that can be healed, also the brain cells that are dealing with the mental parts of the brain. This means that there is a close connection between the physical and mental rehabilitation.

Immature brain cells can be matured in this process, and it is an area that is still investigated a lot. This does not mean that very severe brain injuries can be healed, but it means that the person can be helped to reach a certain state again.

**The local election in 2007**

After 2007, when Denmark went from Amts to Kommunes, the development within rehabilitation for people with a brain injury went from leading to drop drastically in quality.

Before 2007, the Amts were responsible of taking care of people with brain injuries. This meant that people with the same problems were gathered in big centers that were specialized in the different cases.

After the responsibility was moved to the Kommunes, they thought it was too expensive and wanted to do the rehabilitation by themselves. This means that now there are too few specialists in each Kommune to evaluate the different patients.

Denmark went from 14 Amtes to 98 Kommunes.

As a local council, they do not always know what people with brain injuries need and they might choose the wrong solution regarding the rehabilitation, simply because there are so many different affects of brain injuries.

Sundhedsstyrelsen states that there are between 125-375 children and young people each year that need rehabilitation after the hospital. If these patients are divided between the Kommunes that vary a lot in size, some of the Kommunes will only have one, two cases a year. The knowledge about these patients in each Kommune will then neither be expanded nor good enough.

The cure will be to gather the children and young people on a special center. Likewise the patients that have very severe cases on the same center.

Before 2007, Hammel and Hvidovre Rehabilitation centers were leading within this field and were supported financially by the Amts.

Typically, people that have got a brain injury are very tired. There is no clear explanation to this, but maybe because there are less brain cells that have to work harder. Usually they are taking turns to work, but now they have to work more.

As long as the person is hospitalized, the region has the full authority and responsibility. After discharge, the Kommunes take over the full authority and responsibility together with the health sector. The medical treatment responsibility is shared between hospitals and general practice. The region has also a responsibility to ensure development and research work, and municipalities will contribute to this, among other things, in order for the health and education of health professionals to be performed at a high professional level.

## **Second interview is with Andreas Binderup Thomsen (35 years old) - kommunikationsmedarbejder på jobcenter i København**

When Andreas was 21 he was in a skiing accident. He lost the control of his skis and drove right into a tree with the head first.

Right after the accident he got picked up by a helicopter and brought to Grenoble which is one of the leading hospitals in the world within neurosurgery.

From the accident he got 5 skull fractures and 3 spine fractures, he got a trauma on the right frontal lobe and a large brain hemorrhage. He was in coma for 3 weeks and on the Glasgow scale he was placed in category 3. His parents went to be with him at the hospital and were told that there was a 50% chances that he would never wake up again.

After he woke up he was sent to the hospital in Århus to start the rehabilitation. He does not remember the first 5 weeks after the accident and basically had to start all over again: learning how to walk and talk.

After the Hospital in Århus he got to Hammel neuro-center and then next to the brain injury center i Århus.

After 1,5 years he was so far in the rehabilitation that he was able to start up an education and finished within the normal time. He has no cognitive problems meaning that he still had his logical thinking. He is educated within communication.

Throughout the rehabilitation, Andreas met many other people suffering from a brain injury. Most of them were "adults" that already had a life, job, family that they had to fit into after the rehabilitation, but since Andreas was only 21 and had not started his life yet he did not had to fit into an existing role.

3-4 years after the accident he was at a stage where he only suffered from mental tiredness, was color blind and had lost some of his sense of smell. This is his current stage also.

When he was done with the education he had difficulties doing a whole day of work and also had to quit some jobs because he could not live up to the expectations from himself and an employer (He did not tell about the brain injury).

He was very naive and thought that he would be able to work as a normal person as soon as his education was done. He struggled with this for 5-6 years.

The last employer that fired him, made him realize that he had to deal with his problems and had to recognize it. After this he started to see a psychologist at the Center for Brain injuries where he met other people with the same problems, the same mental tiredness.

He went through a long period of time when he did not want to accept that he had a brain injury. Therefore he did not fill "cured" until 13 years after the accident where he finally accepted that he had a brain injury.

He is suffering a lot from mental tiredness and struggle with it every day. On an average day he will experience mental tiredness three times. He explained that it starts like if a black cloud is covering the mind. He would start having blurred vision, have troubles talking and his head start hurting. It is different from when being tired in the evening. Feels like not being alive for a moment. His current way to deal with it is to take a power nap for 7-10 minutes where he has to lay on the floor because he broke his back in the accident.

After this he realized that he could not do a normal work week of 36 hours and he got a flextime job. He is now working 4 days a week, 5 hours. The employer is fully aware of his condition, knows why Andreas sometimes needs to lay down, has a blackout or is tired in the end of the day.

The hardest parts of living with a brain injury was to accept it. He had to work a lot on his perception of himself in relation

to not being able to do what he used to do.

He went skiing again 1 year after the accident, because he needed closure and needed to know if he still liked it. Now he is always skiing with a helmet and carapace. Likewise he is always biking with a helmet. (*Hjernekasen*, 2016)

#### **Reference list:**

*Hjernekasen* (2016) P1 8 February

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#### **Evaluation:**

Through this interview it was discussed how the Danish system is dealing with drain injuries. This gave a lot of knowledge that will be very useful in the following research. Likewise, an interview with a man that lives with a brain injury is made. The interview gives for the first time some knowledge telling about the feelings related to living with a brain injury.

#### **Reflection:**

A lot of new knowledge was gained. From this interview a much better understanding of why the Danish system is like it is today was gained.

While listening to this interview, notes were taken and in the end these notes were formed into a text. Since the interview was in Danish, it took a very long time to structure the material. Another method needs to be explored next time.

In the first part of the interview it is only one point of view that was given and therefore it is still questionable if the change happened only because of financial reasons or also because of distance to the different centers. By having the rehabilitation done in each municipality, the families will have their unfortunate family member closer to home. Though the quality of the rehabilitation seems to have worsen up.

In the second part of the interview, a man living with a brain injury is interviewed. In this interview, the Team is for the first time introduced to the feelings related to living with a brain injury and the feelings related to accepting to live with a brain injury.

Likewise, the Team is at the first time introduced to the term mental tiredness which is a condition that many people with brain injuries experience every day. It sounds like being the main condition that prevents them from having a normal life.

**Activity:****Visit to Strandgården Rehabilitation Center****Objective:**

Get an understanding of how the patients are managed in the rehabilitation center Strandgården in Nykøbing Mors. The Team aims also to get feedback on the project's current direction.

**Experiment/data:**

The visit consists of one hour interview with an occupational therapist and a physiotherapist working in the center since approximately one year. The observation of the facility is also included.

Currently, there are eight people living in the center (soon one more will join). The people are from 22 to around 60 years old. They are called clients. The maximum capacity is 14 places.

An audio record of the conversation has been made. The relevant information is reported below.

*The project was presented*

- What are the usual problems for them?

It very much depends but all the problems that they would have in another normal situation, e.g. dressing, showering. Cognitive problems in structuring and planning an activity, having an overview. Eg. How to dress: what do you put on first: shoes or socks? One client, when starting brushing his teeth, does not know when to stop because he loses cognition of time. There is no signal from the brain saying you are done (could go on for one hour). He would also not know when he had to brush teeth.

Taking shower: some might not know they have to remove the shampoo when taking shower. In this situation, the occupational therapist stands beside the shower.

Patients have a schedule on the wall but that does not mean that they will follow it.

Some of them, when you give a verbal instruction, they will not always understand what they have to do. Then you have to show with your body.

- How can they know when a person is ready to go back to the community? Are there some standards?

Is not always their decision. There are economical reasons: the amount of time given to the client is decided by the Kommune from where they come from. If when the given time is passed and the client still needs support, the center will give directions about which are the areas of assistance needed (for how much time: might be all day long, and in which situations). There is not such thing as a check list that must be completed in order to return to the community.

- Clients are often not able to express what they need because they are not aware of the necessity. The center supports the clients by telling them what they need and then the community will take the decision of providing the necessary aid or not (e.g. go to permanent residence for TBI or not).

- Having a family to support the injured person influences the overall decision regarding when to replace the patient in the community (if they have kids or not, if the family lives close etc.)

- Several factors influencing the recovery process: age (is not the main factor), area and severity of the damage, motivation of the person (most of them are very motivated to improve).

- To perform a task usually they guide the client physically (either showing or touching them).

Some of them need visual guidance (e.g. pictures) while with others, verbal guidance can be used.

The method used changes as the patient progresses, e.g. from visual to verbal guidance.

- Fall back can be caused by the change of medication used or when the cure is concluded, but they usually work with known activities that are repeatedly performed.

- How do they deal with personal space? (Thinking also about the help in the shower).

E.g. going to the toilet is one of the first things that the client requires to do by themselves (if they are able to speak).

Most of them anyway accept the help .

- Daily structure: there is a daily schedule (every patient has it) or weekly schedule.

Clients in general prefer to have a schedule (but at the same time, some people can get confused if they have too many tasks to do on the schedule) - anyway is individual.

- Each patient is connected to a team of professionals: occupational therapist, physiotherapist, nurses, speech consultants, etc.

- Teach them e.g. how to plan their day, how to cope if you can just use the left part of your body etc.

- Tools can be: special kitchen tools, walking aid.

- Assessment of the home: they always go the client's home before he returns to the community to verify if it is suitable. They also do some training there and have meetings with the person that will take care of the client when back to the community (they make a report on the patient to hand out to the professionals that will take care of them in the community).

- GAP: back to the community, the injured person will train only 2-3 times a week while in the center is everyday.

- Recurrent issues/more relevant things? Basic activities such as: dressing, personal hygiene.

Those are also the areas in which the community hopes the patient to be independent because otherwise it will mean more costs to assist them. For this reason, it can happen that the community makes a check list (can be 3-4 points which are considered top priorities) for the patient with goals that should be achieved before his return to the community (eg. be able to dress, go to the toilet independently).

Sometimes the goal set is unrealistic so they break them down into smaller goal, e.g. Instead of getting fully dress, they change it to put on t-shirt.

Being able to perform personal hygiene and dress is not always achieved because it depends on the patient's conditions when he arrives to the center.

- They get patients mainly from Brønderslev, Hammel, Grindstide (00:27:20) , Skive (from all Jutland).

There is another similar center in Lønner.

- Every person has his own room (kitchen and bathrooms are always accessed from the corridor). There is training kitchen.

- Occupational Therapists take care of all basic activities, such as cleaning, cooking, personal hygiene, etc.

- Some people have no cognition of time. E.g. a patient would prepare to shower in the middle of the day even if showering is scheduled to happen in the morning and he might have done it already.

Some of them do not understand the clock, what an hour means etc. But most of the people are able to read a watch.

- Some people are able to use technology, but many have difficulties in using tablets or smartphones.

- Presentation of Concept 1 - Systems of objects; Concept 2 - Add on device; Concept 3 - Smart object.

Comments: not many patients with issue of brushing teeth; But e.g. the shower, the caretakers will not have to stand beside the shower to assist the patient (many money are spent on this).

- Regarding stigmatizing objects: people are often not even aware, or they are very motivated in getting better so they will not care about having an object that shows that they have a problem (They do not care how it looks like).

- The occupational therapist does not think that having a multipurpose tool (referring to SAR) would confuse the person with TBI. She says it could be nice to have a tool that can help in different situations.

- Authority issue - Might be an issue that the person will not listen to the directions gave by the device if a person has a previous different routine in performing a task.

- Human contact and relationship between the person and the therapist are very important and can not be replaced.

- Introduce the product in the center - that would be important so that the person can get used to use the tool in the everyday activities. Also because in a center they can train the person in using the tool everyday, but back to the community, the introduction of the tool can be trained just 2 or 3 times a week.

- The Community is the one that pays for aid tools. They also approve the request of buying the tool.

The tools they know are found e.g. by personal research, occupational therapist meetings and conferences, a database that contain all the tools.

- Staying at the center: minimum three months.

A person has been here for two years because the community has no place to allocate him.

- Can happen that a person is sent to an elderly center if the patient poses too big costs for the community.

- People that come to the center must be at least 18 years old. Otherwise they go to specialized centers (rehabilitation is different for young people since the brain is still developing).

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### **Evaluation:**

The visit to the center was useful to get a different perspective on the topic of research, the data collected confirmed that the direction taken regarding personal hygiene it is a relevant topic that can be further explored.

### **Reflection:**

In order to get the most out of the meeting with experts, could be useful to better structure activities to perform during the session, by also using activities different from normal interviews.

**Activity:****Interview with Jeanette Gadegaard****Objective:**

Get an understanding of the challenges that people with brain injury face in their everyday life by watching a presentation with Jeanette Gadegaard.

After the presentation was viewed, an e-mail-conversation took place, to expand the knowledge about her challenges.

**Experiment/data:****The following information was given through the presentation:**

Jeanette Gadegaard is a 48 years old lady that has suffered of a brain injury 8 years ago (Ill. 1).

She is living at home with her husband and two children of 18 and 20 years.

The day after her 40 years old birthday, Jeanette fell while ice-skating and hit her left part of the back head on the ice. After this, she was not diagnosed until a year after the accident and when she was finally diagnosed it was with a moderate Brain Injury.

14 days after the accident she was still very dizzy, confused and tired. Therefore, she went to the doctor and was afterwards sent to a MR-scan where they found a bleeding in the brain.

From this scan they found out that she has a moderate brain injury and whiplash. This started a long process where they had to find out if she was affected and how bad her condition was.

She was afterwards sent to a test at Herning private hospital to evaluate her cognitive skills. Here they tested her abilities to remember and recognize numbers. In this test she felt very stupid and was crying because she had to acknowledge that she was not able to do the tests.



Ill. 1 Jeanette Gadegaard

She further tells that the social worker from the municipality, that was working on her case, did not know enough about brain injuries and therefore did not offer her any rehabilitation. But because she did not get any better and her condition got worse, her doctor had to step in. He helped her convincing the municipality to get a rehabilitation course in communication. She had the course 2 years after the accident.

**Effects of the accident:**

Today she has problems with both short- and long-term memory. For example, she can go on a vacation to the same city two times within two years and not remember the place. She remembers everything that happened before the accident, but if you ask her a question about it, she might need 10-15 minutes to answer to the question.

She is not able to cook anymore. She can only perform one part of a task at the time, otherwise she will get confused. She easily gets confused, stressed and tired when cooking because she has to keep track on both what she is doing and what has to be done next. She does not have any sense of timing and does not know when to start cooking the different meals according to each other.

When she has friends over, they need to tell her when she has to start heating up the food and they have to help removing the dirty dishes after eating.

After the accident she went from being a A-person to a B-person. An A-person is going early to bed and getting early up in the morning, while a B-person is going to bed late and getting out of bed late.

She went from restless to just being silent.

She became very clumsy. She has troubles keeping the balance and will sometimes be tripping or even fall. She will trip over things because she has lost her peripheral vision. She is therefore only able to pay attention to things that are right in front of her eyes. For example, when she goes grocery shopping, she will sometimes take a piece of fruit from the middle of a pile because she is only seeing what is right in front of her. Then, when the fruit pile falls down she will try to put it back, but is not able to do so because she does not understand the structure of how to build up at pile. Therefore, she will eventually need help from some of the staff.

In the first period after the accident she felt stupid and blamed herself for not being able to do the tasks that she would normally be able to. And she still feels stupid every time she asks the same question two times in a row or does not remember what she did yesterday.

#### **After the accident she has suffered of:**

- Great tiredness.
- Troubles falling asleep and disturbed sleep.
- Epilepsy: when her brain gets stressed and therefore she needs a lot of breaks during the day.
- Tinnitus.
- Nausea.
- Light and sound sensitive.
- Bad visual view – She only sees what is going on right in front of her eyes.

#### **She gets medication against:**

- Epilepsy.
- Euphoria.
- Insomnia.

### **Weekly schedule**

For better structure, she has a schedule for each day in the week to follow:

#### **Monday**

Pray-day - after the accident and because of trauma in her childhood she became Christian and has found peace this way.

#### **Thursday**

Training in water, but she has stopped this for a little while because it takes too much of her energy. First of all because she has to be social while being brought to and from the pool and afterwards all the things that have to be done before and after being in the water.

#### **Wednesday**

She is together with four other women and do different creative stuff. They crochet, paint and perform other creative tasks. She stated that once in a while she is drifting away in her mind because all the talk takes a lot of her energy.

#### **Thursday**

This day she relaxes because Wednesday takes a lot of her energy. This day she is either walking or writing on novels. She is an author.

#### **Friday**

She has a caretaker coming for 45 minutes. Then they either cook together or do some practical stuff around the house. Unfortunately it is for only 45 minutes meaning that they are not able to get a lot of stuff done and will usually not be able to cook a whole meal.

#### **Weekend**

In the weekend she spends time with the family.

### **E-mail conversation:**

#### **First mail exchange:**

In this e-mail conversation she was asked to elaborate on her difficulties, needs and how is she dealing with it today. Furthermore she was asked if she is able to do personal care herself and if she has just the slightest difficulties doing it.

#### **Her reply was as follows (First reply):**

"Hello Ulla,

I have cognitive issues and personal care I have no problem doing.

Throughout my day I have my alarm on my cell-phone ringing every time I need to take my medication, take a shower, need to brush my teeth, remember my wallet or 5 minutes before I have to leave for an appointment. This way I remember to do everything, but on the other hand it is very stressing that my phone is ringing all the time.

My cognitive issues are mostly concerning housework. I have lost my practical abilities to do daily chores. This is for example to empty the dishwasher, vacuum clean, clean the floors and do simple cooking.

When I was younger I was even hired as a kitchen assistant and was really good at cooking and baking. Therefore I am very sad to have lost this ability.

In general I am only able to perform one step in a task at the time. Afterwards I will lose the track, get confused and not be able to continue. I simply need a picture-cookbook with simple dishes and baking. Or maybe a practical speaking calendar. But maybe that has been invented already? Another thing that could help me could also be a DVD which I could follow step by step to do a simple dish. That could really support me.

I have a home tutor/caretaker coming every Friday for 45 minutes. She is helping me with grocery shopping and we are practicing to go grocery shopping and actually getting home with the right stuff.

Furthermore, sometimes she helps me to prepare a meal, but since it is only for 45 minutes we do not have time to do much.

Cleaning is also very difficult for me. I do not remember what kind of cleaner to use and how the cleaning should be done. My husband is doing the cleaning now and is not as comprehensive as I would like, but since I cannot do it myself, I need to live with it. Before the accident, I would vacuum clean every second day, but now it is only done once a week. I have activities almost every day and need therefore a lot of small breaks during the day. In relation to personal care I only have a few things. For example when I am brushing my teeth I will sometimes lose track of time and then easily brush my teeth for up to 6 minutes. Another thing is that, sometimes, after I have taken a shower, I will forget if I have used my deodorant already and therefore I will apply it multiple times. I do not understand numbers anymore, but is still eloquent. I easily get confused and do not always understand what people mean with what they are saying. I am not able draw a copy of a drawing from a book anymore. I have troubles understanding what time it is - I am not always able to understand my watch and need therefore my phone to tell me what time it is. I hope that this answered your questions and if you need to know more just mail me. Regards Jeanette Gadegaard.”

### **Second mail exchange:**

In this email she was asked to explain more in detail about what kind of help she needs in order to do a cooking task. For example if she needs images, text or what kind of guidance she would need. She was also asked if the phone has a text telling what to do when it is ringing, who sets it and if she has tried different ring-tones. Furthermore our current idea with the toothbrushing system was attached for her to give some feedback on it.

### **Her reply was as follows:**

Hello, I need a lot of guidance for cooking  
It has to either be written down or be shown with text and pictures.  
It has to be written down to every minor detail and has to be crystal clear/bulletproof.  
It has to be written with very big letters so that I can be guided.  
If I go grocery shopping the shopping list has to be with pictures of the groceries.

It sounds like a smart solution for brushing teeth and it is very exciting.  
With teeth-brushing I am once in a while brushing too long, 5-6 minutes because I am losing track of time.  
Therefore I have considered to buy an electrical toothbrush with a timer on to solve it.  
It sounds like a smart solution with the green/red light when a person has to brush teeth.  
Though with a bad memory it could be difficult to remember what the colors stand for. If red or green means that it is time for brushing teeth. People with brain damages would have a hard time remembering what the colors are symbolizing.  
Likewise a lot of people with brain damages has difficulties with left, right, space and sense of direction  
Maybe it is still best if the phone is ringing and with text telling that it is time for brushing the teeth.  
I have my phone ringing with text explaining me what to do. brushing teeth, taking a shower, feeding my budgies in the outdoor pavilion. It is very stressing.  
I am good at thinking outside the box.  
I guess you can get apps already that tell you what kind of products to use for the shower, Shampoo for the hair, soap for the body, towel to dry your body etc.  
I have no problems myself in that area.  
For me it could be a great help if I could get a app telling my what kind of cleaners to use for different cleaning tasks. for example what do you use for the floor, refrigerator, toilet, windows etc.  
I am never able to figure it out.  
I am not able to remember from time to time.  
Everything I have to remember during the day has to be put into my phone with an alarm. Otherwise I will forget to do it.  
I am spending one hour every Sunday planing the following week. I type everything into my phone in the calendar.  
It is a very hard task for me and I takes a lot of my energy.  
Please write again if you need any further explanations or call me and I will explain it over the phone if that is better.  
Thanks for sharing your ideas with my and I think it is a very exiting project and I really want to help where I am able to.  
I am happy that some people are trying to make products that can help people like my self.  
Have a nice weekend.

Greeting Jeanette Gadegaard

### **Facebook conversation (translated from danish):**

#### **Conversation started Marts 7th**

Ulla Tanderup Gade  
07-03-2016 16:01

Hello Jeanette we are a group from Aalborg University that are currently doing your master thesis. In this project we are working on making a tool that can help a person with cognitive difficulties to perform daily tasks. I just saw your presen-

tation on TV Midt-Mokka and was wondering if I can ask you some more detailed questions in relation to your difficulties?

Jeanette Gadegaard

07-03-2016 16:17

Yes of course you can send them on my email:

1234@hotmail.com (In order to protect Jeanette's privacy a replacement email is used).

Ulla Tanderup Gade

07-03-2016 16:19

Thank you so much :-) I will write you a mail tomorrow morning.

Jeanette Gadegaard

07-03-2016 16:20

Nice :-) If you need somebody to test the tool, I would also like to do that.

Ulla Tanderup Gade

07-03-2016 16:24

That would be really great :-) I think we will have a prototype in a month or two that we will need somebody to test. I will write you as soon we have it. Furthermore I can also send you our current ideas? If you want too see them?

Jeanette Gadegaard

07-03-2016 16:29

Thank you. I would really like to hear about your ideas and test also.

I think it is really exciting that you are trying to help/support people like me with brain injuries.

I am so excited to see it.

You can also get my phone number : 12345678 (In order to protect Jeanette's privacy a replacement number is used)

I look forward to hear from you.

### **Marts 8th**

Jeanette Gadegaard

08-03-2016 17:53

Hi, I look forward to hear from you.

Ulla Tanderup Gade

08-03-2016 19:36

Hello :-) I have just send you a mail about our project. And you just take all the time you need to answer it :-) And thank you so much :-)

Jeanette Gadegaard

08-03-2016 19:57

Thanks, I will read it thoroughly and get back to you.

### **Marts 9th**

Jeanette Gadegaard

09-03-2016 10:11

Hello I have tried to answer your mail as well as possible.

I have a hard time remembering everything that you are asking about.

It can be difficult to read and understand a long mail when you have a brain injury. So if I have not explained myself well enough you just call me.

I forgot to tell that I have difficulties concentrating and bad short- and long-term memory.

Greetings Jeanette

### **10. marts**

Ulla Tanderup Gade

10-03-2016 10:01

Hello Jeanette

I think your mail is answering my questions very well :-) Right now I have no further questions, but I will get back to you as soon as I have any :-).

Thank you so much again for taking you time to help us.

Greetings Ulla Gade

Jeanette Gadegaard

10-03-2016 12:27

You are welcome.

### March 29th

Jeanette Gadegaard

29-03-2016 19:07

Hello. Do I hear from you soon again? :-)

### March 30th

Ulla Tanderup Gade

30-03-2016 09:47

Hello :) I have not forgotten you, but time has just passed by so fast :-)

I have just sent you a mail with some of our ideas and concepts.

I hope you enjoyed your Easter :-)

Jeanette Gadegaard

30-03-2016 10:26

Thanks, yes time is passing by fast.

I had a good Easter thanks.

These days I am relaxing because I am going to Randers to make a presentation tomorrow night.

I will look at your mail as soon as I can.

Have a nice Wednesday.

Ulla Tanderup Gade

30-03-2016 10:27

That sounds great :-).

### April 5th

Ulla Tanderup Gade

05-04-2016 08:54

Hello Jeanette

I have just read your mail and I am glad that you see some potential in your project :-) We recently had to change the direction a little because we have not been able to find somebody that have difficulties with personal care. Therefore, our focus is now to make a similar system to help in a cooking task instead. You mentioned a while ago that you needed help even for making simple dishes. So I was wondering what a simple dish could be? Would pancakes be simple for example?

Greetings Ulla

Jeanette Gadegaard

05-04-2016 09:40

Pancakes would be a fine starting dish where all the ingredients that are needed could be shown.

Another simple dish could also be buns or a cake. I would really like to be able to bake that when I have friends coming over. Simple and easy dishes are hard for me and many other.

So exciting project.

Greetings Jeanette

### April 6th

Jeanette Gadegaard

06-04-2016 09:13

The recipe has to be very detailed, where you are guided through the whole recipe. Maybe with pictures or text, but it has to be big letters.

I would really like to test the book or app or whatever it is you are making :-)

Ulla Tanderup Gade

06-04-2016 10:06

I am glad that you are so helpful and hope that we will have a prototype ready as soon as possible :-) At first I think it will be an app with two recipes. The first one will be pancakes and the second one stegt flæsk med persillesovs.

I was wondering, since you are dyscalculia, how do you understand numbers best? Is it best to write the number with letters, such as: one two tree or is it better to tell the number by words?

Jeanette Gadegaard

06-04-2016 10:08

It sounds really nice with pancakes and stegt flæsk med persillesovsen.

I look forward to make the dishes.

And I am best at understanding one, two, tree.

Ulla Tanderup Gade  
06-04-2016 10:10  
Thank you so much for you help once again :-)

Jeanette Gadegaard  
06-04-2016 10:12  
You are welcome, I think it is an exiting project and am looking forward to try it out when you are ready.  
I read yesterday that Hypnosis might be able to help the memory, for people with brain injuries?  
Aalborg University and Århus University are currently making a test with it.  
Have you heard about it?

Ulla Tanderup Gade  
06-04-2016 10:17  
No, but can take a look at it :-)

Jeanette Gadegaard  
06-04-2016 10:18  
Yes :-)  
Read about it on Text TV yesterday where Aalborg and Århus University have some test people.  
I hope I am not wrong, but I do not think so.  
I would really like to know if it could help me also. Just a little.

Jeanette Gadegaard  
06-04-2016 10:22  
[http://www.avisen.dk/kommune-vil-hypnotisere-syge-ledige\\_379692.aspx](http://www.avisen.dk/kommune-vil-hypnotisere-syge-ledige_379692.aspx)

Ulla Tanderup Gade  
06-04-2016 10:28  
It looks very exiting :-) I really hope that it is working. I can write you back if I find out more about it :-)

Jeanette Gadegaard  
06-04-2016 10:28  
Thank you

### **Illustrations:**

Ill. 1 Own illustration

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### **Evaluation:**

The presentation and e-mail conversation has given a really good insight in some of the problems that people with brain injuries are facing. She does not have the challenges that we are aiming to solve, but the type of challenges she has can be transfered/translated into our scope. She is mentioning that, while cooking or cleaning, she will be in doubt of how and when to do it. She explains it as she is only able to do one part of a cooking-/cleaning- task and then she will loose the track of it. These are exactly the type of challenges that we are aiming to solve, but just within the personal care area. She is mentioning a few challenges within personal care and those are the timing of brushing teeth and remembering if she has put on deodorant already. Likewise, she tells that she is using her phone to remind her of doing stuff, but also that it is very stressful for her to do it this way.

### **Reflection:**

The Team learned a lot and she will really like to help in the further development of the product. She even offered to test the product, but since she is not dealing with the problems we are aiming, the collaboration will be on a reflective level. She has so far been very helpful and good at reflecting about her own needs and challenges. If possible, a personal meeting in the future would be very useful.

**Activity:****Testing picture guidance****Objective:**

Make a test that would help the Team to find out how many pictures are needed for the device to explain a task. In this test, four tasks were created:

**The first test** was to make a cup of tea from loose tea. The pictures for this test were taken in another kitchen and therefore the focus in this test was to see if the tested person could link the images to the kitchen he/she was in. In this test, the pictures were taken from the view of the person making the tea.

**The second test** was to give the tested person verbal instruction with the aim of placing some objects in the right order.

**The third test** was to make another cup of tea. This time it was with a teabag and the pictures for the task were taken in the kitchen where the tested person was standing in. Furthermore, the pictures were taken by another person and therefore showing the individual making the tea.

**The fourth test** was a series of pictures showing how to arrange some objects in a specific order. These pictures were taken by another person and therefore showing a person performing the task. (Appendix 6)

The following description of Mik is given by his sister.

**Who is Mik?**

Name: Mik Jensen  
Age: 21 years old  
Diagnosis: Landau Kleffner Syndrome

When Mik (Ill. 1) was 4-5 years old he got meningitis and was close to die. Later when he was 8 he got epilepsy which resulted in a minor brain damage. Because of this he lost his ability talk and had to learn all over how to talk.

Today he is 21 years old and living at home with his mom and dad. Mentally he is a little younger, around 13-14 years old. This means that he just got into the teenage-stage and has started to not always do as his parents say. Likewise he has gotten into an age where he wants to be more independent.

He is very spoiled and his mom is very protective of him. In his current stage, he is very driven by if he want to do something or not. Therefore it is sometimes difficult for his parents to make him do stuff. He does not always want his mom to tell him what to do.

Today he is able to speak again, but is not able to read. Some words he is able to read, but only because he recognizes them/sees them as pictures. It is bothering him a lot that he is not able to read and write because some of his friends will write him a sms and he then needs help to reply.

He does not consider himself as handicapped, but as challenged. It is bothering him that he is "different" especially when it comes to girls. He has a hard time understanding that other people do not understand his difficulties. He is aware that he has some difficulties, but in his mind everybody knows that.

He is working in a protected workplace where he is every day picked up by a cab and brought to the workshop. Likewise he is picked up at work and brought home again.

He cares a lot about how he looks and how other people see him. He wants the newest technology and currently he has an Iphone 6. He needs help to learn how to use new technology and it needs to be cool in order for him to even try it.

He is able to do most things by himself, but he has a few areas where he needs more guidance than others. For example he has difficulties evaluating situations. A case could be that he would try on a t-shirt. Then he would not know what to do with it after trying it on and he would just throw it in the laundry basket. Another case could be that he would be asked to clear the table after dinner. If there would be some unused cups he would be in doubt of what to do with them. Should they go back into the cabinet, go into the dishwasher or stay on the table.

Another area that he has difficulties with is to think ahead. He is not able to understand that he needs to wash his clothes in order to have some clean clothes for tomorrow. Likewise he is not always able to understand the consequences of his actions.



Ill. 1. Mik Jensen

## Experiment/data:

### Task description - task 2.1

The first test is to make a cup of tea, with loose tea. Mik should perform this task by guidance from a series of pictures shown on a screen. The picture series was taken in another kitchen and with similar items. Mik therefore had to relate the pictures to the kitchen that he was standing in. Before the test he was told where to find the objects needed to perform the task. Furthermore he was told to say next when he needed the next instruction (the next picture) and back if he needed to look at the previous picture again. The pictures were shown on a computer which was held by a person. The person holding the computer was standing approximately 1,5 meters away from Mik on the right side.

### Notes and observations from the test with Jon Sjøgaard (fellow student) - Task 2.1

He was able to perform the task from the pictures shown. He had to stop and look closely at the pictures once in a while and did also do some of the steps before they were shown in the guidance. He skipped a lot of the pictures because he already did the task. E.g. was putting the objects back right after using them and when the guidance in the end showed to put them back he just asked to skip it because he did it already.

He had to turn all the time in order to see the pictures and was almost standing with his back/side to the kitchen table all the time. Once in a while he forgot where to find stuff and was thinking out loud saying: "Where is the spoons", 2 sec. later "oh yes, in here". He asked for the objects but gave the answer himself.

### Notes and observations from the test with Mik (Landau Kleffner Syndrome) - Task 2.1

He performed the test very well. It took a little longer for him to do the task compared to Jon. A few times he had to go closer to the screen in order to see and understand the picture. Just as Jon, Mik had to turn every time he had to look at pictures and was also standing with his back/side to the kitchen.

A few times he forgot where to find the objects to use for the test. Compared to Jon, Mik asked every time and needed to be told. Likewise, a few times he asked if it was right what he was doing or was searching for approval.

In the picture series there were 3 images indicating how much tea was needed. For this step he only added two teaspoons of tea and his body language expressed that he agreed with himself that it was enough. He only filled the cup half full of water even though the pictures show an almost full cup of tea.

When he got to the picture showing that the boiling water should be put into the cup he did not wait for it to boil and turn off by himself. This either indicates that he wanted to finish the task faster or that he did not understand/know that he had to wait for it to boil. Either way, it has to be indicated more clearly in the guidance that he has to wait.

In the part where he had to choose a kind of tea, he started taking a teabag with tea and at first did not understand that he had to take an empty teabag and fill it up himself with tea (He was told in the beginning of the task what he was supposed to do). When he realized that he was wrong he needed approval of that he was back on the right track again. Next up, he seemed confused about what to do with the teabag that he took at first and did just throw it into the cabinet with the cups, not the cabinet with the tea. After this he looked for the loose tea and chose another kind of tea even though the tea shown in the pictures was among the tea he could choose from. This shows that he is able to relate the tea on the picture to any kind of tea.

While he was performing the task he was putting back some of the objects after use by himself. Therefore he got a little confused when the guidance started showing that he should put back the objects. He even went to get the milk again and then realized that the picture was meant to show him how to put back the milk. Like with the boiling water, he was also in doubt of how long time to leave the tea in the water, to be done.

He was very shy throughout the test and seemed a little nervous about if he was doing the task right. He also needed approval once in a while. Some of the pictures used for the test are shown in Ill. 2 and the whole picture sequence can be found in appendix test with Mik - task 2.1.



III. 2. Pictures from task 2.1 guiding through that task of making a cup of tea

**Notes and observations from the test with Mik (Landau Kleffner Syndrome) - Task 1.1**

In this test he was given a verbal instruction to arrange some objects in a specific order. He did arrange all the objects and had one mistake. The same test was made with two fellow students and they likewise had one mistake each. The right order is shown in III. 3. Mik swapped the last two objects he put on the table: the keys and pencil sharpener.



III. 3. Picture from task 1.1 showing the order of the objects

### Notes and observations from the test with Mik (Landau Kleffner Syndrome) - Task 2.2

In this task, Mik had to make a cup of tea using a pre-made teabag. He performed the test very well and a little faster compared to task 2.1. The pictures for this task were taken in the kitchen and with exactly the objects used for this task. The first picture showed all the objects standing on the table and Mik did not go and place all the objects on the table as shown. He went to get each object throughout the guidance when an action was shown with the object. He did more or less the same “mistakes” as in task 2.1. Additionally, in this task there was a picture tea indicated how much water should be in the boiler. He did not pay attention to this. Furthermore, there were two pictures indicating that the tea had to change color in order to be ready. This he did not pay attention to either. There are used two different spoons in the task. One to stir in the tea and one for the sugar. Mik used the same spoon for both tasks resulting in a spoon that had a lot of sticky sugar.

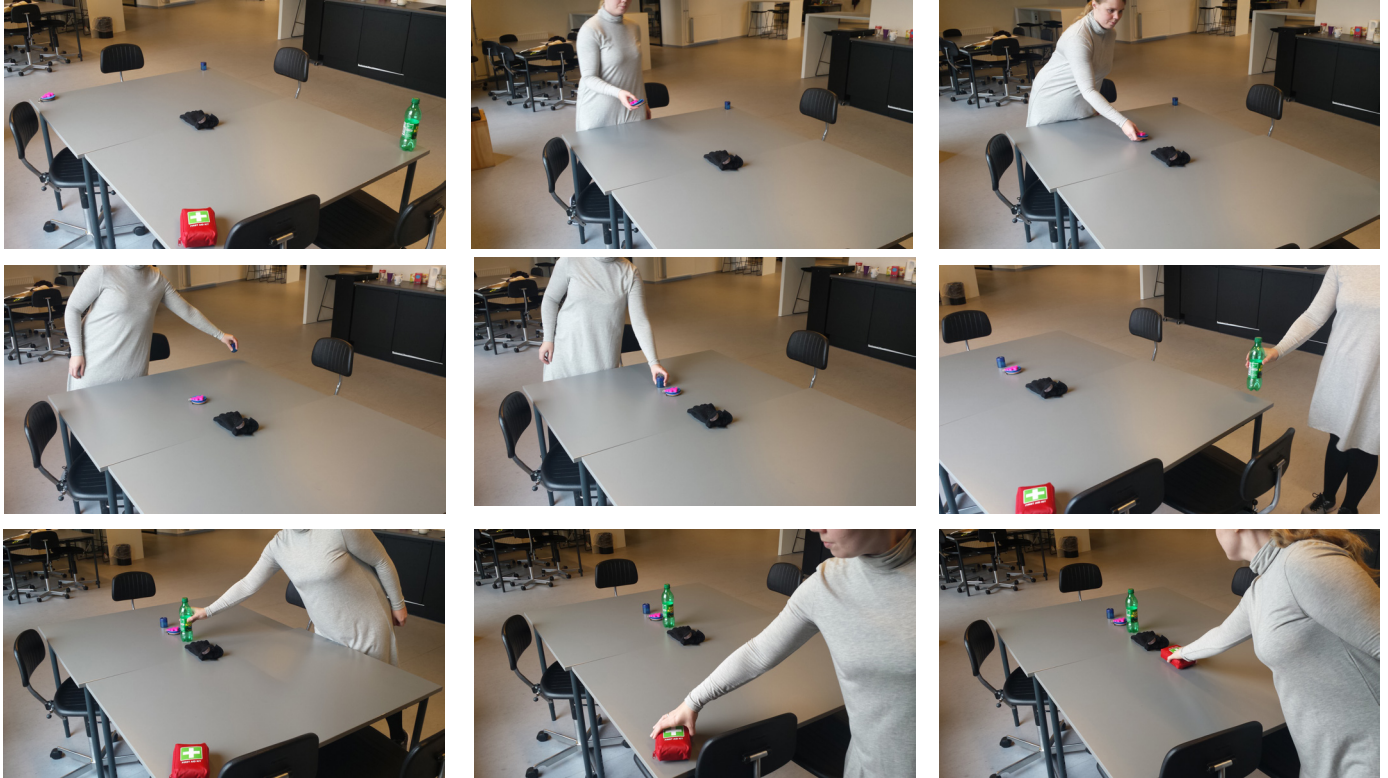
In this task the pictures are taken from third-person view and Mik seemed to understand the pictures better this way. In task 2.1 the pictures was taken from the view of the person doing the task. Some of the pictures for this task are shown in Ill. 4 the whole picture sequence can be found in appendix test with Mik - task 2.2.



Ill. 4. Picture from task 2.2 showing the task of making a cup of tea.

### Notes and observations from the test with Mik (Landau Kleffner Syndrome) - Task 1.2

In this task Mik had to place some objects in a specific order by following a series of pictures guiding him through the task. He placed the objects in the right order and did the task within a reasonable time. Once he placed an object on top of another object, but then moved it back when he noticed that it was wrong. Once he also had to move some of the objects in order to make space in between them for another object. Some of the pictures can be found in the following Ill. 5 the whole picture sequence can be found in appendix test with Mik - task 1.2.



Ill. 5. Picture from task 1.2 showing the task of arranging objects in a specific order.

### Illustrations:

- Ill. 1. Own illustration
- Ill. 2. Pictures from task 2.1 guiding through that task of making a cup of tea (Own illustration)
- Ill. 3. Picture from task 1.1 showing the order of the objects (Own illustration)
- Ill. 5. Picture from task 1.2 showing the task of arranging objects in a specific order (Own illustration)
- Ill. 4. Picture from task 2.2 showing the task of making a cup of tea (Own illustration)

### Evaluation:

Mik was in doubt of both the amounts and timings (Amount of water, time to let the tea to infuse). Therefore, a more clear indicator has to be found and tested. The pictures taken from the view of the person doing the task seemed to be harder to read compared to the pictures taken from a third-person view. Likewise Mik was at some points ahead of the guidance and got confused when the guidance that he was ahead of emerged. Therefore it has to be tested how our product can adapt to changes in the task. Mik also needed approval once in a while if the task was being done correctly. Therefore it would be nice to add an approval feature to the product. Though, it has to be tested if there is still need of approval if no other people are present while testing.

### Reflection:

For the next testings, the device showing the pictures should be placed in a spot that is more appropriate to look at. Likewise, the picture quality has to be better. The pictures should be taken from a third-person view and be taken in an environment known by the participants. The testing should be concerning the task of brushing teeth (or personal care).

**Activity:****Choosing the task to develop****Objective:**

The aim of the activity was to evaluate the identified tasks under several criteria in order to choose the most valuable choice.

The chosen task is the one that will be further developed in the design process.

**Experiment/data:****TASKS RANGE**

The range of tasks that has been taken under consideration emerged from the research material and data collected so far. These activities are the basic ones in which the occupational therapist usually trains with the patient during the staying at the rehabilitation center.

**CRITERIA**

In order to evaluate each task, some criteria have been identified. They span from testability to relevance according to different stakeholders (Ill. 1).

**FINAL CHOICE**

According to the findings obtained from the graph, the decision of covering both SHOWERING and TEETH BRUSHING has been made.

The reason for choosing them is because both tasks are very well defined (unlike e.g. cleaning which can refer to many different subtasks: clean table after eating, clean windows, clean floors etc.) and are performed in the same environment: the bathroom.

Illustrations:

Ill. 1. Tasks and criteria (Own illustration)

**Evaluation:**

Summarize and evaluate. Did the activity meet the objectives and to what extent? How did you evaluate? Did you use external feedback, calculations, estimations, etc.? And what is the validity of the result?

The use of criteria in evaluating the possible choices helped the group reflecting on the relevance of each direction under several points of view. It also offered the possibility to get an overview on the possible issues brought by the implementation of each task.

**Reflection:**

The graph was done using the information obtained so far, this means that actually is still questionable the validity of the choice.

TASK	CRITERIA	Promote					
		Amount of Users	Testability	Kommune	Center	User	Get knowledge
Showering		A	3	1	1	1	1 - 2
Brushing teeth		A	2	1	1	1	1
Toilet visit		A	3	1	1	1	3
Dressing (change clothes)		A	2	1	1	1	1
Cooking (main meals)		B	1	2	2	1	1
Cleaning (main cleaning)		B	1	3	3	1	1

1 easy      A high  
 2 medium    B medium  
 3 difficult   C low

# Relevance

Kommune	User	Expanding to other tasks	Task's Reiteration	General considerations
A	A	←	2 - 6 times / week	Could be a problem to test it but it is of high relevance for each individual to be able to perform independently.
A	A	← Cover bathroom activities	2 - 3 times / day	Exploring this direction would not be too problematic.
A	A	←	6 - 8 times / day	Both speaking about this task and testing it would be problematic. This would very much influence the feasibility in exploring the topic even though it is relevant.
B	B	Can be performed in different places (ironing)	2 times / day	Both speaking about this task and testing it would be problematic. This would very much influence the feasibility in exploring the topic even though it is relevant.
B	B	Big task (contain several sub-tasks: different recipes etc.)	3 - 6 times / day	Diving into this task would bring the risk of clashing with areas as cook book and cooking apps.
C	B	↓ can relate to // //	1 time / week	It is not very relevant compared to basic tasks in which the desire for autonomy is high both for TBI individuals and for the municipality whom has to cover the costs.

**Activity:****Meeting with Kim Velf - Contact for Hovedtropperne****Objective:**

To find a way to get in contact with young people suffering from brain injuries and to share ideas and intentions of a potential product.

**Experiment/data:**

Kim is the contact person for an organization called Hovedtropperne. It is a sub-group under the brain injury organization in the north of Jutland (Hjernesgade Foreningen Nordjylland).

Kim got a brain injury when he was 10 from being kicked in the head by a horse. He did not get any rehabilitation and was therefore sent home right after the hospital.

Today, he is struggling with mental tiredness and was until recently sleeping three hours every day when he got home. He just started a new kind of treatment, which he could not go into detail with, that has reduced his need of sleep to 15 minutes of rest on the sofa when he gets home. He is working a part time job, 3 hours a day, as a "handyman", doing all kinds of jobs in a painting company. Besides the tiredness, he has difficulties remembering what he did yesterday, but he has his wife and oldest daughter to remind him of it. He is 30 years old today and has therefore learned to deal with his injury long ago. Therefore it does not bother him to talk about it at all, though it took a long time, approximately 17 years, to get to the point of accepting.

In general, brain injuries are a taboo-topic to talk about, in Kim's opinion. It is often a hidden disability and is therefore hard to talk about it. Furthermore, the disabilities are very individual and hard to accept since it is concerning tasks that the person cannot do anymore.

In the beginning of this interview, a presentation of the project was shown to explain the current stage of the development. Furthermore, the different tasks that we are considering to solve are presented. These tasks are as follows:

- Taking shower;
- Brushing teeth;
- Dressing;
- Removing unwanted hair;
- Putting on make-up;
- Toilet;
- Cleaning;
- Cooking.

Conversation between one of the Team members and Kim:

**Ulla:**

"What kinds of tasks in the daily life do you think are the biggest issue to have somebody else helping with? In this sense I am thinking of those that have cognitive problems. The activities could be showering, cooking, dressing cleaning etc."

**Kim:**

"A lot of people experience that they are not able to clean anymore but instead of helping the person to clean himself again, the municipality hires somebody to do the cleaning. A lot of people also experience not being able to cook anymore and a lot of those would really like to cook themselves again instead of getting pre-made food.

People with brain injuries would also like to be able to put on clothes themselves and shower themselves again. You have to cross personal boundaries to have someone else help you with these tasks when you are 30 years old.

I just met a woman that has no language anymore and is sitting in a wheelchair. She is in the middle of her 40es and probably needs to do most tasks regarding the ones that you have listed."

**Ulla:**

"So far it has been very difficult to find the people that have the problems we want to work with."

**Kim:**

"I think it is because they are hiding and do not want to tell people that they are not able to do it anymore. It takes a long time to accept that you are not able to do certain tasks anymore. For me it took 17 years.

In the club we have here in Aalborg, many of the members are self-reliant and are therefore able to come to the club by themselves. They are almost all in the stage where they have learned to live with the disabilities and have accepted that they need help with certain tasks. There is one guy called Christopher Strøyer who is studying at the University. He gets

help all day.”

**Ulla:**

“Maybe we could contact him also to get some insight.

But now when we have talked a little about the disabilities I would like to present the ideas we have so far:

- The system of objects ( a toothbrush and toothpaste communicating with a cup)
- An smart device attached to an existing object ( a projector on top of a mirror showing what to do)
- A hidden smart-object that can show images of the tasks. (a mirror to show how to perform a task)”

**Kim:**

“I like the idea of the product blending in and to incorporate a solution in an existing product. Everybody has a mirror in the bathroom and a screen hidden in a mirror will therefore not be standing out. Will the mirror also be able to recognize the person? Or movements?”

**Ulla:**

“Yes that is possible, But do you think that a person with a brain injury would prefer a smart-object/device instead of a caretaker?”

**Kim:**

“I think people will prefer to have a device to guide in the tasks instead of a caretaker.

He uses the phrase: “kan selv, vil selv“ meaning I can to do it myself and I want to do it myself.

**Furthermore I believe that a device that can not tell other people about mistakes and errors would be preferable. Therefore, the person with the brain injury does not have to be reminded of mistakes and look a caretaker into the eyes after something embarrassing.**

I think the idea with the mirror could be expanded to many hospitals and rehabilitation centers. Then each mirror could be programmed to help with exactly the task that should be done in front of it.

It is really a great idea to combine mirror and screen and I think it has so many possibilities.

Making a build-in solution with a screen in a mirror could be expanded to many other rooms. Mirrors are often found in many rooms in most houses or could easily fit into most rooms in a house. If the solution is needed in the kitchen on the other hand the solution could be made as a cabinet door. If the focus is moved to the kitchen, the starting point could be simple dishes such as boiling an egg, piling potatoes, do the dishes or making a cup of coffee.”

**Ulla:**

“We do not know yet if it should be a mirror or another device and furthermore, we also want to give to possibility of customizing the product to different degrees of needs. E.g. give the possibility of verbal communication, written communication, picture communication. In this case, for the one that does not understand writing can be told and the one that does not understand verbal guidance can be shown.

Likewise, the one that is not able to understand a random picture showing a towel or shampoo, can have pictures taken of the shampoo and towels in their own bathroom.”

**Kim:**

“Well why not just make the communication type that meets the one with the greatest needs?

I really think the idea with the mirror is a great idea combined with what you are saying with the picture communication. It could help really many people that have got a brain injury. Also the idea of taking pictures of where the different things are in the specific users home could be of great value. If that appears on the mirror it would be really nice. It is a really nice idea with that mirror.”

**Ulla:**

“Yes and the pictures only have to be taken once, but they will be used multiple times. Furthermore, this idea can easily be expanded to other rooms. E.g. it could show how to shave or cook a dish.

Of course there are many different dishes, but a starting point could be on a favorite dish or a simple dish.”

**Kim:**

“It could just be of a simple dish like boiling an egg, cook pasta or doing the dishes. Seriously I think the idea with the mirror showing those pictures could be great. The Mirror can I guess also updates when it is needed like any other tablet or smart-phone?”

**Ulla:**

“Of course. The only downside is that the mirror is only placed in the bathroom. And if it needs to help with other things, the user has to go forth and back. And we do not know if it should be a mirror yet.”

**Kim:**

“Then you just have to put op more mirrors that are able to communicate. There could be a mirror in the hallway and in the bedroom. And in the kitchen the screen could just be placed on a door to a cabinet.

Then the mirror in the hallway could also help the person with the brain injury put on a jacket or to help her/his children to tie shoes. Most people with children still want to help their children, but might need some help themselves.

Since I am the one coming with all the great ideas I need to get some credit. “Laughs”

I see endless possibilities in the idea with the mirror showing pictures of how to perform a task.”

**Ulla:**

“The next question is then who is going to pay for this device?”

**Kim:**

“If it is payed by the person then “Sygesikring Denmark” will be the one to talk to. They will probably be able to offer a discount on it. Maybe 85%.

But then again most helping tools are lent out by the “aid centrals” (Hjælpemiddel centralen) in the municipality. Of course somebody has to pay to create the mirrors, but if you sell it the right way to the right people, then I really think you and those making it will earn a lot of money.

**E.g. there are 55 people every day that get a brain injury, meaning 55 new costumers every day just in Denmark.** And since you are already working in English I am sure you can expand it to other languages also.”

**Ulla:**

“Well since we are talking so much about the mirror idea, we first of all have to find out if it is possible. And how expensive the technology is. But I also want you to consider the other concepts.

Next I want to show you two videos. One of Buddy and one with Jibo to show what kind of robotic technology we are considering and being inspired by.

Exactly how our product should look and how it should work we are still in doubt of, but one thing is sure. It should have a screen that is able to transmit the communication to the user.

Robots for example are able to recognize a specific person’s face and this could also be used in a mirror or other screen device.

It might also be able to recognize when a person has open or closed the mouth.”

**Kim:**

“If you want to work with a robot it could somehow be connected to the mirror-screen in the bathroom and then they can communicate about the different tasks. The robot could go to the person and remind of brushing the teeth.”

**Ulla:**

“In the beginning we wanted to make a tool that reminds of when to do the different tasks, but we quickly found out that people have their phones to remind them of these tasks.”

**Kim:**

“There is an app called “show my day” that is doing that already. It is though very expensive.”

**Ulla:**

“Do you know if you can get a discount on apps like that one?”

**Kim:**

“Well “show my day” is mostly directed to people that are doing rehabilitation. In this case you will get a password to use in the time-frame where you are in rehabilitation and then afterwards you have to buy it yourself, but it is expensive.”

**Ulla:**

“Do you think if we are considering to do a robot that is able to recognize your face, movements and remember how you performed the task last time will be a problem?”

**Kim:**

“No I think it is more because there is a person that has to come many times in the day and help you with different tasks. But if they have some kind of smart device that is able to help them, then another person does not have to come all the time. Even though the robot is able to remember the persons pattern and what is needed to be done, it is not the same as a person remembering.

The device can say things like. “*Know you have to go the bathroom, and brush teeth*”. Then afterwards when you are using the toilet it could say: “*remember to wipe the right way*”.

I think the big difference is at the point where you need to have someone else to help you. People have gotten used to have devices helping you and it is a normal part of being a person today. Whereas is it not normal to have another person helping you unless you are old, handicapped or sick. Likewise many people do not want to be considered handicapped when just have a brain injury.

When talking about the more social aspects then it is more an organization like us, the brain injury organization that will help with that.

Which reminds me of that there is a café this Monday where people that have brain injuries and relatives meet and drink coffee together, eat cake and do different creative stuff together.”

**Ulla:**

“Is that something we can attend?”

**Kim:**

“Yes, you are very welcome. In fact, another girl from the university will also be there this Monday to do some interviews. Something with the feelings related to getting a brain injury.”

**Ulla:**

“What about you? What difficulties do you have?”

**Kim:**

“Well I get tired very fast and have had a headache the past 20 years. Likewise the memory is not that good. E.g. I can come home from work and say to my wife that I will take a shower and she will ask why? You took a shower yesterday. The bad memory is mostly related to what I did yesterday. Furthermore I am not able to do more things at the same time. The difference between me and many other people with brain injuries is that I have had 20 years to get used to living with it. You have to accept the brain injury before you can move on.

When you continue your work I want to be a part of it since I am the one coming with all the ideas. “Laughs“  
But try to find somebody that is still in the process of accepting that they have a brain injury.”

**Ulla:**

“What happed to you?”

**Kim:**

"I got a big hole in my head and got removed a big part of my frontal lobe. Actually they say, as I understand it, that the part I got removed is the part where the personality is placed. So I apparently have no personality  
In my opinion if you are not living with a brain injury and are not a close relative you will never get a complete understanding of how it is. You can ask as many as you want, but never understand it.  
I consider myself as an expert and not the professionals working in the field. They have just read a lot of books. And a lot of it is also right, but what about all the stuff that is not mentioned.  
I really want to help and get some credit. Not money, but attention directed on this problem."

**Ulla:**

"Well of course we will mention you in the report and if we end up with a nice product to work further on. We might start up a collaboration with somebody that can help making it. Otherwise I can get you in contact with Karl – the robot researcher that we are also working with. I know that he will continue with the project."

**Kim:**

"I would really like that, but I still really like the idea with the mirror and think it has a great potential.  
With that idea you are able to expand endless. Do not think too limited.  
Why build a small house when you got the space for a big one?"

**Ulla:**

"True I'll take that with me. You know why include all the different opportunities when we just can pick the worst one, the one where someone has to take the pictures of the users things. I think that most people would understand that what kind of communication."

**Kim:**

"You know the law says that when you get out from the hospital and rehabilitation centers there need to be someone from the municipality - a visitor or what else it is called that could do it. Then it is all about educating those visitors to take some pictures and then put them into that mirror, then their task is solved in a way."

**Ulla:**

"The problem though arises when they need to know exactly what pictures we are talking about, you know a picture is not just a picture."

**Kim:**

"Yes, but that should hopefully be found on the rehabilitation centers what the different problems are (in relation to cooking, taking a shower etc.)."

**Ulla:**

"Yes but will they know when and what picture that will trigger the brain and guide the person to the next step? That is of course very individual."

**Kim:**

"It's all about how you program, you just need to program it right (laughs)."

**Ulla:**

"Our expertise is not exactly within the scope of programming, so that we need somebody else to do.  
I guess now we can say that we have a good idea "

**Kim:**

"I agree, especially after I came with more ideas (laughs)."

**Ulla:**

"But we are still at the point where we need someone who can try this product."

**Kim:**

"I can find that for you, shouldn't be a problem."

**Ulla:**

"That would be very nice."

**Kim:**

"Just bring me something written, that is also one of my injuries, that I can not formulate me very well in writing so if you bring me something written, then I can send it out to the members in our news-mail / letter that is sent out every 3 months. We can also send it on mail, if the date doesn't fit you. We can put it on social media I can also send out questionnaires and that sort of thing. If you do all the groundwork I will make sure it gets out there."

**Ulla:**

"That would be awesome, if we could get one or two who could try whatever we end up with. When we talk about taking a bath using the bathroom, it is something that people are intimate about, so we do not know if we will be able to test that, but then again we need help to see if the idea works. The things that you most likely would like to be able to do by yourself again is personal care. So you have to be opened about helping yourself."

**Kim:**

"Sell the idea as a way for the inflicted to self help themselves, this will especially sell for people with brain injuries."

**Ulla:**

"Yes because you must know that you used to be able to do these things, and then when you do it you will just get confused when you reach a certain point in that task, that is my understanding at least."

**Kim:**

"Yes. I think that is the reason why so many people spend so much time accepting that they have a brain injury, because,

it can't be right, look at me.”

**Ulla:**

“True, cause you can't always tell by looking at the person that there is something wrong.”

**Kim:**

“I think the thing with people maybe being able to do stuff themselves at some point again will draw a lot of people in. There is so many possibilities in this idea that you have, i have heard many good ideas, but i think yours is the best. Especially the idea with the mirror showing pictures of the steps in the task.”

**Ulla:**

“Yes, What about if it was able have a conversation with you, not like it could respond to questions but it could maybe ask questions, at least not in the beginning.

We could also put a camera on the device so that it could see if the task was done correctly, measure the time on how long you for example brush your teeth, or if you spent too much time on it cause you forgot what you are doing. Though it should not be connected to the Internet, because then we might get into trouble with it being classified as surveillance.”

**Kim:**

“Yes, but that mirror, and that little robot thing could be made so that they could talk to each other.”

**Ulla:**

“Yes no problem, if we imagine, that we start with doing the bathroom device, you probably do not want to bring something from the bathroom to the kitchen.”

**Kim:**

“No!

You have to start somewhere and it is possible to apply updates, and further develop.

If the idea with a mirror showing how to brush your teeth is developed I am sure that you at some point also will be making a mirror that shows how to put on a jacket, tie shoes etc.

You can easily expand the idea to other people with similar difficulties and remember to not only focus on a specific target group but look at everybody with problems like this.

The health care system is also still in doubt of when to call it a senhjerneskaide, is it after 10 months or after 2 years. In my opinion it is as soon as the person gets out of the hospital phase.

No matter the age, people within this category have the same type of problem and need similar guidance.”

**Ulla:**

“So far our reason for taking a younger age-group is because we assume it will be easier for them to accept to use a device like this for guidance.”

**Kim:**

“I do not think that is always the case. My now dead grandfather knew more about computers than I do today.”

**Ulla:**

“Okay.”

**Kim**

“But I think I should be getting home now.”

**Ulla:**

“Thank you so much for taking the time to help us and see you on Monday.”

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## **Evaluation:**

We established a collaboration opportunity and now have the possibility to get in contact with more potential users. From the conversation, some of the aspects of having a device instead of a caretaker were highlighted.

Kim thinks that we are in the right track in relation to the tasks (Brushing teeth and showering) we have chosen and also thinks that no matter what task we start with there is a great opportunity to expand. In general Kim thinks that our target group and in general people with brain injuries prefer to have a tool to help instead of a caretaker.

Our suspicion with that brain injuries are a taboo topic to talk about is confirmed, which puts us in a difficult position, since we are both targeting people that do not want to talk about their problems and a taboo topic like personal care.

## **Reflection:**

It was a great talk and most of our questions were answered. He did not always answer directly to the questions asked and therefore next time we have to prepare more for the conversations. Furthermore since those are people with brain injuries it could be an idea to ask the same question in many ways to get the answer needed. Sometimes I would ask him one question but he would answer to something else. For next meeting it would also be preferable to have some models to show and some more detailed concepts.

**Activity:****Interview with Helene Høyer about Melvin****Objective:**

The objective is to get an understanding of the relationship between man and robot/machine. Melvin is a robot that is designed to help elderly suffering from arthritis to pull up and down the pants when going to the toilet. Since this robot is helping with an intimate task, a relation between our product and this robot will be set up.

**Experiment/data:****Through review of relevant articles, the following knowledge was gained:**

Melvin is a tool that has been asked for by citizens, living with arthritis, in Aalborg. They asked for a tool that could help them to pull down/up their pants at toilet visits. Through conversations with the users, the company LT Automation that is developing the tool got an idea of what is needed and wanted.

A lot of citizens need help going to the toilet. This is either because of arthritis or partial paralysis of the body. Alone in Aalborg municipality there are 700 citizens (2014) that every day need help using the toilet (Ta' bukserne af med MELVIN, 2015) (Avisen.dk's redaktion, 2015).

**Through conversation with Helene Høyer, the following knowledge was gained:**

Helene Høyer is a former student of Industrial Design at AAU whom is now hired as Sales manager at Melvin ApS.

Melvin is not considered a robot anymore, but a helping tool. This change of opinion was made because the term robot frightened the users. Melvin is a technology push project and therefore the users have not been involved in the process yet. Melvin has so far only been tested on people from the company, but the tool is soon ready for testing on the target-group. It is therefore questionable if the target-group will feel confused using the tool and whether it was what they had in mind when asking for a product to help with this task. Melvin is still under development and Helene is therefore not able to tell much more about Melvin.

In relation to whether Helene is able to help define the relationship between man and machine the answer is: not yet. Since they have not tested the product yet, she does not feel comfortable saying anything about this matter. She therefore told to contact a woman working at the university that might be able to help us with it.

Her contact info is:

Pernille Bertelsen

Associate Professor, PhD

Aalborg University

Department of Development and Planning

pernille@plan.aau.dk

Furthermore Helene invites us to see Melvin when it is ready for testing in week 14.½

**Reference list:**

Avisen.dk's redaktion (2015) *Af med bukserne, Jytte: Robot skal trække tøjet af pensionister* Available at: [http://www.avisen.dk/af-med-bukserne-jytte-robot-skal-traekke-toejt-af-p\\_334853.aspx](http://www.avisen.dk/af-med-bukserne-jytte-robot-skal-traekke-toejt-af-p_334853.aspx) (Accessed: 26 marts 2016).

Ta' bukserne af med MELVIN (2015) Available at: <http://www.denoffentlige.dk/ta-bukserne-af-med-melvin> (Accessed: 26 marts 2016).

**Evaluation:**

We did not define the relationship between man and machine as intended, but we got a contact that might be able to help us. A mail is therefore has been sent to arrange a meeting with Pernille Bertelsen.

**Reflection:**

The wanted knowledge was not obtained, but we got both the contact information of a woman that might be able to help us and we got invited to see Melvin as soon as it is ready for display.

**Activity:****Sum-up of patients' issues****Objective:**

Make a sum-up of the patient's issues that can lead to requirements for the future product. The information is extracted from the data collected so far, such as interviews, visits and desk research.

**Experiment/data:**

Issues related to patients:

1. The patients are very different one from another:

**Worksheet 008:** *"The residents have very different degrees of independence: Some of them have a brain damage that only affects the cognitive skills, and in the more extreme cases, patients are fully paralyzed therefore completely dependent on caretakers (for instance, one resident completely paralyzed had a tablet with the alphabet in front of his face, where he could use his sight to type in his thoughts). Even if residents' condition is very different from one another, all of them are classified as "severe brain injury" since they can not cope with everyday activities. Diversity in needs and conditions of injured people is therefore a very important factor to take into account."*

**Worksheet 020:** *"As a local council, they do not always know what people with brain injuries need and they might choose the wrong solution regarding the rehabilitation, simply because there are so many different affects of brain injuries."*

2. The patients may have problems in remembering what they did 5 minutes ago:

**Worksheet 009:** *"He had a car accident in the 70's when he got an injury on the Frontal Brain and most of his short term memory is gone. He remembers everything before the accident but now he is having a hard time differentiating between what he has said before and what not."*

**Worksheet 017:** *"When the Team member entered his apartment, he joked of having a picture of a gorilla hanging on the wall – it was a mirror. Two seconds later he told the same joke. "*

**Worksheet 017:** *"He can go grocery shopping by himself, but will forget what he wanted to buy by the moment he will arrive at the shop."*

3. The patient has a hard time when going back home:

**Worksheet 012:** *"The first period back home is going to be very hard for the patient, he has to see if he is able to deal with all the issues related to everyday life."*

**Worksheet 012:** *"Having a strategy or reintroduction to everyday tasks would be the best thing. Because there is kind of a trauma from being served and helped in everything and then from one day to another have to do everything by themselves. This is currently a big issue especially for patients with cognitive problems. The environment in the facility is not especially tailored for helping this kind of patients."*

4. The patient experiences a difference between the intensity of training, from center to home:

**Worksheet 012:** *"Also the problem is that in the center they do specialized training to achieve goals, while out in the community they do generalized training."*

5. The method of transmitting information differs from patient to patient:

**Worksheet 012:** *"During training some people are approached with verbal communication, but others, they can better understand gestures, and you have to show them with your body."*

**Worksheet 018:** *"The needs of patients in verbal guiding differs from patient to patient..... It would be a good idea to have combined verbal communication with visual information, because the patients have different needs and impairments."*

**Worksheet 021:** *"Some of them, when you give a verbal instruction, they will not always understand what they have to do. Then you have to show with your body. .... - To perform a task usually they guide the client physically (either showing or touching them).Some of them need visual guidance (e.g. pictures) while with others, verbal guidance can be used. The method used changes as the patient progresses, e.g. from visual to verbal guidance."*

6. Patients need confirmation in tasks:

**Worksheet 017:** *"He knows how to do most tasks, but still needs approval when performing a task."*

7. Patients need explanation of tasks:

**Worksheet 018:** *"They had a patient yesterday that had to clean the floor in the room where the meeting took place. The patient is 63 years old and he had a stroke, he had a hemiparetic stroke but is able to walk. He has problems with organizing and planning. He has to be asked what does he have to do: "For example he should vacuum this floor and afterwards clean it and we were talking before, what do you want to do. Oh, I have to take the vacuum cleaner, and then I have to place the vacuum cleaner somewhere in the plug and where does he starts." He did the task well and afterwards he wanted to wipe the floor. Again, he was asked what does he need and he knew what is needed, but he still forgot that the water has to be warm. He did not wipe the entire floor but he did finish. He had to be fold also to remove the chairs."*

**Worksheet 021:** *"Taking shower: some might not know they have to remove the shampoo when taking shower. In this situation, the occupational therapist stands beside the shower."*

8. Patients want to feel more independent:

**Worksheet 017:** *"His biggest wish is to become more independent, which he could be if he had a device to help him."*

**Worksheet 018:** *"Most of the patients want to be independent, to do the daily activities by themselves. It is very different from patient to patient."*

9. The patient's state is in continuous change, it can get better, be constant or worsen up:

**Worksheet 017:** *"They do not discover the effects of the brain damage before they get at the Center or home. Likewise, the affect of the brain damage will change a little all the time."*

10. The patient might not know for how long to perform a task:

**Worksheet 021:** *"Cognitive problems in structuring and planning an activity, having an overview. Eg. How to dress: what do you put on first: shoes or socks? One client, when starting brushing his teeth, does not know when to stop because he loses cognition of time. There is no signal from the brain saying you are done (could go on for one hour). He would also not know when he had to brush teeth."*

11. The patients may not know / remember that they have to do a task:

**Worksheet 021:** *"Clients are often not able to express what they need because they are not aware of the necessity. .... Some people have no cognition of time. E.g. a patient would prepare to shower in the middle of the day even if showering is scheduled to happen in the morning and he might have done it already. Some of them do not understand the clock, what an hour means etc. But most of the people are able to read a watch."*

12. The patients might get confused / tired if too many tasks are to be done simultaneously:

**Worksheet 022:** *"She is not able to cook anymore. She can only perform one part of a task at the time, otherwise she will get confused. She easily gets confused, stressed and tired when cooking because she has to keep track on both what she is doing and what has to be done next. She does not have sense of timing and does not know when to start cooking the different meals according to each other. The second she is distracted from one part of the cooking by another part she forgets what she just did. When she has friends over, they need to tell her when she has to start heating up the food and they have to help removing the dirty dishes after eating."*

13. The patients might have limited range of sight , different from normal people. They might be able to see just one area - is good to keep into consideration for the further steps of the project:

**Worksheet 022:** *"She is also very clumsy. She has troubles keeping the balance and will therefore sometimes be tripping or even fall. She will also tip things over. She lost her peripheral vision and is therefore only able to pay attention to things that are right in front of her eyes. For example, when she goes grocery shopping she will sometimes take a piece of fruit from the middle of a pile because she is only seeing what is right in front of her. Then, when the fruit pile falls down she will try to put it back, but is not able to because she does not understand the structure of how to build up at pile. Therefore, she will eventually need help from some of the staff."*

Along the visits, several ideas have been presented on how the solution might function. As a result, a series of issues have been discussed:

14. The privacy of the patients is very important:

**Worksheet 009:** *"Him and Karl were having conversations for most of the visit, due to the resident's interest in the technology, the mechanism behind the functionality, but also stressing a lot the factor of privacy, since he was not interested in being monitored. The resident mentioned that some might be scared if the robot would keep following them, to get in touch with them. He also mentioned that he was very positively surprised about the robot."*

**Worksheet 018:** *"When discussing about monitoring the patient, if he does the tasks correctly or at the right time, Anja mentioned that this would lead to ethical problems, both because they wouldn't like to be monitored, but also that some patients of TBI don't even know or recognize that they have a problem."*

15. The patients have enough technology around them/ on them. Don't make one more thing that would just add to all the rest:

**Worksheet 009:** *"One of the caretakers after getting to know the topic of research, proposed a robotic wheelchair with annex screen able to provide information to the patient and drive him where he needs. Her argument was that the residents have more than enough electronics attached to them already."*

16. It is difficult for a device to observe and react in the same way as a person does:

**Worksheet 009:** *"When discussing with one of the personnel member, that takes care of the residents, she considered that having a robot in a center like this would not be very practical. She mentioned that a person would be able to interact much better and easier with the residents. When considering the Double Telepresence Robot, she mentioned that for instance, the camera can just visualize a small area (such as a person's face) and this would not allow to notice anomalies/movements in other parts of the body to be seen. For instance, if the resident would twitch his leg, known from her as a sign of nervousness and therefore not a good sign, it would not be visible by the robot in the camera spectrum. On the other hand, a person directly interacting with the resident would notice and react in a way to soothe the situation."*

**Worksheet 018:** *"The patients that have the motor skills affected, have ADL problems, such as dressing up. They are trying to teach the patients to do the things as they used to do before, because the goal is to gain the motor skills back (e.g. use the affected hand again). If this method does not show results (e.g. the hand performance does not show any improvements), then they use new methods, offsetting and compensative strategies. This method is not the first choice when starting with the training and it is generally avoided, but it is most relevant when the patient has to go home. A robot could help in this situation but not in the case of physiotherapy, when the patient has to train but maybe he is not staying in the correct position. In this case, a person is needed to position the patient correctly."*

**Worksheet 021:** *"Human contact and relationship between the person and the therapist are very important and can not be replaced."*

17. It shouldn't replace the caretaker, it should be a helping tool:

**Worksheet 012:** *"The robot should be intended as a tool to help the caretaker taking care of the patient. But it would not be a substitution to the caretaker."*

18. The patient may have hard time to get used with the technology:

**Worksheet 017:** *"He has a smart-phone which he likes to use - He started using it not too long ago and it would therefore be a good idea to continue using a similar technology in our product. It took time for him to learn how to use a smart-phone, but he is able to use it now."*

19. The device should not be stigmatizing:

**Worksheet 017:** *"He should not have a robot that is following him outside of the department because it would be too stigmatizing - Handicap-alarm - A more neutral product would be better e.g. an app that can go on a smart-phone or smart-watch."*

**Worksheet 020:** *"When he was done with the education he had difficulties doing a whole day of work and also had to quit some jobs because he could not live up to the expectations from himself and an employer (He did not tell about the brain injury). He was very naive and thought that he would be able to work as a normal person as soon as he education was done. He struggled with this for 5-6 years. The last employer that fired him, made him realize that he had to deal with his problems and had to recognize it. After this he started to see a psychologist at the Center for Brain injuries where he meet other people with the same problems. The same mental tiredness. He went through a lot of time where he did not want to accept that he had a brain injury. Therefore he did not fill "cured" before 13 years after the accident where he finally accepted that he had a brain injury."*

**Worksheet 021:** *"Regarding stigmatizing objects: people are often not even aware, or they are very motivated in getting better so they will not care about having an object that shows that they have a problem (They do not care how it looks like)."*

20. The patient might remember if he has a bad experience with the device:

**Worksheet 017:** *"If he had a bad experience using a product once he will remember that there was something he did not like about the product last time."*

21. The device should be able to recognize when the person wants or not / is ready to do the task:

**Worksheet 017:** *"It would be beneficial if the robot could notice when the person is ready to get a reminder, instead of repeating or giving a reminder at a bad time. This is what robots are good at. Is the robot able to recognize when a person is busy or not and able to take a reminder?"*

22. The device must be personalized:

**Worksheet 018:** *"MOBI:DO is an app that is designed for people that have difficulties in performing tasks, such as making coffee, doing laundry, taking the trash out, etc. She thinks that our project is similar with this one. She has been a part only at the beginning of the development of the app, therefore she doesn't know what is the current stage, why is it not used by everyone now. It would be useful to investigate and discover their struggles. The problem that she identifies with*

*the MOBI:DO principle is that it must be personalized, otherwise the patients might not recognize the objects. E.g. the app has to show the exact color and type of towel that the patient has to use, otherwise there is a big chance that he will not recognize it. In this case, the occupational therapist could preset the device with the specific objects that the patients uses.”*

**23.** The device has to be able to draw the attention of the patient:

**Worksheet 021:** *“Patients have a schedule on the wall but that does not mean that they will follow it. W 021: Authority issue - Might be an issue that the person will not listen to the directions given by the device if a person has a previous different routine in performing a task.”*

**24.** The device should not require a high level of using technology:

**Worksheet 021:** *“Some people are able to use technology, but many have difficulties in using tablets or smartphones.”*

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## **Evaluation:**

Summing up the information from the Worksheets with visits and interviews in one document serves as a good overview of what are the issues related to patients and to the device that the Team has presented so far. It also serves as a good starting point for setting the requirements.

## **Reflection:**

The Team is aware of the fact that there are many more issues that haven't been discovered yet and that this is an on-going process. For this, further interviews, visits and investigation have to be performed.

**Activity:****Choosing the task to develop**

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**Objective:**

The aim of the activity was to create an understanding of the relevant tasks according to the project framing, both at the rehabilitation center and at home.

**Experiment/data:**

The Blueprint was developed according to interviews and data acquired during the research (staff at the rehabilitation center, people suffering from TBI, etc.)

In the Blueprint, the tasks that have been taken into consideration are the basic ones that are trained during the staying at the rehabilitation center from the occupational therapist (e.g. toilet visit, showering, cooking, etc.)

The obtained result is an understanding on how does the support offered from the rehabilitation center to the home environment change; but it also gives an overview on the importance of gaining independence in a specific task according to different stakeholders (see Ill.1).

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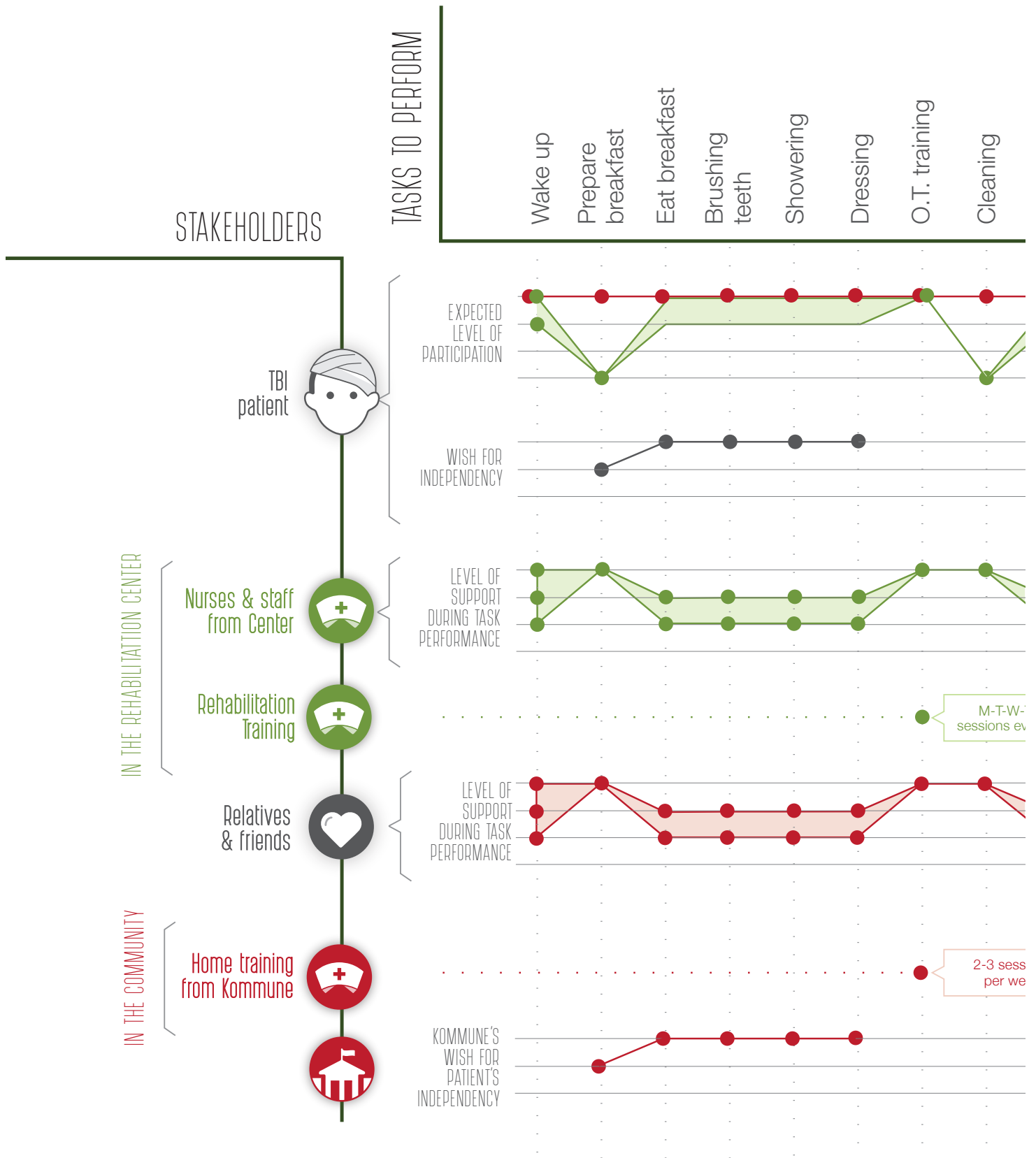
**Evaluation:**

The use of the Blueprint allowed to gain a visual direct comparison of the relevant tasks that need to be performed by the person suffering from TBI both at the rehabilitation center and when back to the community. The tasks are also analyzed under the point of view of other relevant stakeholders: staff at the center, municipality, family.

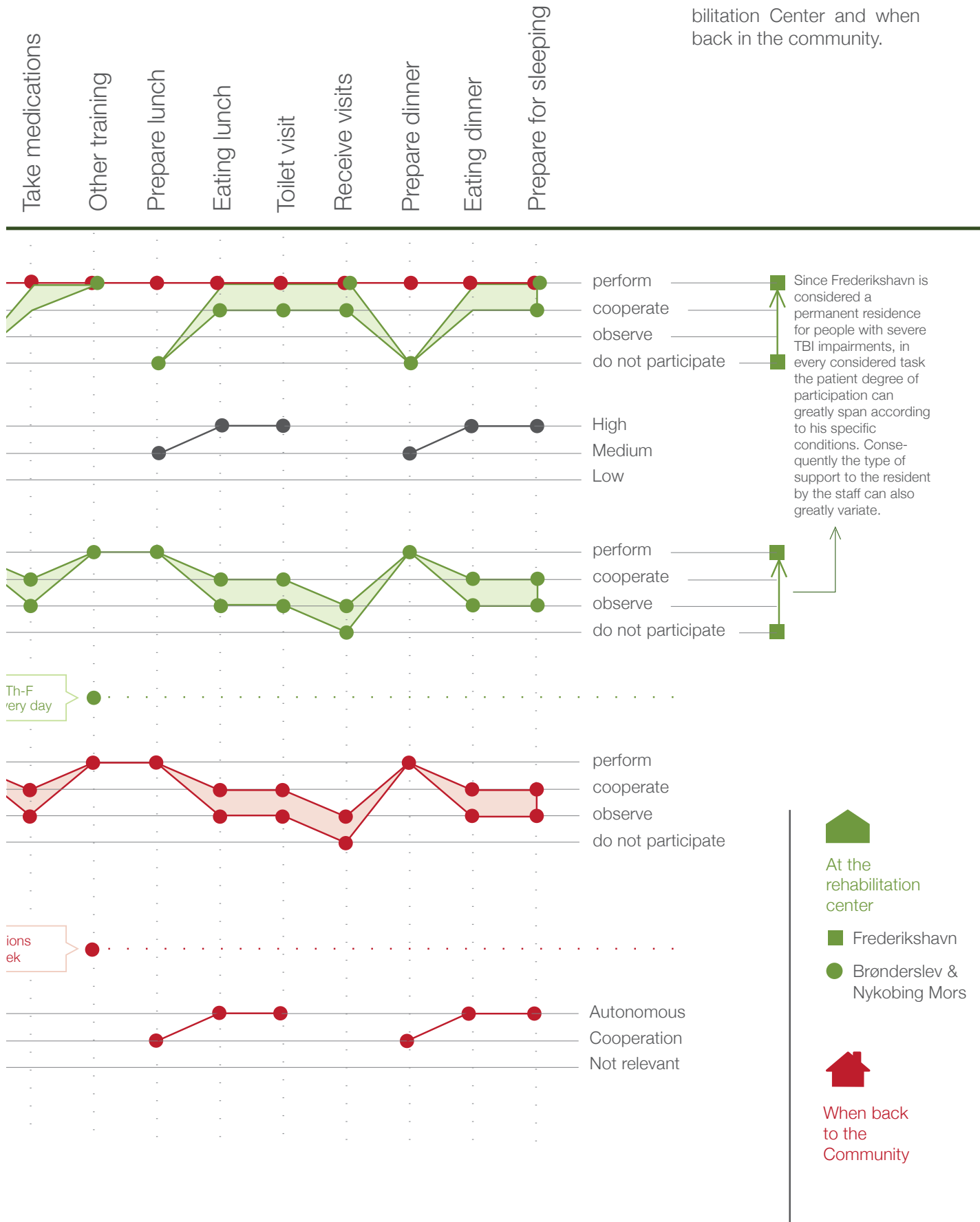
**Reflection:**

Observing the Blueprint, it is once again confirmed the gap among the level of assistance when performing a task in the rehabilitation center compared to the home environment. Furthermore, emerges the desire of independence towards very basic tasks, especially regarding personal hygiene. Both for personal reason (person suffering from TBI) and from economical reasons (high costs for the municipality).

# Blueprint - A DAY in Rehabilitation Center vs. the Community ...



Blueprint regarding relevant activities according to the project framing: a comparison of activities related to occupational therapy rehabilitation both in the Rehabilitation Center and when back in the community.

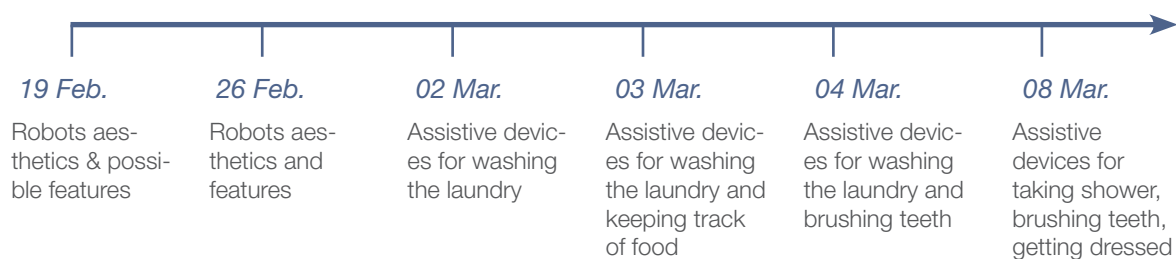


**Activity:****First ideation sessions and the Three Concepts****Objective:**

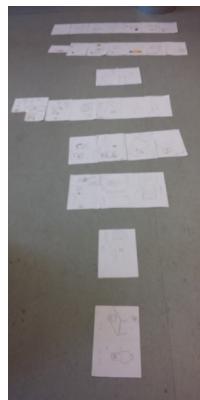
To have an overview of the ideas generated during the ideation sessions that the Team performed so far. To generate requirements of the desired solution. To outline potential concepts.

**Experiment/data:**

The Team had six ideation sessions, where the first two rounds were related to robots and its features, as that was our direction at the respective point, and the following four sessions were about assistive technology in daily activities.



The Team arranged the sketches on the floor, according to areas of focus. The activity took place on the 8th of March. The sketches can be found in Appendix 2, and they are categorized on areas as:



1. Detachable device
2. Scanning device
3. Shower device
4. Brushing teeth
5. Overall device
6. Dressing device
7. Accessibility
8. Washing clothes

III. 1. Sketches arranged according to categories

The sketches have been analyzed and discussed, and a series of key points have been generated, categorized in *Good to have*, *Good to avoid* and *Good to keep in mind*.

**Good to have**

- Ability to recognize the patient's evolution.
- Ability to change the level of giving informations according to the evolution of the patient. The patients may PROGRESS or REGRESS. Possible solutions:
  - The patients may check off when they feel they are ready to perform the task independently;
  - The device changes its method of transmitting information, due to the programming it has;
  - Another person adjusts the program according to the evolution of the patient.
- Ability to gain / have the attention / respect of the patient (it is easier to do this by a person than a tool - bear in mind).
- Ability to sense the interactions of the user, to record the actions, to react in case of wrong use or danger. e.g. if the patient does not take his toothbrush, but somebody else's, he should be corrected.

- Detach parts of the product (e.g. for holiday trips, when visiting friends, etc.)  
it can also be an app on the phone: this allows for stakeholders to have access to the information, or it can act like a diary
- Communication according to needs:
  - Visual - through pictures
  - Verbal - through spoken language
  - Writing - through written language
  - Sounds (e.g.: communication through colors: red = bad, green = good).
- Guide through the process but not perform the task for them, e.g. explain how to take shampoo but don't give the shampoo.

### **Good to avoid**

- Having a camera: might be perceived as invasion of personal privacy.

### **Good to keep in mind**

- Is it a system of products that communicate with each other or is just one device? Does it move by itself? Is it fixed?  
Can it change shape according to the situation: to show something or to adjust for use?
- Is the device able to interact with the surrounding environment? e.g. point at objects with laser light.
- Keep in mind the variations of transmitting information: display (touch screen or just simple display?), hologram.  
The display can hide when not in use.
- What kind of technology would the young adult desire? Bear in mind: customization (color,), would the person want to hide it or to show off with it?  
How should it merge into the environment?  
Not invasive, respect privacy, not to transmit the feeling of controlling.
- The power options.
- Note from Nykøbing Mors: The method of interacting with the patient (visual, verbal, physical guidance) changes as the patient progresses!

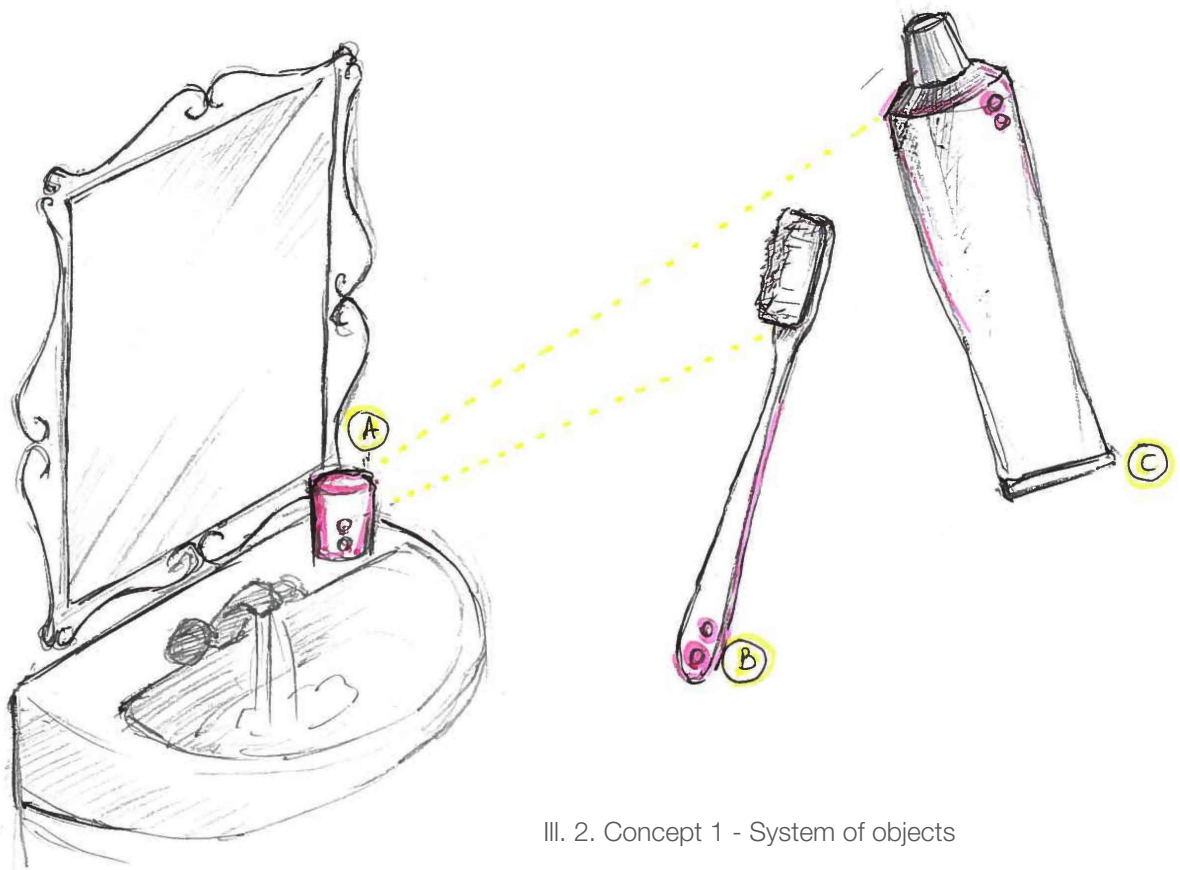
### **The three Concepts**

As a conclusion to all the ideas generated so far, the Team combined them into three possible concepts. They have been exemplified in the brushing teeth task but the same principle could be applied in other tasks (e.g. taking shower, dressing, etc).

#### **Concept 1 - System of objects**

Develop a set of objects able to communicate to each other in order to monitor and ensure that the task is being performed correctly.

Considerations: a drawback could be that the objects would need to be appositely designed. This would raise the costs and would make able to perform only that specific task.



III. 2. Concept 1 - System of objects

A: Has a light incorporated that indicates that the person has to brush teeth. It can sense when the toothbrush (B) or the toothpaste (C) are out of the cup (A).

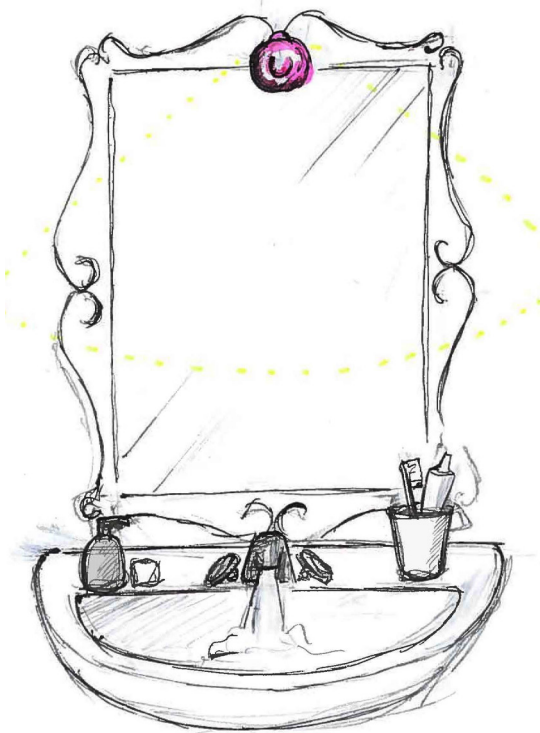
B: Has a chip that indicates when the toothbrush is too old. Tells when it is removed from the cup (A). Tells if it has been cleaned after use.

C: Has a chip that tells if the toothpaste is out of the cup (C).

### Concept 2 - Add on device

Develop a device that can be located in a strategical position in order to give instructions to perform the task. E.g. above the sink for brushing teeth.

Considerations: a benefit could be that the same object could be moved around to assist in different types of tasks.



III. 3. Concept 2 - Add on device

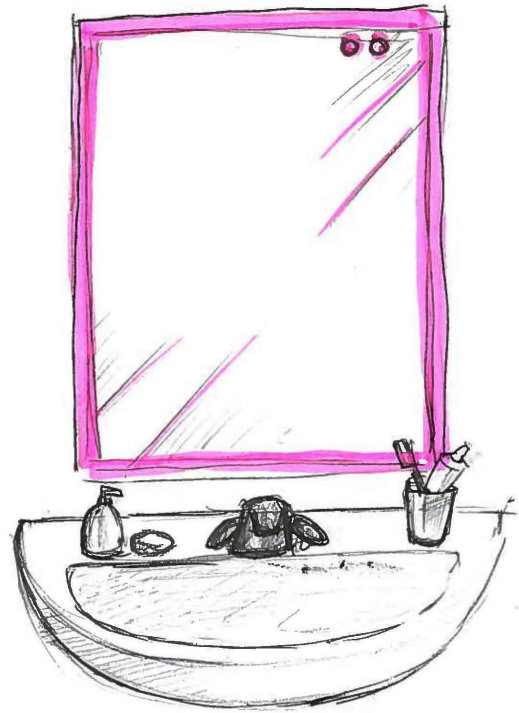
The device projects the steps that have to be followed. It can have face recognition, to check if you are doing the right thing, if you do not skip any step. It should serve as a decorative tool also, be a cool object.

### Concept 3 - Smart object

An intelligent object that is able to assist and guide during the task performance. It would be designed for a specific task. Considerations: the development of such object would increase the costs and would be able to cover only one specific task. E.g. smart mirror above the sink to guide through teeth brushing. The mirror would in this case deal with the fact that by trying to substitute a common object which is part of the home environment, factors such as personal taste and style of the house would need to be taken into consideration.

#### III. 4. Concept 3 - Smart object

A mirror and screen showing the user how to perform a task, step by step.



#### Illustrations:

- III. 1. Sketches arranged according to categories (Own illustration)
- III. 2. Concept 1 - System of objects (Own illustration)
- III. 3. Concept 2 - Add on device (Own illustration)
- III. 4. Concept 3 - Smart object (Own illustration)

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#### Evaluation:

The task has been fruitful, helping to outline the most important features from the sketches made so far and pinpoint three possible concepts.

#### Reflection:

The method of placing the sketches all together, categorizing and analyzing them worked well. It is advisable for the Team to use this method also in future analysis.

**Activity:****Ideation 22.03.2016****Objective:**

Make an ideation round taking into account a list of considerations (shown below). The considerations emerged from: observations, research and data collected so far both regarding user (individuals affected by TBI), context and stakeholders involved (rehabilitation center, municipality etc).

**Experiment/data:**

The ideation was done in regard to the two identified tasks:

- Showering
- Brushing teeth

**List of considerations taken into account during ideation**

Use for more than one task ( it could be movable or not).

Configuration of the product before use to suit specific need of each user (Worksheet 1).

Task performance (Worksheet 2. 4, 6, 7):

- Guiding through the steps;
- Give confirmation that the steps have been performed correctly;
- Monitoring that the steps are performed correctly, and if not, give input for correction.

One interaction way to fit to different users' needs (e.g. one or a combination of visual, verbal etc. instructions) (Worksheet 5) (to lower as much as possible the degree of complexity when performing a task(Worksheet 12)).

Fit to all types of patients: mild, moderate, severe (Worksheet 9).

Remind when is needed to perform a task (Worksheet 11).

Don't jeopardize patient's privacy (Worksheet 14).

Not stigmatizing (Worksheet 15, 19).

Able to adapt to specific situations (e.g. scheduling of the week and of the day might be different from time to time) (Worksheet 21).

Personalization - physical appearance (is it needed?), interaction (Worksheet 21).

Able to draw attention to itself (Worksheet 23).

Establish an authority so that the person will actually follow the instructions and not ignore them.

Movable/ fixed in one place?

Compatible with other devices owned by the user.

**After Ideation**

Each sketch has been discussed, in order to underline related issues and opportunities.

**Sketch 1, 2 - System of objects: make normal objects become smart**

Both sketches further develop the idea of system of objects communicating with one another in order to best ensure that the task is performed correctly. Instead of designing 'smart objects', make smart the normal objects already in use by the user. This could allow flexibility to apply the same concept in performing other tasks.

**Sketch 3, 4, 5 - System of objects: screen unit plus smart object**

Still the concept of having the screen unit communicating with an object involved during the task performance. But in this case, the linked objects are appositely designed smart objects:

- (showering task) universal soap dispenser connected with screen unit
- (brushing teeth task) 'smart holder' for toothbrush and toothpaste that communicate with screen unit (make sure the person is actually following the instructions)

**Sketch 6 - Smart mirror (brushing teeth)**

A screen-mirror to help toothbrushing (could also be applied to dressing)

**Sketch 7, 8, 9 - Instructions' screen (showering/brushing teeth)**

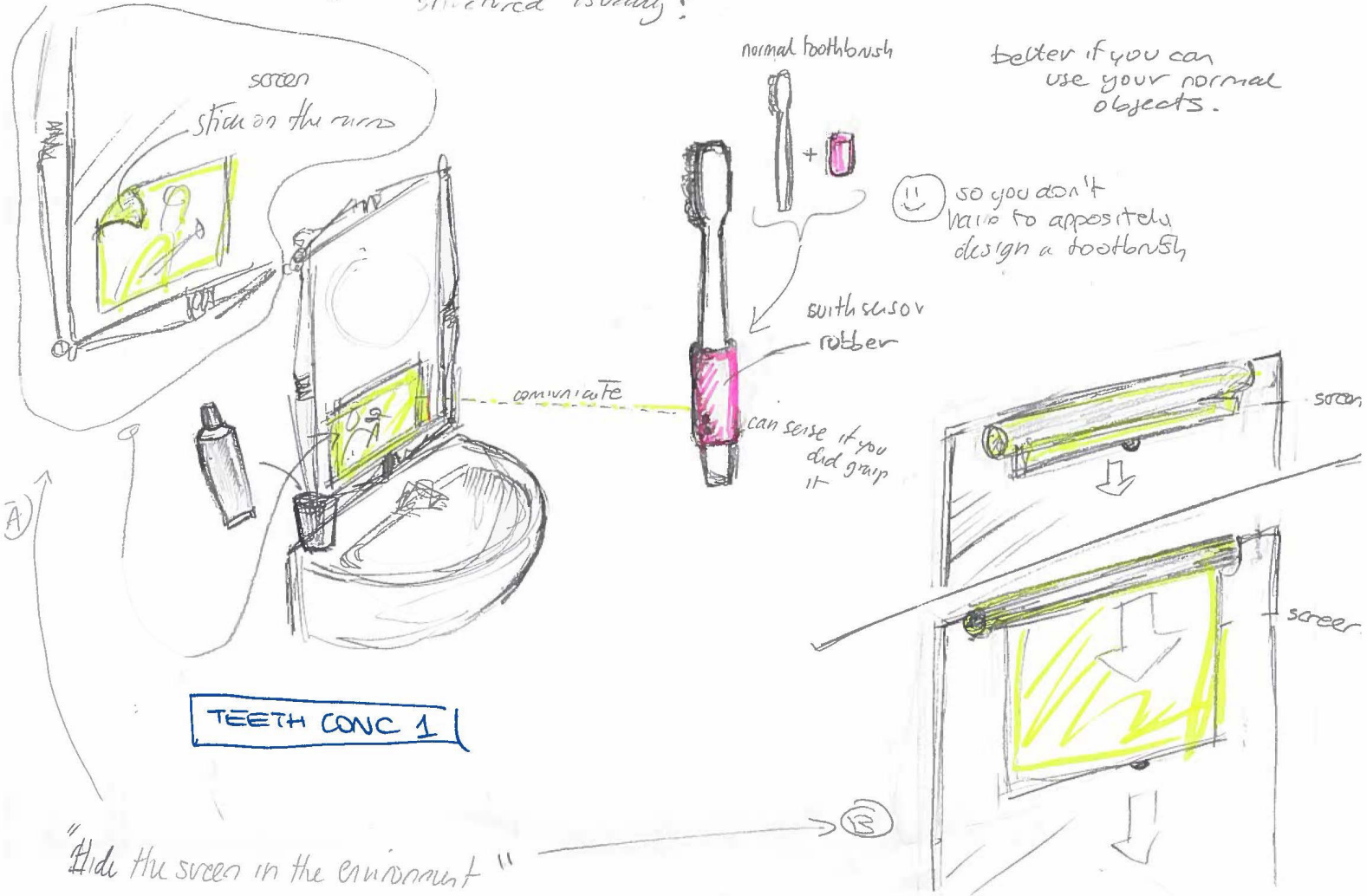
To be placed in strategic spots for the visibility of the instructions.

**Sketch 10, 11 - Varieties for the support of the screen**

Sketch 1 - System of objects for toothbrushing (III. 1)

22/03/2018

BRUSHING TEETH → how is a bathroom structured usually?

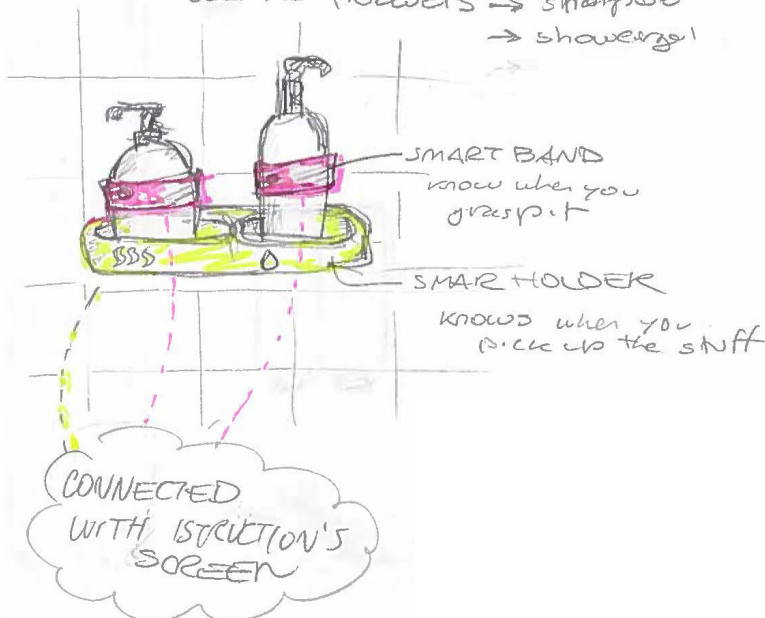


Sketch 2 - System of objects for showering (III. 2)

SHOWER CONC 1

- get the instructions
- use the products → shampoo → showergel

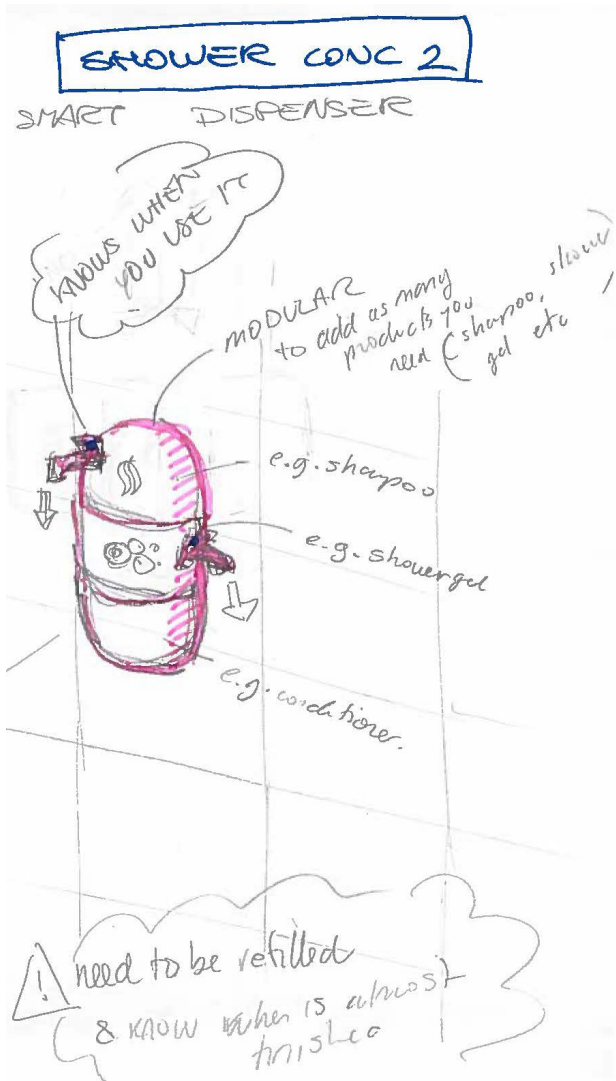
modular  
(can add other products)



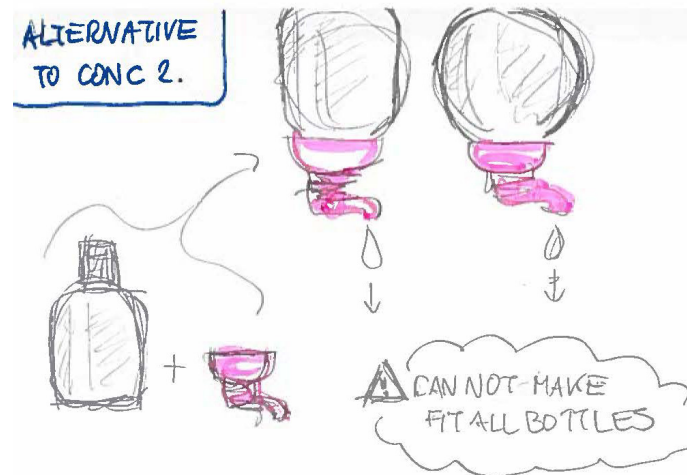
In the second concept (III.1, 2) a display part is always present in order to show the steps and instructions on how to perform the task. But the task is further assisted by monitoring the use of object involved in the task performance (e.g. during brushing teeth, are also involved toothbrush and toothpaste; or in showering are also involved the different bottles used: shampoo, shower gel etc.)

'Smart labels' are applied to normal objects in order to connect them to the task instructions part.

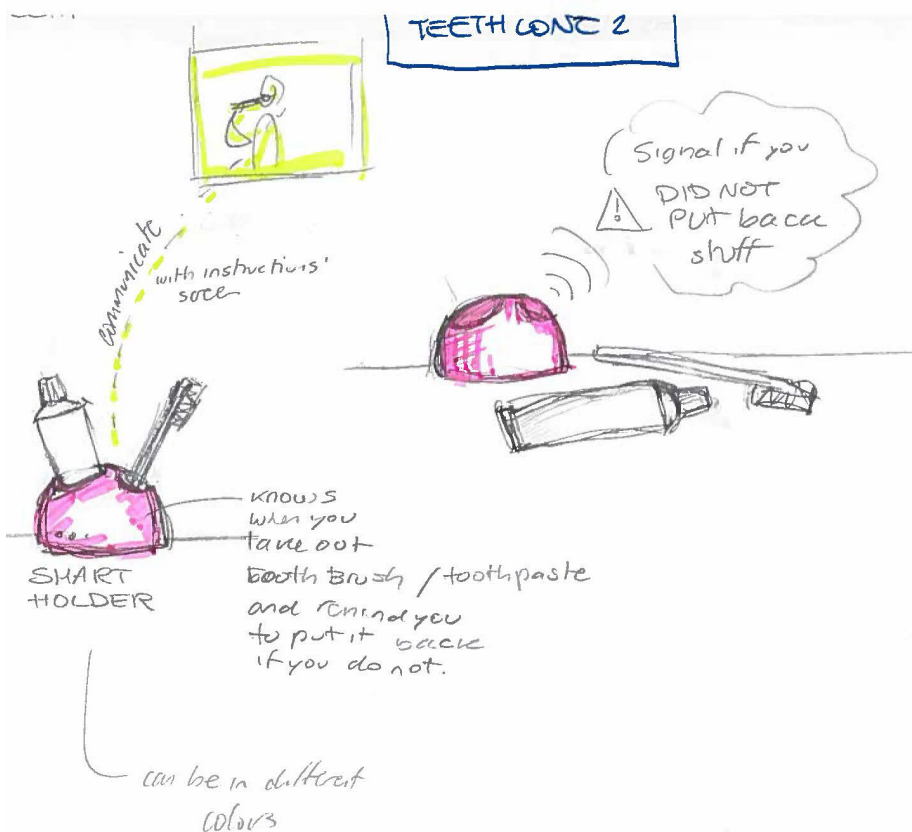
Sketch 3 - Smart dispenser A (connected to screen unit - for shower) (III.3)



Sketch 4 - Smart dispenser B (connected to screen unit - for shower) (III.4)



Sketch 5 - Smart holder (connected to screen unit - for brushing teeth) (III. 5)



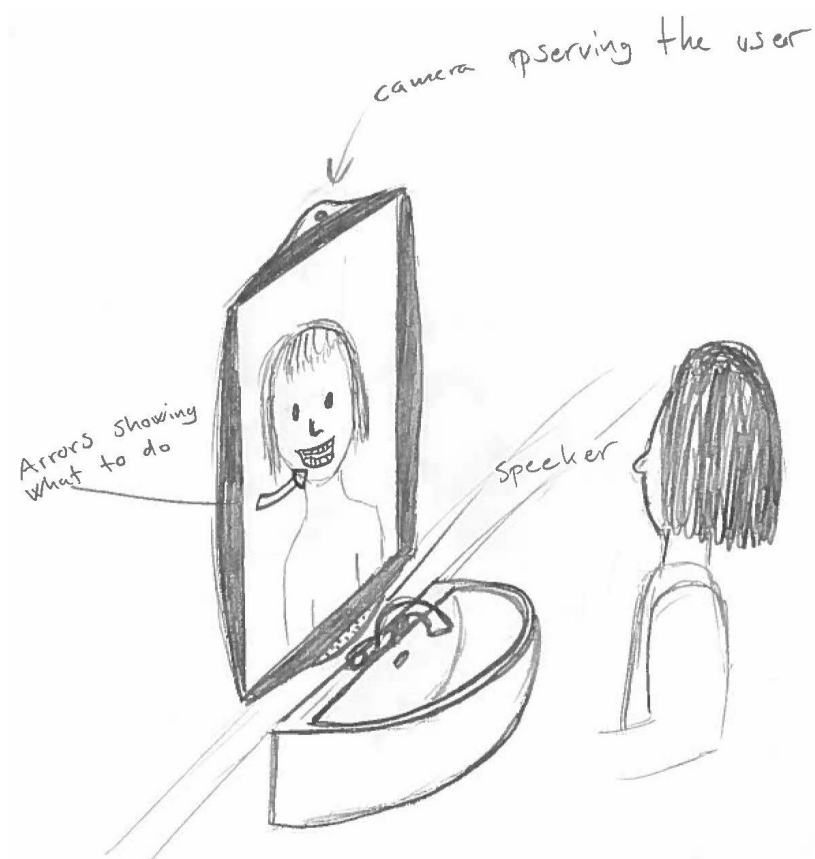
In these three cases, the costs would become higher than in III.1 and 2. This is because the object linked with the screen unit would need to be entirely designed.

III.3 issues regarding re-filling the dispenser, should be modular because the person might need 2, 3 or more types of soaps when showering but other might just use 2 (e.g. shampoo, conditioner, shower gel)

III.4 issues regarding adapting to different kind of bottles: it is not always possible to make the bottle fit.

If the product (e.g. the smart holder) is developed, it will only be able to fit a very specific task and it will not be possible to expand it to serve to other tasks. Unlike concept 1 and 2 in which the same technology, namely the 'smart label' can be applied to the objects involved in the performance of other tasks (e.g. apply labels to the objects used when making laundry).

## Sketch 6 - Smart mirror (Ill. 6)



This concept is constituted by a screen that can look like a mirror when not in use. A camera is incorporated so to have the possibility of recognizing the user and to process information.

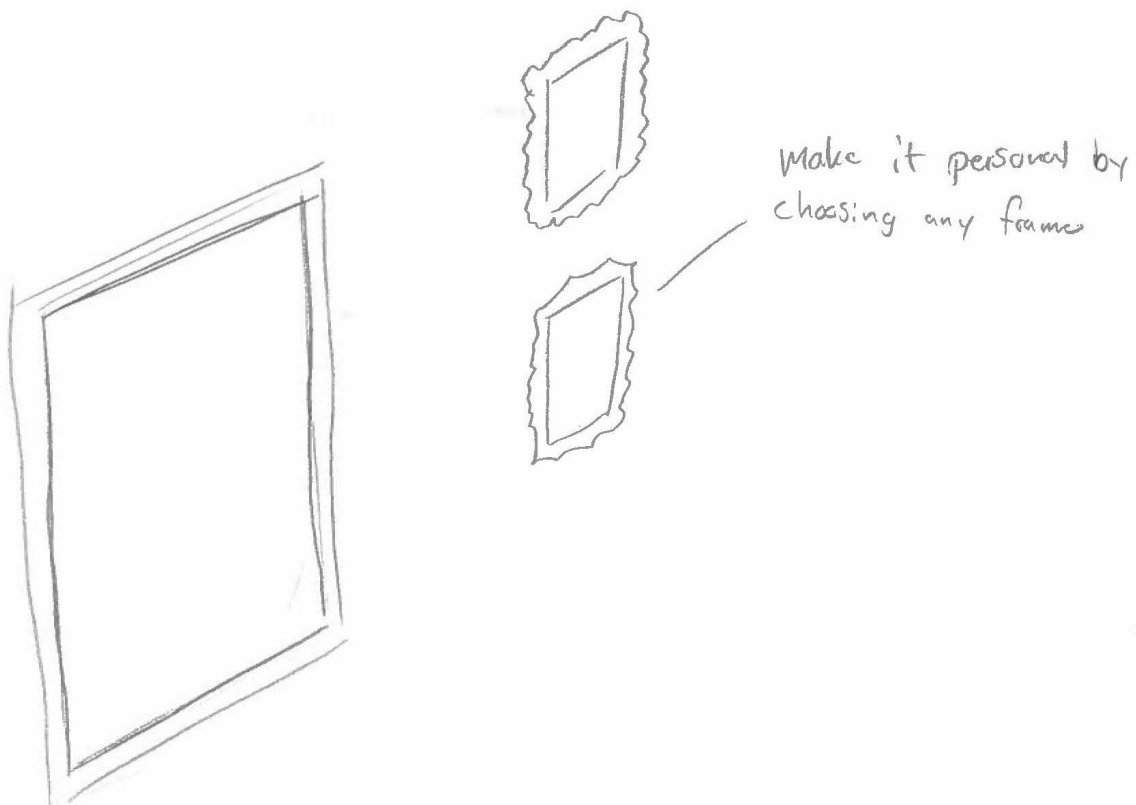
The issue of different users' styles can be solved by the development of a range of frames able to fit different tastes.

Further issues:

- costs will sensibly rise due to use of new and high level of technology (is it really needed? is there any other solution that can rely on largely used technology that would keep costs much lower?)
- furthermore, every bathroom has different amount of space available (different sizing for the mirror)
- designing the frame the product will compete with mirrors and styling
- limited range of tasks to which the concept can be expanded: dressing. Furthermore would you use something like that when showering?

Pro:

- could also assist in other tasks that require the use of the mirror (e.g. dressing)



**Assistive screen**

The assistive screen could be placed in a strategic spot to assist the user in performing the chosen task.

The screen could either hang (III. 7) or be placed on a surface (III. 8).

E.g. use hooks, suction cups (III. 10) etc.

It could also be incorporated in some of the objects used when performing a specific task (III. 9).

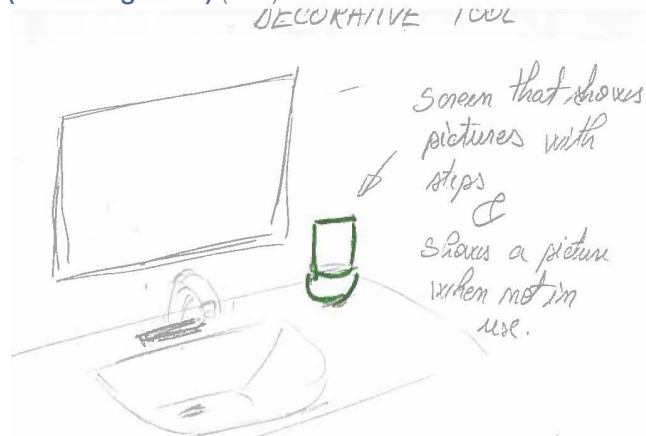
From III. 11 emerges the issue: is it just one screen needed (is it fixed or it can be moved around to assist in other tasks) or could have more than one placed in different spots to assist with different tasks (issue: cost would consistently raise e.g. if you have 4 screens for 4 different tasks).

Most likely the idea of just having one screen that can be moved around is the most feasible (considering costs).

**Sketch 7 - Instructions' screen A (showering) (III. 7)**



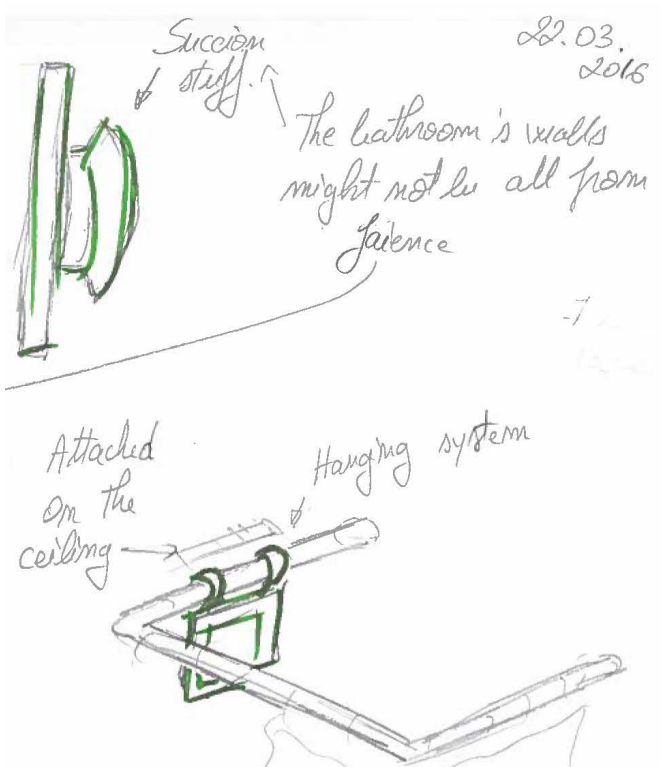
**Sketch 8 - Instructions' screen B (sbrushing teeth) (III. 8)**



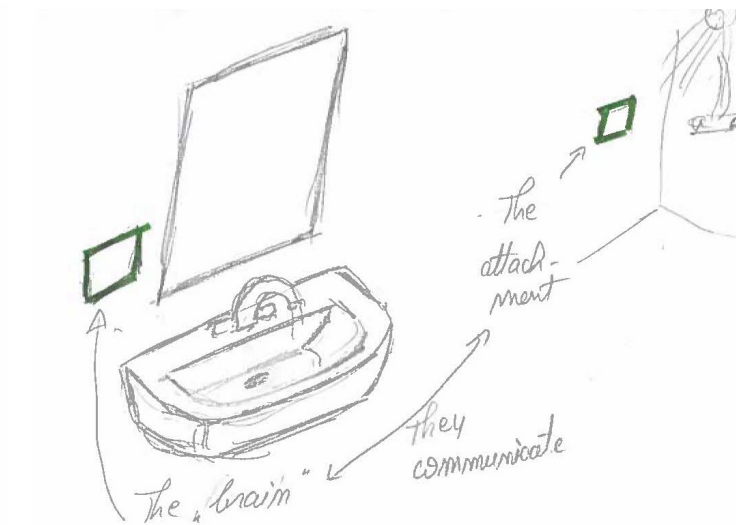
**Sketch 9 - Instructions' screen C (showering) (III. 9)**



**Sketch 10 - Instructions' screen D (showering) (III. 10)**



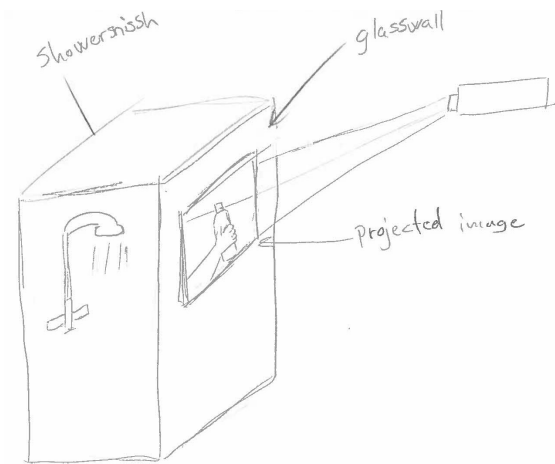
**Sketch 11 - One vs. several screens? (III. 11)**



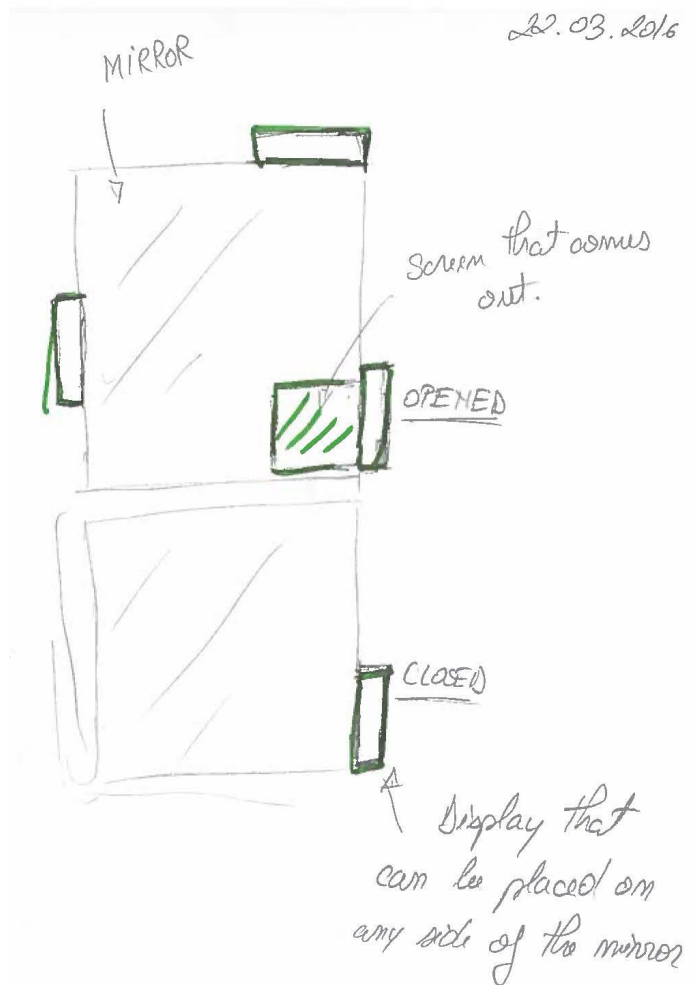
Sketch 12 - No screen: project image A (III. 12)



Sketch 13 - No screen: project image B (III. 13)



Sketch 14 - Hide screen when not in use (III. 14)



**Other options than a screen: projecting and hiding screen**

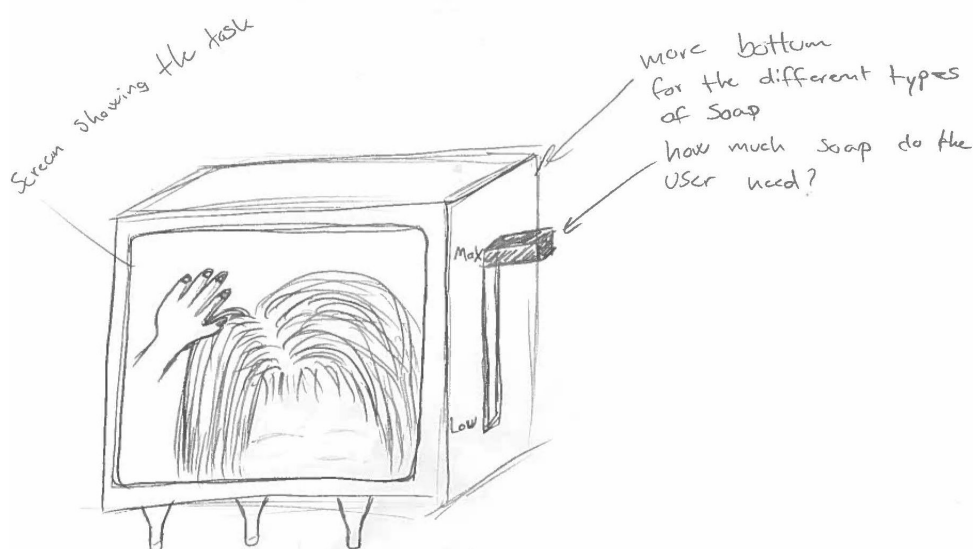
Instead of using a normal screen to display the images, could be used a projector (III. 12, 13) so that when the product is not in use, nothing is visible.

Pro: It would not use a screen space (would still need space to put the projector)

Cons: issue of bright environment in which the image would not be visible (this obstacle can not be overcome); availability of surface in which to project; the quality of the image is usually low for projectors of small dimensions.

Regarding the idea of hiding the screen (III. 14), it could be used the OLED technology. But of course in this case the costs will sensibly 1/2 increase.

Sketch 15 - All in one (III. 15)



In the case of III. 15, the screen unit is incorporated in the object used to perform the task (soap dispenser for showering).

The same issues of sketch 3 would need to be addressed (e.g. refill, signal when is empty etc.).

Furthermore, the technology would be in very close contact with water and other agent, together with the higher costs of development compared to other simpler solutions.

Other issues e.g. interaction with the product (ergonomics), height for optimal view is not the same one for being comfortable with taking soap.

# OBSERVATIONS & CONCLUSIONS

## Support to show instructions

Regarding how to display instructions, the identified range of possibilities are:

- independent screen
- create appositely an object to display information
- integrate a screen on an existing object
- projecting the images on a surface

Independent screen: + no high costs if relying e.g. on a normal screen or on a tablet; - less integrated in the environment

Create e.g. mirror-screen: - higher costs; is it really needed?

Integrate screen e.g. on mirror: + integrate/hide in environment; - what about costs? Is it really necessary?

Projecting image issues: bright environment, need proper surface; dimensions of projector vs quality of the image.

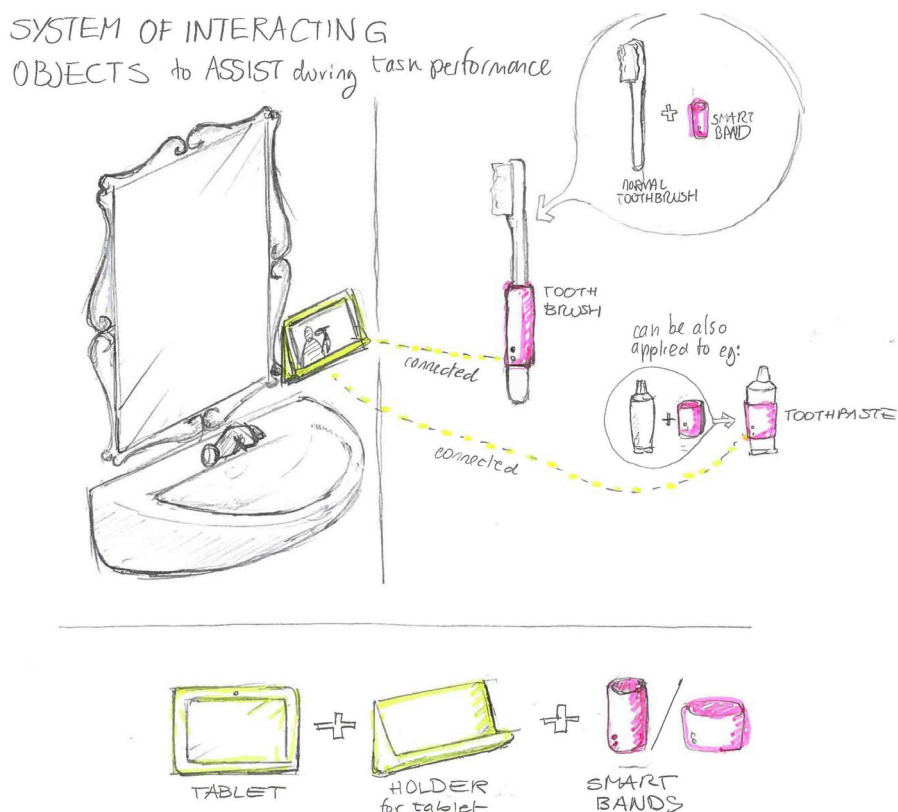
According to costs and benefits of the identified possibilities, the use of existing tablet has been identified as the most feasible solution: tablets are quite cheap, it is not needed to develop a completely new product or use a very expensive technology.

## CHOSEN CONCEPT

An instructions screen can be connected with smart labels that can be applied to the objects used during the task performance. This would ensure that the instructions are followed correctly by the user.

Benefits and risks of developing this idea:

- Verify feasibility regarding technology and costs.
- + Can be expanded to other tasks.



III. 14. System of interacting objects

**Illustrations:**

Ill. 1 to 14. (Own illustrations)

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**Evaluation:**

The activity was useful in order to identify benefits and issues linked to the possible solutions identified during the ideation round. This allowed to operate decisions regarding product development which narrowed the range of possibilities in terms of directions to explore.

The result of the activity is a raw basic concept that will be further investigated and explored regarding feasibility, technology, business etc.

**Reflection:**

The activity led to the desired result of obtaining a raw concept to develop. Many aspects need to be taken into consideration to understand if the concept is feasible and relevant for the stakeholders. Together with further investigation, testing and feedback from stakeholders are needed in order to understand if the solution is valuable.

**Activity:****Meeting with a club for people with brain injuries****Objective:**

To get to talk with more people with brain injuries and get to know about their difficulties.

**Experiment/data:**

Two members of the Team went to a club meeting where any people with different degrees of brain injuries were attending. From this meeting, the Team got to talk to some of the people to hear their stories. The following pictures are taken at the club meetings (Ill. 1 and Ill. 2):



Ill. 1. Picture from last meeting in the club - 07-03-16



Ill. 2. Picture club meeting that the two Team members were attending - 21-03-16

The Team members placed themselves in the end of the table and started a conversation in Danish with two ladies, Else and Mette.

**Else:**

"I got a stroke and then I was hospitalized for 2-3 weeks after which I got home. After 3 weeks I got back to work. I am working with numbers, salaries and calculations and suddenly all the numbers would not make sense. Therefore I had to make some systems to understand the numbers again. I had to calculate salary every second week and for that I had to come up with some kind of system that I could use to understand the numbers. The system was a kind of check list that I used to calculate the salary. That list is now used by my replacement, because I got an early retirement. So as you might understand, I did not get any rehabilitation and the check lists has been my way to deal with this."

**Ulla:**

"I guess that it can be difficult to get the rehabilitation that is needed? Our understanding so far is that it can be difficult."

**Else:**

"Yes the municipality can be really difficult to talk to and it really takes a lot to get what you need. You really need to want it otherwise the municipality will not give you the help you need."

**Else:**

"Mette, tell what happened to you."

**Mette:**

"I got a stroke while I was out running.

Well everything was strange in the beginning. I could not do anything by myself. It felt like there was some light bulbs that needed to be turned on again. It was really a long process."

**Ulla:**

"What about with personal care? Did you have any problems in that area?"

**Mette:**

"In relation to personal care, one of the first things I remember was that I got a deodorant from a nurse and I did not under-

stand what it was. I did simply not understand what to use it for. Therefore the first thing I did was to put it into my mouth to find out what it was. Furthermore, I also thought it was crossing my personal boundaries that somebody else had to put my contact lenses into my eyes in the first long time because I could not do it myself. Another thing I remember and this is both funny but also embarrassing. In the first long time after I took a shower I would step out from the shower onto my towel. Then I would try to take it up from the floor and I did not understand why I could not get the towel up from the floor. But that was of course because I was standing on it. This, I kept doing for a very long time and every time I did it, I did not understand why I could not get it up from the floor. It took me so long time to understand that I could not take it up while I was standing on it. Today I am aware of it.”

**Else:**

“Stuff that used to be logical are suddenly illogical.”

**Mette:**

“Another think I did was to practice my fine motor-skills and strength in my arm by taking glasses and put them into the cabinet. I did not have any strength left in my right arm. Lucky for me I am now able to laugh about it.”

**Else:**

“Of course it does not help anything to just sit down and cry about it, but most people will do that in the beginning.”

**Mette:**

“Well I did not understand anything and was therefore not that sad in the beginning. I did simply not understand the consequences.”

**Ulla:**

“How long time did it take before some of your lost skills came back?”

**Mette:**

“Well I still have a lot of things that I can not do or need a long time to think about in order to do it. Not everything is routine yet. Once in a while there is a thing where I really have to think a lot about how do it. Not the deodorant or towel, but something else. Especially when I get tired.”

**Ulla:**

“The stage you get to when you are tired, is it like being drunk or dizzy?”

**Else:**

“It is being inside a big bubble that you can not get out from. You are not a part of anything and you are just observing what is happening around you.”

**Mette:**

“Likewise you do not care what is going on outside your bubble. At the same time I got a lot of medication, anti-depressives, so I was just sitting and drooling.”

**Ulla:**

“The brain is really a fragile organ.”

**Mette:**

“Yes. Also long time after I got home I had the same nightmare, but I did not know what it was until I went to a check-up. It was the Mr-scanner-sound that scared me. The sound was horrible.”

**Else:**

“It sounds like somebody removing the tarmac right outside a window.”

*Conversation is interrupted by a phone call.*

**Kim:**

“I have someone that might be able to help you.”

**Johnny:**

“Well it is not me that has a brain injury, but my wife.” (Ill. 3)



Ill. 3. Johnny and his wife Birte

**Ulla:**

"Well tell me about her."

**Johnny:**

"She got a clot in the left side of the brain and is therefore not able to talk anymore. She is partly paralyzed in the right side of the body.

We have together practiced some sentences that when I start them she is able to finish them. Likewise we have practiced some names. If I start them she will be able to finish them. Our hope is that in some time she will be able to say a whole word without help. The doctors has told that she should never be able to talk again, but since it is going so well already we have our hopes high. "

**Ulla:**

"How did it happen?"

**Johnny:**

"It happened Easter Saturday in 2014. I went to work at 7 o'clock in the morning and it was only my wife Birte and her youngest daughter, Simone, that were home. Suddenly Simone finds Birte laying on the floor. At first Simone thinks that Birte has broken her arm because she is laying on it, in a strange position. Likewise Birte is not able to get up. Simone thinks that Birte is talking to her, but I think it was just random sounds.

Then she calls me and I tell her to call 112. Then I calls some of our neighbors and get to talk with some that will go over and help. But only a few are awake at 7 AM on a Saturday. I was about 20 minutes drive away and started driving home. When I got home the ambulance had not arrived yet and Birte was still lying on the floor. When she saw me she turned her head and smiled at me. She took my hand and gave it a little squeeze to kind of tell me that she knew that I was there and then she closed her eyes again.

Shortly after, the ambulance arrived, but they were not able to tell what was wrong. After this, Birte was brought to Aalborg hospital where they checked if she had a bleeding in the brain, which she did not have. At first, they were not able to check if it was a clot in the brain because Birte would not lay still. It was therefore not until 4 o'clock in the afternoon they found out that it was a clot. The doctors do not understand that she was not feeling sick or felt ill before it happened. It was a quite big clot. But there was nothing with her before it happened.

From Hammel they have afterwards told us that they think it would have been better to drug her and get the scan, but at the same time they do not know if it had made a difference. There are many different opinions on what should have been done. "

**Ulla:**

"I guess it is sometimes difficult to be a doctor that needs to make the right choice."

**Johnny:**

"Yes, but I just thought that there was a procedure to follow in cases like this one."

**Ulla:**

"Yes of course."

**Johnny:**

"She then stayed a month in Aalborg until there was a spot for her in Hammel. In Hammel she was for 3 months and after this she was sent to Brønderslev where she was for 3 months. 7 months in all.

When she got to Brønderslev she was there for a month before she could go home for visits in the weekends. After that she got home every weekend."

**Ulla:**

"It must have been very hard and I can not even imagine how hard."

**Johnny:**

"Well in Hammel they used a lot of time on the rehabilitation. E.g. that the deodorant should not be put in the face. She has all the time really wanted to help and get better. She gave signals to show that she really wanted to be helped and try. So in our case it had a great impact that she wanted to get better and was aware of that she needed to get better."

**Ulla:**

"So are you helping her now with brushing teeth or taking a shower?"

**Johnny:**

"No she was able to do that by herself when she got home, but when she takes a shower I always go with her and help. She needs me to be there because she can not do it 100% by herself yet. As long as I am there everything goes fine."

**Ulla:**

"Does she prefer that it is you that helps her instead of a caretaker?"

**Johnny:**

"She asked for the caretakers to stay away. She did not want their help at all. There are minor things that she needs help with, and the rest she prefers to do by herself.

In the three first months after she arrived home an extra team of caretakers came to help her, but often the planning was really bad. They would come at 10, but Birte had to leave for rehabilitation or speech therapist at 9. Of course they had to take care of emergencies before they could come to us, but it was really nice when they stopped coming. Often we were just waiting for them to come so that we could do something or go somewhere."

**Ulla:**

"You say that she does not like to have a caretaker to come and help her. Do you have any idea why that is?"

**Johnny:**

"I think it is because she wants to do the things herself. She wants to be independent, but then on the other hand she does not have a problem bossing around with us at home."

**Ulla:**

"You said that you help her taking a shower, how do you normally do that?"

**Johnny:**

"Well she drives out to the bathroom in her wheel chair and then she moves from the wheelchair to a chair that is placed in the shower. Likewise there is a mat in the shower to make sure that she will not slip. Before she moves from the wheelchair to the shower she takes off her clothes.

She is using the wheelchair most of the day, because it is much easier to clean and dust when she is sitting in it.

But she is also able to walk around a little."

**Ulla:**

"What are you then helping her with in the shower? Or is it more because she feels safe having somebody with her?"

**Johnny:**

"Well I give her the shampoo when she needs it. Since she is partly paralyzed in the right side of the body she is not able to squeeze the shampoo out from the bottle herself. We have tried with a pump, but without luck. They are not giving the right amount of shampoo and then she has to pump many times which is not easy for her. I guess they are designed to save soap. Another thing is also that the pumps that we got for the shower so far were too tall to stand where they were meant to be standing."

**Ulla:**

"Have you considered automatic pumps?"

**Johnny:**

"We have just got an automatic pump to dispense soap at the sink."

**Ulla:**

"Is it only to help her that you are with her when she showers or?"

**Johnny:**

"I think it is also because she thinks that it is cozy to have me with her."

**Ulla:**

"How does she handle to wash her hair? I usually use two hands to do that."

**Johnny:**

"That is not a problem, she just uses one hand and then I help her when she needs to wash it out. I hold the shower-head for her."

**Ulla:**

"Do you think she is able to feel when the shampoo is all washed out?"

**Johnny:**

"I am not always sure about that. Sometimes she keeps washing it for a very long time. Maybe because she does not know if it is washed out or because she wants to make sure that it is all washed out. At first she takes the shower-head and washes a little and then I take it and hold it for her while she washes the rest out."

**Ulla:**

"What about conditioner, does she use that?"

**Johnny:**

"No not really."

**Ulla:**

"What about shaving legs or in the armpit?"

**Johnny:**

"She shaves her legs herself and I help her to shave in the armpits because that she is not able to do herself."

**Ulla:**

"I guess most women want to make themselves nice for certain occasions. Does she put makeup on by herself?"

**Johnny:**

"Yes mostly, but once in a while her daughter does it. She does not use makeup every day. Only when we are going out."

**Ulla:**

"How old is her daughter?"

**Johnny:**

"She is 18."

**Ulla:**

"Okay because I imagined a girl around 5-6 years."

**Johnny:**

"Well that is because there is 10 years between my wife and me. I am 34 and she is 44. She has two daughters from an earlier relationship. One who is 18 and the other one is 21."

**Ulla:**

"Then she also got her first child when she was young I guess?"

**Johnny:**

"Yes when she was 22 or something. But she is actually also is a grand-mom today. Her granddaughter is two.

That is really frustrating for her that she is not able to be the grandmother that she wants to. It is really hard for her that

she is not able to talk with her. Birte is only able to make sounds or a few words if we help her. In general it is really hard for her not to be able to talk with her children and her grandchild.”

**Ulla:**

“I understand that must be very frustrating. Is she able to communicate by writing?”

**Johnny:**

“Once in a while she is able to write a word or the first 3 letters in a word. Other times she writes the last few letters in a word and then she goes back and writes a few more letters in the middle of the word. Sometimes we are able to see what she is writing and other times some of the letters have been swapped and then it is difficult. It does not happen that often, but sometimes she is able to write something. Before she got sick we got a blackboard that she is now using once in a while to write a word on.”

**Ulla:**

“As you describe her it seems like she is fully well-functioning just is not able to talk.”

**Johnny:**

“Our understanding is that she understands everything that is happening around her. But it has happened a few times that she did not understand what was going to happen. The worst case I remember was the first time she came home for a visit from rehabilitation. We told her many times that it was only for 2 hours and there was no doubt that she understood it. But when she had to go back to the rehabilitation she got very upset. I think she thought that she was home and not going back.”

**Ulla:**

“I guess that must be frustrating for all of you?”

**Johnny:**

“Yes but I really think she is the one that is felling the worst.

We have started speech therapy where she has gotten a tablet with an app to help her. This app allows her to write in some words and help her to find the words again if she is going to talk with somebody else.

But we have kind of given up on that because it takes too long. At first she has to open one program and then she has to open another program. It takes too long to use is that way. It is much easier for her to point at what she wants.

We have also created a book with pictures that she can bring with her when she is going out. Then she is able to find the picture to explain what she wants. Just some standard pictures.”

**Ulla:**

“That sounds like a good idea.”

**Johnny:**

“Yes but she does not really use it.

She has also just got an attendant to help her for 15 hours a month, but she does not always like that. She has started to do some swimming which she really likes.”

**Ulla:**

“It would be really nice to meet her, but of course she is not within our target-group since she is are able to understand how to do everything.”

**Johnny:**

“No not really. Your solution should show how to perform a task by pictures right?”

**Ulla:**

“Yes.”

**Johnny:**

“Well in the beginning she needed that kind of help. Having pictures of what she needed to do or having somebody to show her how to do stuff.”

*Conversation ends and Ulla goes to Kim and talk a little with him.*

**Ulla:**

“Can you tell me a little about the organization Hovedtropperne?”

**Kim:**

“Yes it is a club for young people between 15 and 35 that has gotten a brain injury. Right now we are trying to get to the young people out there, but it is really difficult. It takes a really long time to accept that you are living with a brain injury and therefore need help. Likewise that you need to talk with somebody else about it. For me it took 17 years.”

**Another woman:**

“For me it took 10 years.”

**Ulla:**

“I forgot what happed to you.”

**Kim:**

“I got kicked in my head by a horse when I was 10. To make it even worse a song about a man that was kicked in his head when he was a boy and not too smart, came not that long after my accident. Ib grønbech with “*han blev sparket af en hest*” (He was kicked by a horse).

*Charlotte puts on the song Kim was talking about and Anca interrupts to ask if we have gotten all the questions answered.*

**Ulla:**

"Yes most of them."

**Kim:**

"Do you not know what you want to ask about? Well I can not tell you. (Laughs) "

**Ulla:**

"Well we would really also like to get in touch with some caretakers that go to help people with brain injuries."

**Kim and Charlotte:**

"Then you should talk to our union boss Jens? Do you want his e-mail? Just write that you have spoken to us."

**Charlotte:**

"His e-mail is: Jmh-aeh@aalborg.dk

*Jens Martin Hansen, Områdechef, Aalborg Kommune, Handicapafdelingen, Sohngaardsholmsvej 2, 2. 9000 Aalborg, Tlf.:99317467, E-mail: jmh-aeh@aalborg.dk"*

*Ulla moves over next to Charlotte to talk with her.*

**Ulla:**

"Hi so what happened to you?"

**Charlotte:**

"Well in 2014 on my 9th semester at the university I knocked the back of my head on a windowsill. Because of that I got a concussion and had to take a break from my study. I was not able to think straight anymore."

**Ulla:**

"What education do you have?"

**Charlotte:**

"I have a cand. merc. (Master's degree in business) with focus on international business communication."

**Ulla:**

"Wow! That sounds like a tough study. Did you finish it now then? And what are you doing now?"

**Charlotte:**

"I just finished it and I am off for two months from the job-center to get back on track.

A long time after the accident I was really confused and did not know what to do. Therefore I had to realize that I had to take a break from the study. "

*While talking about this, Charlotte is struggling to hold back tears.*

**Ulla:**

"So what are the effects from the accident now?"

**Charlotte:**

"Well it only happens when I get really tired, but then I can suddenly not remember how to do something or I get confused about how to do it. E.g. I can go to a store to buy something and when I get there I suddenly do not know why I am there and what I wanted to buy. Some things I had to learn all over and I needed a lot of repetition to perform some tasks again. What is it that you are looking for?"

**Ulla:**

"Well we want to make a device that trough image guidance can help you to take a shower or brush your teeth."

**Charlotte:**

"I do not have problems with that, but I can be in **doubt of how to clean or cook once in a while. It mostly happens when I am tired.**"

**Ulla:**

"You said that you finished up your education now."

**Charlotte:**

"Yes, but I had a secretary to do all the writing because I was not able to. I have attended a reading course because I have troubles with that."

*Charlotte gets even more upset.*

**Ulla:**

"But I guess that it is nice to be done with the study. Are you considering a full-time or part-time job? Myself I would like a part-time job in the beginning, but that is also because I am a mother."

**Charlotte:**

"Definitely a full-time job. The last few weeks of my education I was working 60 hours a week. My education is for bosses and leaders. And I am also very high in leader skills. I have done some of the tests to show that through the study."

*Ulla tries to make her happy again by speaking a little about a test called a DiSC-test that she also did recently. Charlotte knows the test and tells that she was high in D, High in leadership. Suddenly Charlotte looks like she gets confused and look and me and say: "So you wanted to know what happened". To that I reply: "yes".*

**Charlotte:**

“Well sometimes I have difficulties finding the right words. I can be in the middle of a conversation and **struggling to find the right words**. I can be “talking in circles” when talking to people. I have done a lot of interviews for my master thesis and while reading them I realized that I have been repeating myself and “talking in circles”.”

*The conversation is turning to other stuff and we notice that the meeting is slowly ending. I thank her for the conversation.*

**Kim:**

“Well I hope that you got all your questions answered?”

**Ulla:**

“Yes, most of them. For example we wanted to know if you think it is needed to take pictures of the person him/her self doing performing the task or should it be somebody else.”

**Kim:**

“It should be a Victoria’s secret model for men and a man for women.” (Laughs)

**Ulla:**

“So pictures of where to find the things needed but pictures of somebody else guiding through the showering?”

**Kim:**

“Yes.”

*Kim starts talking again about how much he liked the idea with the mirror, the conversation ends and we say goodbye.*

---

**Evaluation:**

We got a lot of knowledge about how it is to live with a brain injury. Everybody at the meeting was very helpful and opened about talking about their problems. None of them had the problems that we are aiming to solve, but some of them have experienced problems within personal care and was therefore able to reflect on them. This gave a lot of ideas for the further product development.

**Reflection:**

We learned a lot, but since this interview was only loose conversation and we did not have any concepts to bring for the meeting we did not get any specific feedback.

**Activity:****Wireless technology research****Objective:**

To research on the existing wireless technology for devices to communicate with each other. To make a comparison between them and choose the one most appropriate for the application in question.

**Experiment/data:****ZigBee**

A mesh network specification for low-power wireless local area networks (WLANs) that allows devices to communicate between each other. It is specially designed for device-to-device communication, the groundwork for The Internet of Things (IOF) (ZigBee Alliance, 2015). It can also be found in machine-to-machine (M2M) communication.

It is used in a wide variety of markets, as the Ill. 1. is depicting.

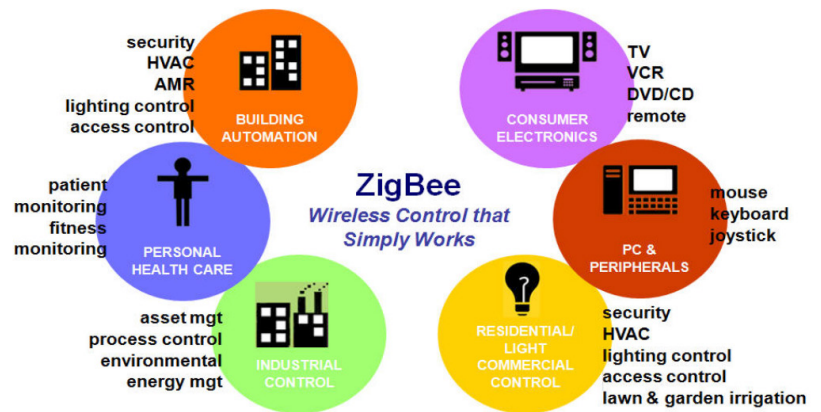
It has a very low power consumption, with a battery life spanning over several years. It has been created with the specific purpose of being used for low data rate control system sensors, that use data transfer of just 250 Kbps, in comparison with bluetooth, which has been created with mobile devices as epicenter, and working at a speed of 1 Mbps (Thakur, 2012). Ill. 1. shows the types of communication between the devices.

**Advantages:**

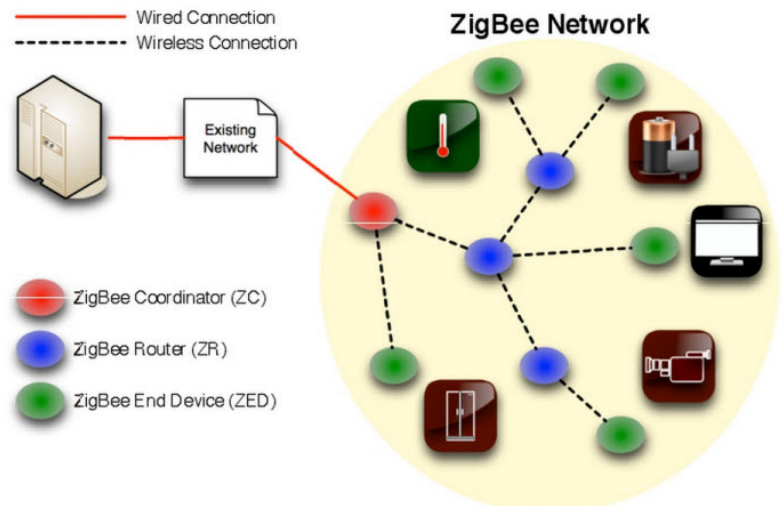
- Reliable and self healing
- Supports large number of nodes
- Easy to deploy
- Very long battery life
- Low power consumption
- Low cost
- Easily implemented
- WFlexible network structure

**Disadvantages:**

- Not many end devices available yet
- Replacement with ZigBee compliant appliances can be costly
- Highly risky to be used for official private information (Kanwar, A., Khazanchi, A., 2012)



Ill. 1. ZigBee Applications, 2012



Ill. 2. What is ZigBee Technology, 2013

**Bluetooth technology**

A global wireless communication standard that allows for devices to connect over a certain distance. It uses radio waves to create connection with a phone or a computer. In order for two devices to be connected via Bluetooth, they have to pair. The maximum amount of devices that can connect is eight. The communication takes place over short-range, ad hoc networks entitled piconets, which represent the network established through Bluetooth. The moment a network is established, one of the devices becomes the master, and all the other connected devices become the slaves.

There are two main Bluetooth technologies that are widely used: Bluetooth BR/EDR (basic rate/ enhanced data rate) and Bluetooth low energy. The former is to be found in devices such as headsets and speakers, while the latter is generally used in the newest devices, such as smart home devices or everyday applications, such as fitness watches or beacons. (Bluetooth technology basics, 2016). The main difference between those two is that the former consumes much more energy for functioning than the latter. Another difference is regarding the number of slaves connected to the master. Bluetooth Classic allows the connection of seven slaves at a time, while Bluetooth Low Energy allows for as many slaves to be connected to the master as they are programmed. This is influenced by the memory available. Since the project is within the home category, the advantages and disadvantages of the Bluetooth low energy are considered.

Bluetooth networks are also named piconets and they contain masters and slaves. The master /slave model controls the flow of transmitting data. The master can be connected with up to seven different slave devices. The slave can be connected with just one master, therefore it can communicate just with the master. The master is the one that coordinates the data, and it can send and request data from any of the slaves.

Every Bluetooth device has a unique code, a 48-bit address that can be found with the abbreviation BD\_ADDR. <https://learn.sparkfun.com/tutorials/bluetooth-basics/all> (Accessed: 14 April 2016).

Advantages:

- Extremely low power consumption
- Compatibility with almost all devices
- Easy to setup
- Robust
- Reliable
- Very large number of slaves, compared to Classic Bluetooth Technology.
- Real-time operation

Disadvantages:

- It streams 'state' data, does not stream content
- It doesn't function the same as Classical Bluetooth, it would consume a lot of energy if so.

## ANT

A Wireless Sensor Network (WSN) used for communicating wireless over a short range in applications that use an ultra-low power networking. It can be used from point-to-point applications to complex mesh networks.

Advantages:

- Ultra low power consumption
- Highly resource optimized
- Network flexibility and expandability
- Low system costs

ANT+ is an improved version of ANT that makes the communication between two devices to be completely understandable, fact that is a problem in the normal ANT. Advantages of ANT+:

- Power consumption optimization
- Cheaper
- Improved latency
- Easy implementation (ANT+, 2016)

## References:

ZigBee Alliance (2015) [Online]. Available at: <http://www.zigbee.org/> (Accessed: 28 March 2016)

Thankur, A. (2012) *ZigBee Technology*, Engineers Garage [Online]. Available at: <http://www.engineersgarage.com/articles/what-is-zigbee-technology> (Accessed: 28 March 2016)

Kanwar, A., Khazanchi, A. (2012) *ZigBee: The new Bluetooth Technology* [Online]. Available at: <http://www.ijecs.in/ijecsisue/wp-content/uploads/2012/12/67-74.pdf> (Accessed: 28 March 2016)

*Bluetooth technology basics* (2016) [Online]. Available at: <https://www.bluetooth.com/what-is-bluetooth-technology/bluetooth-technology-basics> (Accessed 29 March 2016)

ANT+ (2016) *ANT/ ANT+ defined* [Online] Available at: <https://www.thisisant.com/developer/ant-plus/ant-antplus-defined> (Accessed 22 April 2016)

**Illustrations:**

III. 1. ZigBee Applications (2012) *ZigBee: The new Bluetooth Technology* [Online image]. Available at: <http://www.ijecs.in/ijecsissue/wp-content/uploads/2012/12/67-74.pdf> (Accessed: 28 March 2016)

III. 2. What is ZigBee Technology (2013) [Online image]. Available at: <https://www.elprocus.com/what-is-zigbee-technology-architecture-and-its-applications/> (Accessed: 28 March 2016)

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**Evaluation:**

The best technology for the application the Team is aiming to create is Bluetooth Low Energy. It is widely used in System of Objects applications due to its advantages and continuous progress.

**Reflection:**

The Team had in mind before making the research that the best choice would be Bluetooth LE, but making the research was needed to support the decision. The Team needs to further investigate the types of Bluetooth Low Energy and choose the one most suitable for the application.

**Activity:****Internet of Things - relevant projects****Objective:**

Explore the field of Internet of Things and systems of objects communicating one another. Together with the aim of understanding the state of the art regarding the field of: how to make normal objects become 'smart' (connected by technology). This is intended also as an activity to provide inspiration for concept development and to identify the technology currently implemented in the field (what kind of data can be extracted and the issues that are encountered when developing such products).

**Experiment/data:**

Some relevant projects are now examined according to the current framing of the project which aim to upgrade existing, non-connected devices.

## TERMINOLOGY

**Internet of Things (IoT)** - is the network of physical objects (devices, vehicles, buildings and other items) embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data. IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems.

This results in: improved efficiency, accuracy and economic benefit. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020 (Dave Evans, 2011).

**Nearables** (or nearable technology) - is a term used to describe the idea of smart objects (everyday items with small, wireless computing devices attached to them).

These devices can be equipped with a variety of sensors and work as transmitters to broadcast digital data, usually using Bluetooth Smart protocol. Thanks to this, these objects are able to provide mobile devices in range with information about their location, state and immediate surroundings. The word 'nearables' is a reference to wearable technology - electronic devices worn as part of clothing or jewelry.

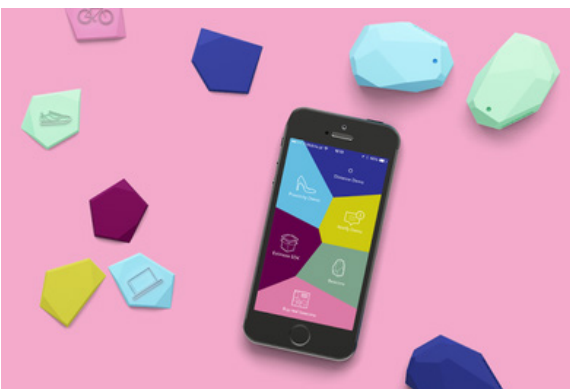
**Beacons Technology** - The term iBeacon and Beacon are often used interchangeably. iBeacon is the name for Apple's technology standard, which allows Mobile Apps (running on both iOS and Android devices) to listen for signals from beacons in the physical world and react accordingly. In essence, iBeacon technology allows Mobile Apps to understand their position on a micro-local scale, and deliver hyper-contextual content to users based on location. The underlying communication technology is Bluetooth Low Energy.

**BLE (Bluetooth Low Energy)** - is a power consumption Bluetooth with low energy requirements. It can last up to 3 years on a single coin cell battery.

- Lower Cost: 60-80% cheaper than traditional Bluetooth.

- Application: is ideal for simple applications requiring small periodic transfers of data (classic Bluetooth is preferred for more complex applications requiring consistent communication and more data throughput).

## Estimote Stickers and Beacons



III. 1. Estimote Beacons and Stickers



III. 2. Estimote Stickers



III. 3. Estimote Beacons

Both Beacons and Stickers are small wireless sensors that can be attached to any location or object.

The difference between Beacons and Stickers is that:

- Beacons have a bigger battery and were designed for venues like retail stores, museums or airports
- Stickers can turn things into “nearables” (smart objects fully detectable by your mobile device).

**Aim** - create contextual awareness: use the data extracted from Estimote products to build a new generation of mobile apps that can connect the world to each smart device.

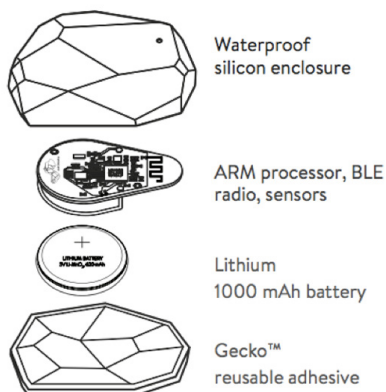
**Obtained data** - micro-location, ownership, approximate location, temperature and motion

**Compatibility** - Estimote Beacons are certified Apple iBeacon™; they are compatible as well as support Eddystone™, an open beacon format from Google.

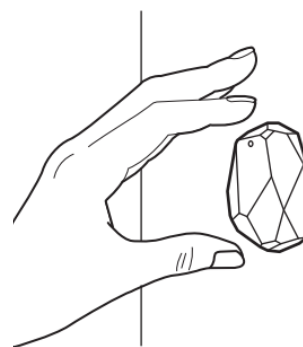
**How they work** - Beacons and Stickers broadcast radio signals which a smartphone/ tablet can receive and interpret (the app Estimote SDK, can be installed on a smartphone. Estimote’s SDK and Cloud tie everything together by granting apps full access to the metadata, including beacon ownership, object type, and precise location. They also enable security and other services on top of the beacons).

### Beacons Components:

- silicon waterproof case
- ARM processor
- memory
- Bluetooth Smart module
- temperature and motion sensors
- coin battery (non-rechargeable lithium battery, last for about 2.5 - 3 years. Can be extended to over 4 years by activating power modes. Estimote Stickers last for around one year)
- built-in antennas (to broadcast radio signals)
- Gecko™ reusable adhesive



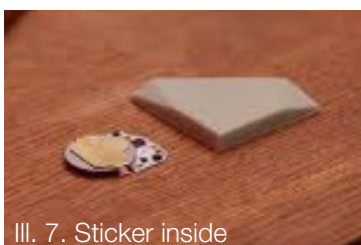
III. 4. Beacons components



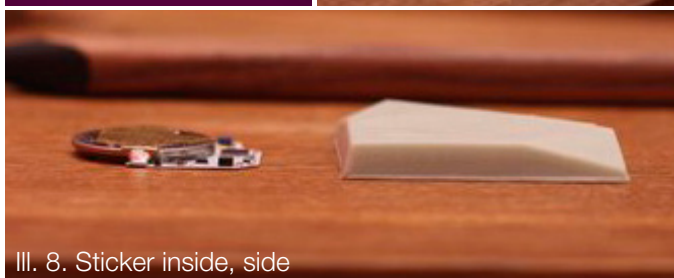
III. 5. Beacon with hand



III. 6. Sticker side



III. 7. Sticker inside



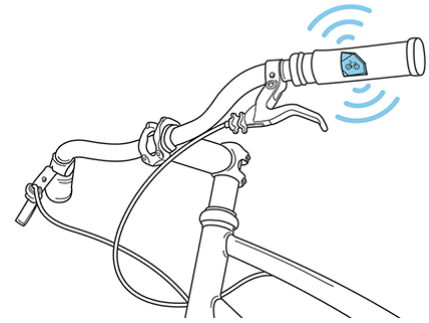
III. 8. Sticker inside, side

### Stickers Components:



- Adhesive on one side
- small PCB inside
- broadcast a Bluetooth Smart signal up to about 7 meters (20 feet).
- the advertising interval is dynamically adjusted by adaptive algorithms, to optimize for energy efficiency and signal stability (Currently, settings cannot be edited)
- depending on usage, the battery can last up to a year.
- sensors: accelerometer, temperature (Stickers are waterproof, however, extreme weather conditions can impact performance. E.g. heavy rain can limit the range and very high/low temperature can decrease battery life)

**Stickers Data:**

- sticker type (for example fridge, dog, computer etc.)
- sticker ID (numerical value)
- orientation in space
- motion in X, Y, Z
- temperature
- broadcasting power (used to calculate proximity)
- battery level
- firmware version



III.9 . Bicycle sticker

	Estimote Beacons	Estimote Sticker Beacon
		
<b>Supported packet types</b>	iBeacon or Eddystone only one type active at a time	Nearable and iBeacon both packets broadcast simultaneously
<b>Supported platforms</b>	iOS, Android 3rd party support for <a href="#">Xamarin</a> , <a href="#">PhoneGap</a> , <a href="#">Node.js</a>	iOS, Android 3rd party support for <a href="#">Xamarin</a> , <a href="#">PhoneGap</a> , <a href="#">Node.js</a>
<b>Broadcasting range</b>	configurable, 3 m to 70 m	configurable, 3 m to 15 m
<b>Advertising interval</b>	configurable, 100 ms to 2000 ms	configurable [1], auto-adjusts to conserve battery, in motion: 1250 ms (Nearable), 5 s (iBeacon) still: 2500 ms (Nearable), 10 s (iBeacon)
<b>Sensors</b>	accelerometer, temperature requires connecting to the beacon	accelerometer, temperature broadcast in the Nearable packet
<b>Compatible with Indoor Location?</b>	yes	partially: can't be used to map a location, but are <a href="#">detectable by Indoor Location</a>
<b>Battery life</b>	depends on settings ~ 3 years w/ default settings (950 ms interval, 15 m range)	depends on settings ~ 1 year w/ default settings (intervals as above, 5 m range)
<b>Replaceable battery</b>	Yes	No
<b>Price</b>	\$99 per dev kit w/ 3 beacons [2]	\$99 per dev kit w/ 10 stickers [2]

III. 10. Comparison table



Ill. 11. Pixie beacons



Ill. 12. Pixie in hand



Ill.13 augmented reality

## Pixie Point - bluetooth beacons

Developed by a company called Pixie, the product is an always-on locating tag that works with Bluetooth LE. The tags are flanked by a smartphone app. The beacons can create a digital map of all the tagged items. In fact, they have 'device to device communication' and not only 'device to phone communication'. Pixies uses the network they create to show the user exactly where they are located through augmented reality (live view mode).

**Dimensions** - 3.2 mm thick

**Range** - up to 50 feet from your phone indoors and 150 feet outdoors (accuracy under a foot). The range extends when multiple beacons network together.

**Uses** - location of things, last known location of things that are outside the maximum range, used to organize things ( e.g. app can tell whether there are all the items needed when packing up a bag, erasing the need to root around a dimly lit backpack), make lists of things (e.g. make a list that let see only items in the bag and not the other tags around).

**Components:**

- Water-resistant and UV-coated to protect the radios, circuitry, and processor inside

- Battery (last up to 18 months)

**Costs** - 1 pack (4 Pixie Points) - \$69.95; 2 packs (8 Pixie Points)– \$129.95; 3 packs (12 Pixie Points) – \$189.95

## Smart Beacon tōd (By RowdyRobot)

It is a Bluetooth 4.0 smart beacon project that was seeking manufacturing funding on Kickstarter in 2012.

**Power** - the device is driven by a single coin battery which has a life expectancy of up to several years.

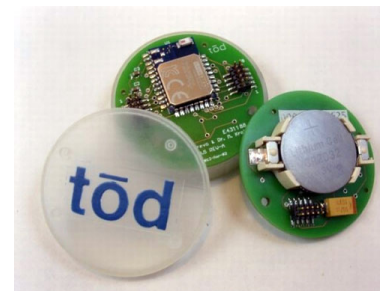
**Transmission range** - is adjustable between 3 and 500 feet and enables to trigger actions and connect real world events via smart phone, the beacon itself and the tōd Cloud service.

**How it works** - use three core events of 'in range', 'out of range' and 'scheduled' for users to create tōd interactions around everyday actions, things, people, and places. Access rights can be customized from public, private or into specific groupings and the app comes loaded with 10 default app setting including Proximity, Location, and social networking.

**Examples of application** - receiving an SMS when your pet has left a certain range of your backyard, locating your car in a busy parking lot, setting up an email notification alert in case your child does not get home from school at a certain time, etc. Other similar apps do similar, pseudo proximity functions but they do not allow for 'set and forget' applications. With the tōd Smart Beacon, a person can place it in the desired location, set the desired interactions and permissions, and then let it do the work. Therefore developers are able to create add-on modules like motion detection and temperature sensors for the device.

**Material** - water resistant case

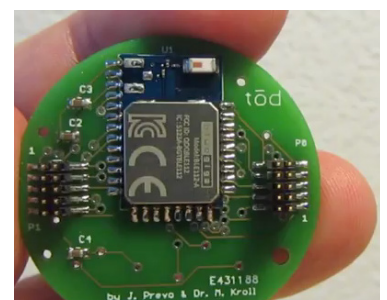
**Compatibility** - Currently compatible with iPhone 4S, the new iPad, Mac Mini, Mac-Book Air and the Droid RAZR.



Ill. 14. Tod beacon open



Ill. 15. Tod plus phone



Ill. 16. beacon inside

## Wireless sensor tag

By the Company: CAO Gadgets in Irvine. The tags are driven by an Ethernet Tag Manager hub giving the sensors a range of up to 200 feet and communication and control ability to smart phones, tablets and Web browsers.

According to the developers Motion and temperature tags are currently available with additional types of wireless sensor tags like human presence and current sensors in development. The tags are outfitted with a LED, buzzer alarm, and a 3-D magnetic sensor that can track the angle and motion of each of the tags.

**Power** - each tag has a removable coin cell battery (expected lifetime up to several years).

**Measurements** - Each tag automatically logs temperature and each time it is moved, opened or closed.

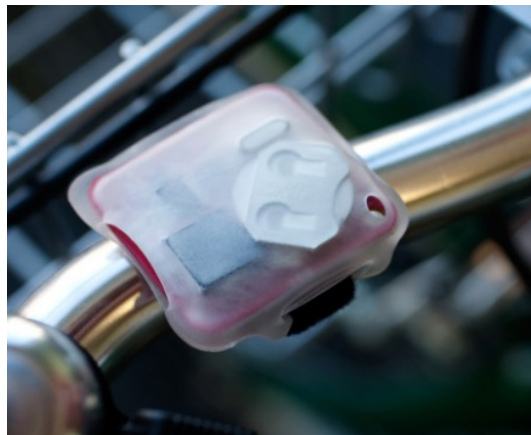
**Use** - You can attach the tag to key chains, put inside your wallet, or strap to TV remote controls. If you turn on the "Lost Item" feature, it will make the tags buzzer beep until located.

**Material** - The tags case is made with an elastic material that can be strapped on objects using the attached Velcro tape.

**Cost** - individual tags \$15.



III. 17. Tag in fridge



III. 18. Tag on bike



III. 19. Tag dimensions

## Home Bluetooth Sensors: Clime

The Clime sensors aim to make a smart home by collecting environmental data through its sensor system (optional hub that can collect data from several Climes and make it available anywhere in the world through a cloud service).

**Monitoring** - temperature, light, humidity or movement.

**Power** - run on replaceable coin batteries (can last about a year or more).

**Transmission range** - pair with a smartphone over Bluetooth.

**Uses** - as basic home security setup that notifies you when doors or windows are opened; simple reminder to water plants (indoor or outdoor) when the soil gets dry.

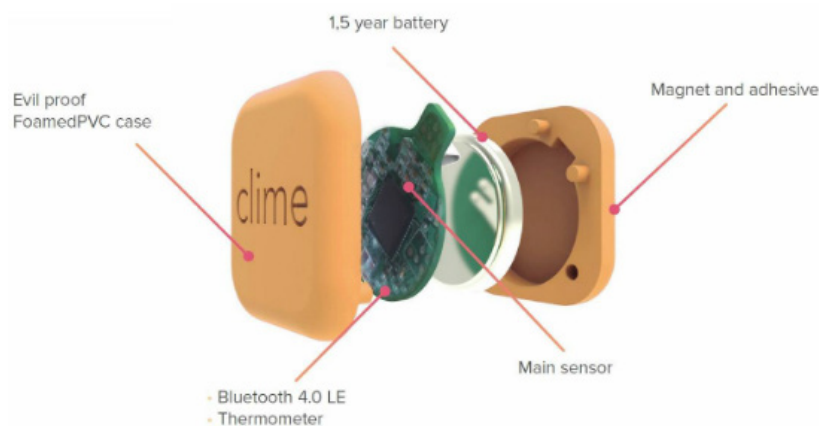
Eventually the sensors will be able to integrate with home automation platforms so their data can trigger other smart gadgets (e.g. by tying Clime's temperature data to a smart thermostat, or the moisture data to an automated sprinkler system).



Ill. 20. Clime plus phone



Ill. 21. Clime in hand



Ill. 22. Clime components

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## Evaluation:

The research gave an exhaustive overview on existing products currently available on the market together with the technology embedded within them.

## Reflection:

The research regarding 'nearable' technology confirmed the possibility of obtaining 'smart tags' of fairly small dimensions. Furthermore:

- when desiring to keep small dimensions, a coin size lithium battery is currently the best choice (the smaller one can last about 1 year while the slightly bigger one up to 3 years);
- the sensors can usually detect information such as: orientation in space, motion in X, Y, Z, temperature, broadcasting power (used to calculate proximity), battery level.

**Activity:****Personas****Objective:**

Create two personas that would represent the particular group that the Team is targeting. The purpose of having the personas is to help the Team and the clients to engage with the specific target group.

**Experiment/data:****Persona - Chris**

Living at home with his child and wife

When Chris was 21 he was in a skiing accident. He lost the control of his skis and drove right into a tree with the head first. Right after the accident, he was transported by helicopter to Grenoble hospital, which is one of the leading hospitals in the world within neurosurgery. He was in coma for 3 weeks and the chances for him waking up again were 50%. From this accident, he got 5 skull fractures and 3 spine fractures, he got a trauma on the right frontal lobe and a large brain hemorrhage. Before the accident, he was working as a skiing instructor, had a high-school education and was able to do normal cooking.

**General informations**

Today Chris is 35 and has had a moderate brain injury for 14 years. He has a part time job as an all around / handyman at a painting store. He has cognitive difficulties such as color blindness, lack of smelling / taste sense, great tiredness late in the day, extreme headaches when having to make too many decisions and memory difficulties.

**General needs /difficulties**

He forgets what happened yesterday in detail and where to find different things around the house.  
E.g. he would sort his things in boxes and shortly after forget what he put into the boxes.

**Main issues regarding cooking**

When cooking, he often gives up before even starting because the task is too complex, he needs to make a lot of decisions and it gives him a headache. He is able to cook, but it is not a pleasant task for him to do.

Making too many decisions during a cooking task make him tired and gives him a headache.

E.g. When he has to decide if the milk has the right temperature in order to mix it with yeast, or deciding whether a dough has the right consistency in order to get the wanted result.

He is not able to read.

**Whishes**

- To be able to perform daily tasks again without getting a headache.



## Persona - Sara



Living at home with her two  
Children and husband

When Sara was 40 she fell while ice-skating and hit her left part of the back head on the ice. From this accident, she got a bleeding in the brain, but it was not discovered until 2 weeks after the accident and she was not officially diagnosed with a brain injury until a year after the accident. She did not get any rehabilitation.

Before the accident, she was working as a Danish and Math teacher at Varde Gymnasium, but had to take a leave right after the accident because of great headache and tiredness. In the end, she had to get an early retirement.

### General informations

Today Sara is 48 and got a moderate brain injury 8 years ago. She is on early retirement and has cognitive difficulties. Her difficulties are bad short and long term memory, dyscalculia, remembering the order of a task, sense of timing and critical sense (need of confirmation). Furthermore she suffers from tinnitus, nausea, light- and sound sensitization. Before the accident she enjoyed to cook for her family.

### General needs/difficulties

She needs help to remember when to do different tasks/activities. Currently her smartphone is ringing when she needs to do something.

E.g. Brush her teeth, take a shower, take her medicine and 5 minutes before she has to go somewhere. It is very stressful for her that her smartphone is ringing every time she has to do something, But currently it is her only solution. If a task is not put into her phone, she will simply not remember.

She needs help to perform daily activities such as cooking, emptying the dishwasher and cleaning.

### Main issues regarding cooking

When cooking, she is only able to perform one part of a task at the time and then she will forget what to do next, get confused and not be able to perform the rest of the task. She loses track of what she is doing.

E.g. she will be cutting onions, suddenly she will not remember what to use the onions for, then she will not remember what to do next and therefore not be able to continue.

She has dyscalculia and is therefore not able to understand amounts of the different ingredients. Likewise, she has no sense of timing.

E.g. she does not know when to start heating up a dish in order to have it done at a specific time. Likewise, she does not have a feeling of how long time it takes.

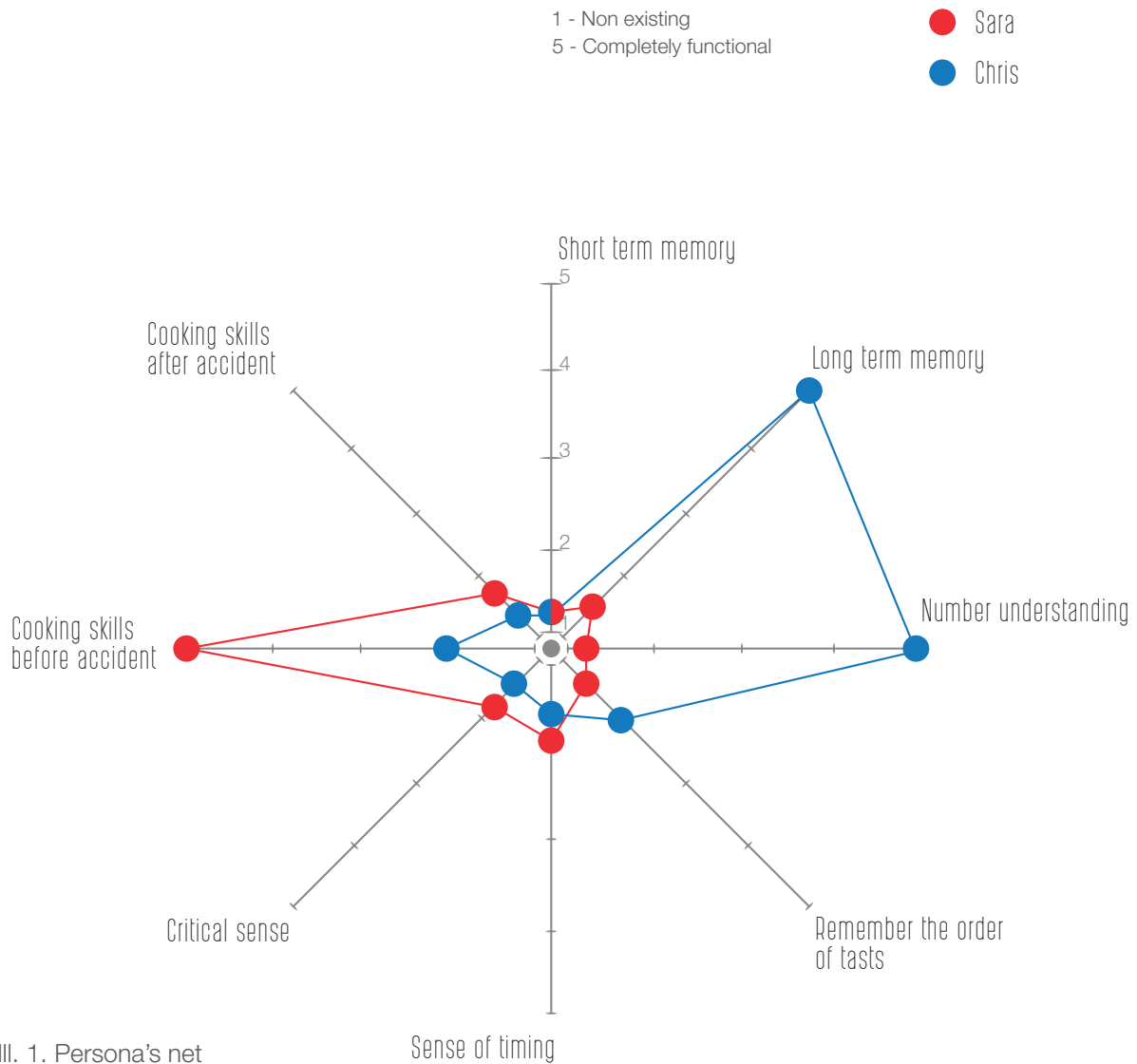
E.g. she can be whipping cream, but suddenly it has turned into butter because she has lost track of time - she is drifting away.

She has a bad visual view meaning that she is only paying attention to what is happening right in front of her eyes. The consequence of this is that she is very clumsy and quickly loses the overview of a cooking task.

### Wishes

- Wishes to be able to perform daily tasks again. Mainly cooking and cleaning.
- She would like to have a simple picture cookbook with simple dishes.
- She would like to have a talking calendar to tell her of appointments.
- A video that step by step tells how to prepare a simple dish.
- A remembering machine that is able to talk.

A persona's net (Ill. 1) has been made to map down the characteristics of both personas.



Ill. 1. Persona's net

Illustrations:

Chris - LinkedIn (2016) *Andreas Binderup Thomsen* [Online image] Available at: <https://www.linkedin.com/in/andreas-binderup-thomsen-5369b214> (Accessed: 30 March 2016)

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Ill. 1. Persona's net (Own illustration)

## Evaluation:

The created personas give a good overview of the possible user of the product. They also represent a good ground for creating the user's description.

## Reflection:

The method of creating the personas helped for discussions and set the ground for creating the user.

**Activity:****Testing MOBI:DO****Objective:**

Research and test MOBI:DO app, in order to understand how does one of the currently existing apps on the market function and see relevant features that the Team could use in the current project.

**Experiment/data:**

Currently on the market there is a range of different apps that are able to guide a person to perform a task through pictures or/and videos. One of these apps is called MOBI:DO and is created to help people with cognitive difficulties to perform different tasks (Appendix 4).

On MOBI:DO's web page, the following benefits of using MOBI:DO are stated:

**The effects of using MOBI:DO**

- The citizen will get more independent in practical tasks, both inside and outside the home.
- Reduction of paperwork for the staff, e.g. reminders and notes.
- Achieve a more uniform use of helping tools, e.g. in relation to moving a citizen from one center to another.
- Get a better structure for the citizen and the staff.
- Have more free time for social activities.
- Reducing vulnerability when the support persons are absent.
- Produce digital evidence of work for staff.
- Give the citizens a say in their own daily lives.

**The results of MOBI:DO can be felt by:**

- Fewer work injuries for the staff.
- Higher quality for the citizen and staff.
- Improved resource distribution.

**What is MOBI:DO able to do:**

The guidance in the app can be customized to the specific persons needs, skills and organizational needs.

Based on activity analyses and ADL-approach (ADL - General Daily Life Application) it is possible to break down the tasks in minor steps and specific details depending on the individual citizen's needs and difficulties. The tasks are then made as a guide that are created on a computer or tablet. A specific task/work discretion is made for each task step by step. This way each citizen gets a tool that is based on his/her specific needs.

The possibilities with MOBI:DO is to:

- Write text explanations;
- Insert situation pictures or pictograms;
- Record voice messages;
- Make indications of time;
- Record video guides;
- Create calendar appointments with guidance.

**Uses**

MOBI:DO is today used for daily structuring, homework, recipes, laundry, packing sports bag, task list and other tasks. The system operates through QR codes, and automatically starts the task when a QR code has been scanned. The system is easy and intuitive to use and can among other be used by people suffering from ADHD, autism, acquired brain injury, mild dementia and learning disabilities. Furthermore MOBI:DO can also be used for transmission of citizen related information internal in an organization and instruction in the use of technical and physical aids for the staff.

Afterwards, a 30-day-try-version of MOBI:DO has been tested by one of the group members to get a feeling of how it works in reality.

**Installing MOBI:DO**

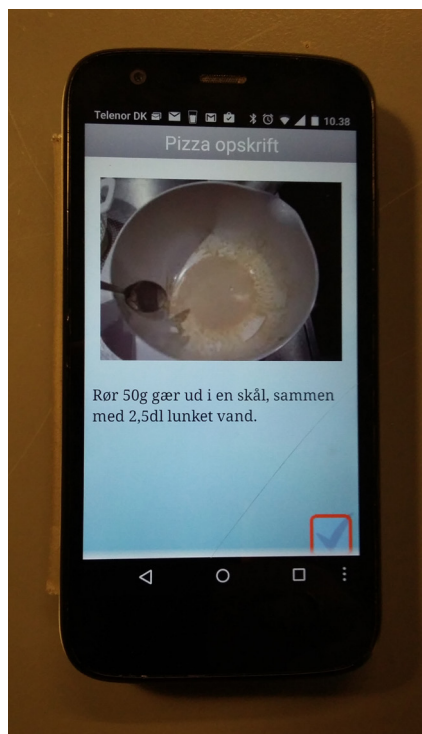
In order to use MOBI:DO, it is needed to install the app on a tablet or smart-phone. Then order an activation-key either through the app or the web-page. In this case, the testing person from the team gave a wrong e-mail address and was shortly after called by MOBI:DO's service team. They asked to get another e-mail. They were very friendly and asked to

call back if more help is needed.

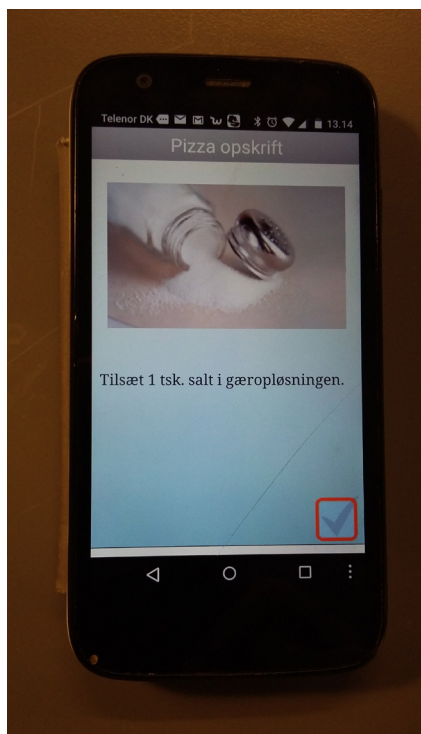
Afterwards, an e-mail is received with some information about MOBI:DO and how to get started. In the e-mail, there are two attached files: one with the activation-code and one with user informations (These can be found in appendix folder 4). The file with the activation-code contains both a letter-code and a QR-code. Then, by opening the app, is possible to write in the letter-code.

For the next step, the QR-code had to be scanned. In case the testing person does not have a QR-scanner already installed on the phone, it is needed to follow a link to the app-store, to download it (as it was in this case). After finished downloading, the MOBI:DO app has to be opened again, write the letter-code again and scan the QR-code from the email. After scanning the QR-code, the app showed a text-box with informations about the activation. From this point, it was not possible to go back to the main menu and the app had to be closed and opened again.

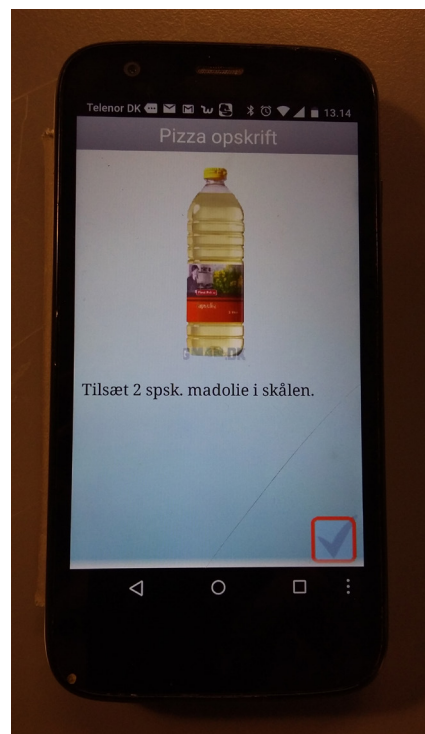
When the app was opened again, a QR-scanner appeared and the testing person thought that it did not work the first time. Therefore the person scanned the activation-QR-code again and large text boxes full of numbers popped up on the screen. This time I could go back to the QR-scanner and realized that is was ready to be used. In the bottom of the activation file there was 4 QR-codes which could be scan to try out some tasks. One for making a pizza, one for cleaning



Ill. 1. First step in Pizza recipe - TeleCall (2013)



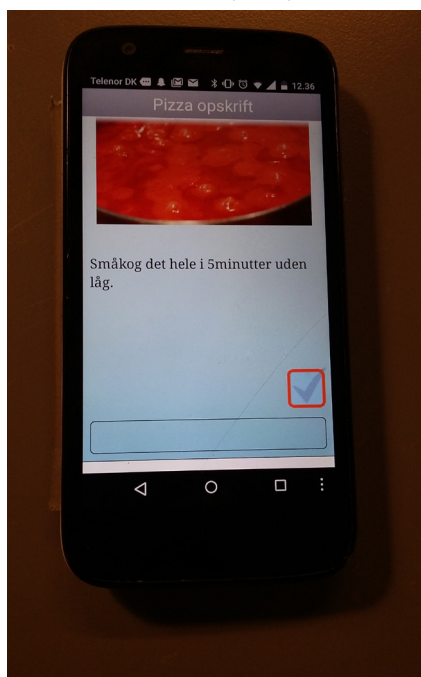
Ill. 2. Second step in Pizza recipe - TeleCall (2013)



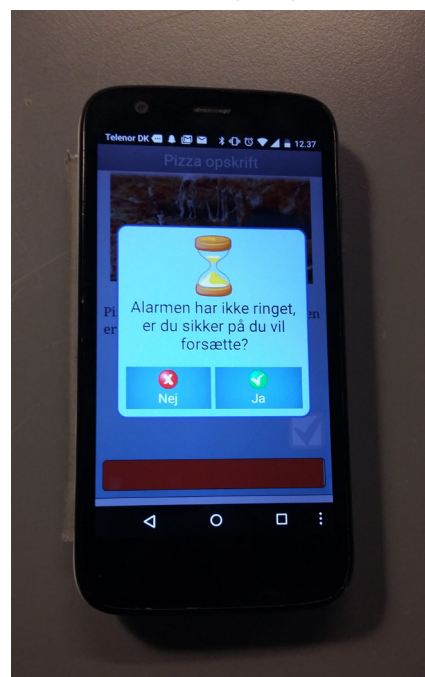
Ill. 3. Third step in Pizza recipe - TeleCall (2013)



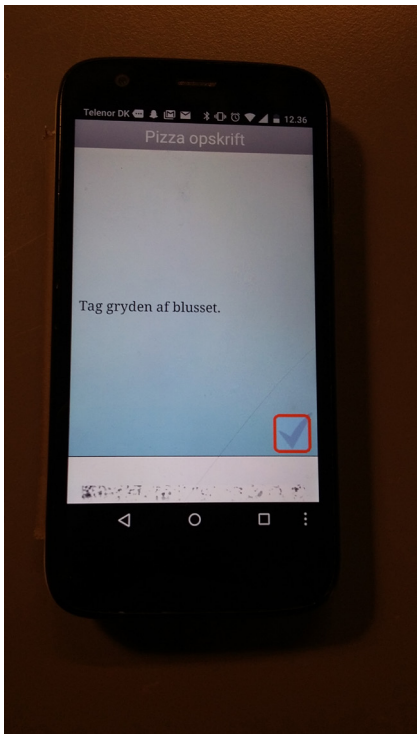
Ill. 4. Fifth step in Pizza recipe - TeleCall (2013)



Ill. 5. tenth step in Pizza recipe - TeleCall (2013)



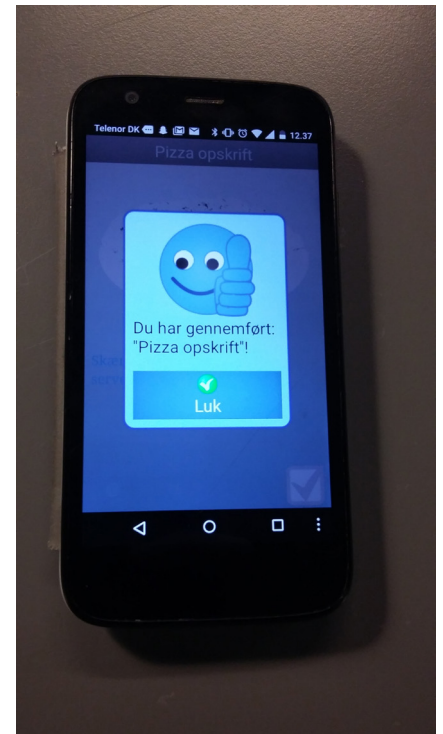
Ill. 6. tenth step in Pizza recipe with alarm box - TeleCall (2013)



Ill. 7. Eleventh step in Pizza recipe - TeleCall (2013)



Ill. 8. Twelfth step in Pizza recipe with alarm box - TeleCall (2013)



Ill. 9. Seventeenth step in Pizza recipe with finish symbol - TeleCall (2013)

clothes, one for a morning routine and one for How to use MOBI:DO.

### Making pizza with MOBI:DO

In order to start the task, the testing person has to scan a QR-code. After scanning the QR-code, the first step of the task appeared. In this part, there is a picture of a bowl seen from the top with yeast and water mixed together (Ill. 1). Underneath, there is a text telling what to do. In the right lower corner of the screen there is a check mark that has to be pressed when being done with the task.

After pressing the check-button the next part of the task pops up.

Every time a step of the task is finished, the testing person has to click on the check-mark in the bottom and the next part of the task will appear.

At step number 10 it gets to a point where the testing person has to make the tomato sauce boil for 5 minutes. On this interface there is a countdown-line in the bottom that the testing person did not see at first because the screen had to be moved a little up. If the testing person tries to go to the next step, the app tells that 5 minutes has not passed yet and asks if you want to continue before the 5 minutes has passed. A small box with two buttons and a timing symbol appears. In order to continue, the testing person has to push the yes button (Ill. 5, 6).

In step number 11, the testing person is asked to take the pot away from the stove but there is no picture to show this step (Ill. 7). When the testing person then tries to go to next step, a pop-up text box asks if the testing person is sure that he did the task. The testing person has to click on yes in order to continue. (Ill. 8).

In the end, when the testing person has finished the whole task, a text box with a smile pops up and tells that the testing person has finished the pizza-task.

### Doing Laundry with MOBI:DO

Another task that MOBI:DO provides help is doing laundry. For this task, each step has small videos that the user can chose to activate. The user therefore has to both click on the check-marks to continue in the task and on a play symbol to play the video showing the task. For all of the videos there is a written text underneath and a man is telling in the video what has to be done. Layout for the guiding is the same as for the pizza recipe.

### General about MOBI:DO

When moving the interface up and down, the testing person can see the previous steps in a very unclear version. The testing person is able to push on the previous tasks, but it is only the picture that appears. It is not possible go back in the task-steps and if the testing person tries to close the App and open again, it will get to the same step. If the testing person then closes the app and goes back to the QR-scanner and scans the QR-code for the task again, it will redirect to the same step again. So in order to go back in the task the testing person has to go through the whole task and start it all over.

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  - III. 3. Third step in Pizza recipe - TeleCall (2013) (Own illustration)
  - III. 4. Fifth step in Pizza recipe - TeleCall (2013) (Own illustration)
  - III. 5. tenth step in Pizza recipe - TeleCall (2013) (Own illustration)
  - III. 6. tenth step in Pizza recipe with alarm box - TeleCall (2013) (Own illustration)
  - III. 7. Eleventh step in Pizza recipe - TeleCall (2013) (Own illustration)
  - III. 8. Twelfth step in Pizza recipe with alarm box - TeleCall (2013) (Own illustration)
  - III. 9. Seventeenth step in Pizza recipe with finish symbol - TeleCall (2013) (Own illustration)
- 

## Evaluation:

When reading about MOBI:DO on the web-page it seem like it is mostly directed to a staff working at a center. A lot of benefits for the staff, for buying MOBI:DO are listed and only a few for the citizen.

It was a little difficult to install the app and get started. It definitely requires a certain knowledge about smart-phones and Apps to install it. The test tasks that came with the 30-day trail was very poorly made and the pictures chosen for the tasks were very random and some of them even had a copyright mark.

- It was very annoying that the testing person was **not able to go back** in the task
- **click on the check mark** every time to get to next step. In the pizza task, a text box popped up a few times to make sure that the testing person did the step already and this pop-up box made the testing person feel that she was doing something wrong.

In order to continue when these boxes popped up, the testing person had to push another button. In the task of doing laundry the testing person both had to push the check mark every time and a play symbol to make the video in each step start. It was annoying to have to push two buttons, but at least the testing person could make it replay as many times as possible.

The intention with this app is for the staff or caretaker to do all the guides. This way it is made sure that the user gets the exact guidance needed. It is most probably a very time consuming process to make all the guides, but once they are made the citizen is able to use them over and over. Trying the trial tasks was not an impressive experience. From interviews with people suffering from cognitive difficulties it has been understood that it is very important to be able to go back and see the previous step in a task. Otherwise the user might not understand why he/she has to do the current step. If the user is just interrupted shortly, he/she needs to go back and see what has happened previous in the task. Furthermore it has been understood through interviews with the target-group that if the tool is annoying or poorly executed from the start, they will very fast give up using it. In this case, the trial-tasks gave a really bad view of what the tool can do and the fact that it was not allowed to go back in a task was very disturbing.

Since MOBI:DO is working by scanning a QR-code, the user must have QR-codes hanging around in the house. Even though QR-codes are relatively neutral, they are not pretty to have hanging everywhere. Furthermore, in case there are too many QR-codes hanging around the house, it can be difficult for the user to know which one is for what, if it is not stated very clearly.

## Reflection:

By the information given in the web-page, MOBI:DO seems like a good solution to buy for a rehabilitation center. All the benefits for the staff are clearly written and the only reviews made are from Occupational Therapists.

From trying MOBI:DO, the impression created was very different as it was a little difficult to install and the trial-tasks were very poorly made. Therefore, the Team considers that the user of such app would very fast give up in using it.

**Activity:****Meeting with Occupational Therapist****Objective:**

To have a meeting with an occupational therapist and have his opinion about the system for patients when they return to their homes. Also, to understand what are the problems that the patients have once they return home.

**Experiment/data:**

The Team member had a meeting at Create Building with an occupational therapist, whose name will be kept anonymous by his desire. He meets the patients that completed the rehabilitation treatment, they live at home and are back to their jobs. He helps them with activities related to work, tasks that they would like to be able to do but, have a hard time or even can not perform.

**Patients**

He has a patient that has his left hand paralyzed and can not use it anymore. The patient can move it a little from the shoulder, but the rest of the muscles are not functioning. When he is moving the hand or just letting it hang without support, it causes headache. He is a software engineer and has problems with making the symbols, since they require the use of both hands. When sitting at the computer, he uses a hand support, for holding it, because otherwise, he would have headache and would not be able to work. His left leg is also a little affected, but he has a stick to help him walking. He has balance problems.

He also has cognitive problems with navigating in Windows, in the way that he loses the overview of the tasks. For solving this issue, the occupational therapist discussed with the patient's boss and advised to divide the task in small tasks and just give him one at a time, and once he is ready with it, he can move on to the next one. So far, this solution seems to work fine.

In relation with personal care, the occupational therapist does not know if this patient has problems also with tasks such as brushing teeth, showering, etc. He assumes that the patient might have problems with dressing or taking shower, because of the balance problems he might need to sit down. It might also lead to confusion on what products he has to use for a specific task. E.g. take the wrong shampoo bottle when showering, or take the hair brush instead of the toothbrush. The patient was also a teacher at the University before the accident and now he cannot be anymore because some of the things he was teaching he can not even understand now. For this reason, he also suffered of depression.

The occupational therapist had his internship at a place with people suffering of hemispatial neglect. He had a patient that needed help with shaving. The patient was shaving only one side of the face and considered that he was done with the task, because he ignored the other side. The patient had to be shaved by somebody else, because he could not feel anything from the left side, and therefore he could not shave completely.

The occupational therapist did not work with patients that need help in their homes but he has seen some of them during his work experience. He has noticed that those patients usually had the problem of losing the overview of the task. He remembers a lady with brain injury that loved to make breads but while she was performing the activity, she forgot to put all the ingredients. She also forgot to close the cupboards and when she was done with cooking, all of them were opened. Mads had to always say "Please close the cupboard", after she would take something out of it. She got very frustrated that she could not realize that she has to close them by herself.

The Rehabilitation Centers try to make the patients be as independent as possible, before going back home. The first three months after the accident is the period in which the person can recover the fastest. After that, there are only small steps in improving or not to get worse.

One of the symptoms the patients have is that they get angry easily.

The patient's motivation to get better is very different from person to person. Some say that they do not want to improve, they just want to be helped and for somebody else to do the tasks for them.

Some can not even realize that they have to get better, they just think that the situation that they are in now is fine. This is also a consequence of the injury. The people that come to the patients and help them in personal care tasks (wash, cleaning, etc.) are called Social og Sundhedsassistent. Those expenses are covered by the Municipality. In case the patient wants more help, then the expenses will have to be covered by the patient. The hierarchy is: doctors - nurses - social og sundhedsassistent.

Other diseases that can cause cognitive problems are dementia, Parkinson, schizophrenia ( the patient took the small brush for washing dishes instead of the palette for turning eggs), stress related illnesses (it does not have that great impact), etc.

The patients are more affected emotionally when they can not perform a task that they are not doing that often as to when they perform a task more often.

They are more affected when they can not perform a task that they loved to do or they were good at before the accident, as when they can not perform a task like cooking or cleaning.

The occupational therapist has not seen any patients living by themselves, they always live with relatives. The patients can also live at nursing homes.

The relatives of the patients are being taught on how can they help the patient in the best way possible for improving. It could also mean that they have to be taught not to help the patient, in order to start doing individually. This represents a big part of the rehabilitation process.

## **Municipality**

In Aalborg, there are three units covering the rehabilitation at home: Træningsenheden Nord, East and West.

When the patient is sent home, it is either the patient, the relatives or the responsible person from the Rehabilitation Center that contacts the Municipality to inform them about the patient that is back in the community. The Municipality sends a therapist that makes a screening about how is the patient doing at home and afterwards, depending on the needs of the patient, he is assigned to one of the areas: training, compensation or nursing home. Then, a specialist from the specific area starts the training program of the patient.

The patient can say that he does not want to have the training if he does not want to get better. Or he can ask to have the training therapist changed, in case the relationship between them does not work.

When the patient is sent home and the situation is getting worse, the patient can talk with the doctor and the doctor talks with the occupational therapists about a new training. The patient can get a treatment of 9 to 12 weeks by the local training center (not exactly sure). When the patients are sent home, the training is more systematic.

The training can take place either at home or at the center, depending on the patient's condition. If the patient needs help from a physiotherapist, the training takes place at the center. If the patient needs help from an occupational therapist, the training takes place at the patient's home, where the occupational therapist tries to do compensation on different tasks.

All the rehabilitation training expenses are covered by the Municipality. The Municipality gets the money from the SKAT taxes.

The therapists receive support, by having meetings with psychologists or having meetings all together where they discuss about what their patients. At the beginning it affects mentally but after a while you get used with it. But it will always be one case that you have not seen before and that would still have an impact on you.

## **Home visits**

The occupational therapist worked in the past for Aalborg Municipality, for the Træningsenheden Nord in Nørresundby. Here, there are three groups of areas: one focusing on people with heart injuries, diabetes, etc., one focusing on joints injury and one focusing on the brain injury.

When the brain injured patient is receiving the first home visit from the therapist to check his condition, his case is sent to the Center, to the area focusing on brain injury. Here, a time of 14 days is given for somebody to take the case and start working on it. If the time of 14 days passes and nobody took the patient's case yet, then, the Center tries to find a specialist within the other two areas.

The occupational therapist worked in the joints injury department, but because they had too many patients within the brain injury department and they needed therapists in that sector, he got to work also in that field. In his department, there were three occupational therapists and four physiotherapists. In the department for brain injury, there were six were occupational therapists and three were physiotherapists. An occupational therapist usually had around 5-10 patients (not sure about this information).

He was going to visit the patients at home one or two times per week, for around half an hour/one hour every time. This varied according to the patient's abilities to perform tasks. He had patients that he visited two times per week at the beginning of the treatment, and then just once per week.

Activities that he was helping the patients with: cooking, doing laundry, vacuuming (problem with cleaning all the floor, with placing the chairs in the same spot as before vacuuming, forget to plug it in), dressing (When they put the t-shirt on, they forget how to take their head out), daily activities. When a method for solving the task was not showing improvements, they used to change the method.

**Mobi-do** (refer to Worksheet no. 35 for a better understanding of the app)

While he was in his studies, the Mobi-do app was launched and he had the chance to try it out on a demented person of around 55 years old. The problem of the person was that when he made coffee, he sometimes forgot to put the filter. The app was helpful in the way that it reminded him that he also has to place the filter.

The problem with the app is more about the knowledge of technology that the user has to have. With older users, it might be challenging to understand how it works, since they are not used with items like ipads or macbooks. Also, the fact that the user has to tick the box once a step is done and for the next one to appear on the screen, requires for the user to have a free hand. This could be a problem with people that have just one functional hand. It also might make the task harder, with more things to do (add one more step during the task).

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### **Evaluation:**

Aalborg Municipality is divided into three units related to rehabilitation at home.

### **Reflection:**

The interview helped the Team to have a better overview over the Municipality in Aalborg, the system behind rehabilitation process and general activities of the occupational therapists. The information got is valuable and for getting to know in more detail about activities within home training, the Team has to contact an occupational therapist within this specific field.

**Activity:****Second club meeting with people with brain injuries****Objective:**

The objective at this meeting was to get some feedback on some of our ideas and concepts.

**Experiment/data:**

A conversation was initiated with Magrethe where she was asked to tell about her difficulties related to cooking. Magrethe is 55 years old and has suffered from a stress-related brain injury for 4 years. She used to work with mentally disabled people and therefore have knowledge about helping people with different difficulties.

She has never really liked cooking and do not have a lot of routines with cooking from before the injury. After the injury accrued she experienced getting a very bad headache every time trying to cook and has therefore assigned all cooking tasks to her husband.

She difficulties are related to a bad short-term memory and lack of system-understanding.

She is able to cook, but it takes her a very long time to locate all tools needed for the cooking task and therefore she uses a lot of energy and end up with a headache. Every time she tries to cook she end up with a bad experience.

She tells that if she need to perform a “demanding” task which cooking is, it is best to do it in the morning. In the morning she has the most energy and throughout the day she gets more and more tired. From around 13:00 her energy-level start falling and by 15-16 she has no energy left. This mean that cooking that demand concentration, surplus, presence and overview ends up being too difficult to overcome.

Some days are better than other days she tells. On a bad day the task of emptying the dish-washer is very demanding. For example she can uses hours to find out where to put the tools. Also afterwards she will not be able to remember where she has put all the things.

This is likewise the case in a cooking-task. she did not like cooking before the injury and know she does not like it a all because she can never find the tools needed.

If she has to make food for her self it is usually just to reheat some food or to fry some cod roe on a pan.

After she told about her current situation the overall concept was explained to her in order to get her feedback. The concept is a guidance that together with a system of smart-objects/-surroundings are able to help a person with cognitive difficulties to perform a cooking-task. By having the communication with smart-objects/-surroundings the system will be able to track what the user is doing and help the user to find the things needed for the cooking task.

**First sub-concept:**

This concept is where the app in each step of a cooking task show how to do the step by video or images. Whenever a tool or ingredient is needed the app will send a signal to a sensor placed on the drawer or cabinet that contain the tool or ingredient needed. The sensor will light up or make a sound and the user will know where to get it the from. (See Ill. 1 for the concept)

**Her feedback:**

That is a great idea. That would help me a lot. It is very difficult for me to remember where to find everything not only in my kitchen, but also in my house. I keep making new systems for arranging my things hat I do not remember the next day. For example I really like to make creative activities that brings me joy and all the small things for that I place in some boxes, but never remember which box contain what and have to look in all the boxes anyway. As soon as I put on the lit I forget what is inside. Then I try to put labels on, but they take up a lot of space and then I end up with boxes inside boxes and can not find anything. It take a lot of time finding the things I need and in cooking it sometimes has to be fast. Faster than I am able to handle.

**Second sub-concept:**

In this sub-concept the app will in each step of a cooking task show how to do the step by video or images. Whenever a tool is needed the app will send a signal to a sensor placed on the tool needed. The sensor might light up or make a sound to make the user know where the tool is. (See Ill. 1 for the concept)

**Her feedback:**

I think it is very different from person to person what is needed regarding sensor-placement. Some people might need sensors on the drawers and some need them on their tools.

In my case I have my utensils in a pot on the kitchen table and I can see those and do not need help to find them, but if a person has things placed in drawers and cabinets he or she might need that sensor placed on those.

**Third sub-concept**

In this sub-concept the app will in each step of a cooking task also show how to do the step by video or images. For this sub-concept the user will from the beginning receive a start-kit with some sensor-stickers that can be placed wherever needed. Whenever a tool with a sensor-sticker is needed the app will send a signal to the sticker-sensor and locate the tool. (See Ill. 1 for the concept)

**Her feedback:**

I think by customizing it this way you will help more different people.

**Forth sub-category**

In this sub-concept the app will in each step of a cooking task also show how to do the step by video or images. For this sub-concept the user will have a kit/box with a lot of smart-utensils including the sensors needed. In this concept the utensils could include many other types of sensors that also track movement and make sure that the tool is used in the right way.

**Her feedback:**

Well in my case I do not need to be helped to use the utensils the right way, I just need help to find them. From my previous work with mentally disabled people I know that there is a very big difference between being born with a brain injury compared to get one later in your life. People that are born with a brain injury have never had a real

I have experienced many different types of difficulties and have also tried to teach some people some very simple dishes so that they are not dependent on someone coming by with food every day. The alternative to cooking your self it to get the microwave-food which are very unappetizing.

**General feedback about the concept:**

I think the most important part is to get an overview of the task in order to not be afraid of doing it. From my experiences I know that some people (depending on the brain injury) will be afraid of the responsibility of having for example both the oven and stove turned on at the same time. It is not very pleasant to deal with something that you can not overcome.

Another thing I noticed is that some of the people was afraid of taking dishes out of the oven because it was hot. They would be afraid of burning them self if they forgot to put on the cooking-glove before taking the dish out. I have practiced the same dish over and over again with some of the people I worked with, but they never learned it. When I started working within this field many years ago there was plenty of help for the people but today all the money go to something else and the people are feed on pre-cooked meals to be heated in the microwave.

I think that once in awhile everyone deserves the joy of getting something home cooked, something that you made your self.

If you are born with a brain injury and suffer from cognitive difficulties you might still be able to regain and remember how you used to do things if you concentrate enough. like using you common sense, but people that are born with a brain injury does not have the same common sense as you and me.

In my case, before I panic in a task I am still able to think in alternatives and consider other possibilities regarding what to do.

Some people would get very angry, frustrated or maybe even run away if something went wrong.

I have not problems telling people that I might look normal on the outside, but I can not keep up anymore with what they are telling me. Then people usually react in a very awkward and comforting way and ask if I want to sit down. The only problem is that, my legs are fine it is my head that can not keep up anymore. People simply do not understand it.

What is difficult for me is also to make choices. For example when having to decide what to wear I need to make a decision and the takes a lot of energy for me. It is all the subprocesses throughout the day. I know how to do them I just can not overcome doing them. Every time I try to do more than I can handle I get a very bad headache that easily can ruin the rest of the day.

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**Evaluation:**

From this meeting the team got some really useful feedback regarding the current concepts. The woman spoken to saw some potential in the ideas and shared her knowledge regarding people born wit a brain injury in reflection to a person with a traumatic brain injury.

**Reflection:**

At this meeting only one woman was spoken to, but from all the people present at the meeting (12 people) 3 had issues regarding cooking. This information might be useful further on regarding estimating the number of end users.

**Activity:****Temperature measuring****Objective:**

To find products and technologies currently on the market that give the option of measuring temperature from a tablet/smart-phone by wire and wireless.

**Experiment/data:****Elma iCelsius**

Elma iCelsius is a product series of temperature sensor probes that can be connected either directly to a smart-phone or tablet or provide a wireless connection to a smart-phone or tablet. The sensor probes are either connected by wire to a smart-phone or tablet or to a transmitter-device that send the information by Wi-Fi to a smart-phone or tablet. Transmitter and sensor probes are shown on Ill. 1 and direct cable connection to a tablet is shown in Ill. 2.

There are many different sensor probes that can be used for different areas of temperature measuring. This is both including grilling, cooking, body-temperature, temperature and humidity measuring. The sensor probe shown in Ill. 3 is called Pro and is used for cooking.



Ill. 1 Wireless iCelsius transmitter (Elma iCelsius – Wireless, no date)



Ill. 2 iCelsius PRO probe connected by wire to ipad (iCelsius Pro Sort, No date)



Ill. 3 iCelsius PRO Probe sensor (iCelsius Pro Sort, No date)

**The technical specifications for iCelsius PRO are as follows:**

- It has a cable length of 100 cm;
  - It has a probe length of 100 mm and diameter of 4 mm;
  - It measures from -30°C to +150°C;
  - It has an accuracy of +/- 0,2°C (From -30 to +110);
  - Its response-time to reach 90% of value in water when stirring is <10 sec.
  - Both probe and tip is waterproof.
  - Price for the iCelsius PRO: DKK 385,00
- (Aginova Inc., 2013) (Elma iCelsius - Wireless, No date)



Ill. 4 Go Wireless Temp in use (Go Wireless Temp, 2016)



Ill. 5 Go Wireless Temp probe and charger (Go Wireless Temp, 2016)

## Go Wireless Temp

Go Wireless Temp is a temperature sensor probe that can be used for general temperature measurement. The Go Wireless Temp comes with a wireless probe, a charger for the probe, a quick-start guide and a graphical Analysis App (Ill. 4 and Ill. 5).

It can be used for many different purposes, but is mostly created for Science projects, Monitoring environmental conditions, Monitoring the temperature in your fish tank or greenhouse, Measuring the efficiency of a Thermos, Measuring the temperature of the air.

It has a small lithium rechargeable battery in the handle. The battery has one year warranty, but the expected lifetime is much longer.

It can be remotely monitored with a mobile device by Bluetooth and is compatible with OS X (apple) and Android.

### The technical specifications for Go Wireless Temp are as follows:

- It has a maximum wireless range of 30 m;
- It has a probe length of 100 mm and diameter of 4 mm;
- It measures from -40°C to +125°C (Maximum +150°C);
- Its handle is able to withstand from -10°C to +45°C;
- It has an accuracy of +/- 0,5°C;
- Its response-time to reach 90% of value in water when stirring is 20 sec;
- Both probe and handle are waterproof. (Vernier, 2015)

### Reference list:

Aginova Inc. (2013) *iCelsius Wireless*, [Online PDF] Available at: [http://www.elma.dk/AkopaCMS\\_Elma/\\_res/Modules/ElmaFSSync/Mirror/brochure/5706445150144\\_UK.pdf](http://www.elma.dk/AkopaCMS_Elma/_res/Modules/ElmaFSSync/Mirror/brochure/5706445150144_UK.pdf) (Accessed: 11 April 2016).

Elma iCelsius - Wireless (No date) Available at: [http://www.elma.dk/\\_dk/Produkter/Lists;220010/Temperatur-og-fugt/Termometer-h%C3%A5ndholdt/p/5706445150144?shop.product.id=5706445150144&TabChoice=Description](http://www.elma.dk/_dk/Produkter/Lists;220010/Temperatur-og-fugt/Termometer-h%C3%A5ndholdt/p/5706445150144?shop.product.id=5706445150144&TabChoice=Description) (Accessed: 11 April 2016).

Vernier (2015) *Go Wireless Temp*, [Online PDF] Available at: <http://www.vernier.com/files/manuals/gw-temp.pdf> (Accessed: 11 April 2016).

### Illustration list:

Ill. 1 Elma iCelsius – Wireless (no date) [Online image] Available at: [http://www.elma.dk/\\_dk/Produkter/Lists;220010/Temperatur-og-fugt/Termometer-h%C3%A5ndholdt/p/5706445150144?shop.product.id=5706445150144&TabChoice=Description](http://www.elma.dk/_dk/Produkter/Lists;220010/Temperatur-og-fugt/Termometer-h%C3%A5ndholdt/p/5706445150144?shop.product.id=5706445150144&TabChoice=Description) (Accessed: 11 April 2016).

Ill. 2 iCelsius Pro Sort (No date) [Online image] Available at: [http://www.elfadistrelec.dk/da/temperaturfoler-icelsius-pro-sort-aginova-iprobe-1000-0002/p/11056484?channel=b2c&utm\\_source=gshopDKda&utm\\_medium=feed&price\\_gs=DKK%20385&gclid=CjwKEAjwIq24BRDMjdK7g8mD6BASJABBI8n3srOu-fyvgB5ynjVxvcuT-GRyzU3qDrlbrof-6Nyw\\_6BoCVYDw\\_wcB](http://www.elfadistrelec.dk/da/temperaturfoler-icelsius-pro-sort-aginova-iprobe-1000-0002/p/11056484?channel=b2c&utm_source=gshopDKda&utm_medium=feed&price_gs=DKK%20385&gclid=CjwKEAjwIq24BRDMjdK7g8mD6BASJABBI8n3srOu-fyvgB5ynjVxvcuT-GRyzU3qDrlbrof-6Nyw_6BoCVYDw_wcB) (Accessed: 11 April 2016).

Ill. 3 iCelsius Pro Sort (No date) [Online image] Available at: [http://www.elma.dk/\\_dk/Produkter/Lists;220010/Temperatur-og-fugt/Termometer-h%C3%A5ndholdt/p/5706445150151?shop.product.id=5706445150151](http://www.elma.dk/_dk/Produkter/Lists;220010/Temperatur-og-fugt/Termometer-h%C3%A5ndholdt/p/5706445150151?shop.product.id=5706445150151) (Accessed: 11 April 2016).

Ill. 4 Go Wireless Temp (2016) [Online image] Available at: [http://www.vernier.com/images/magnify/action.gw-temp.ga-ip-ad.\\_temperature-of-ice.001.jpg](http://www.vernier.com/images/magnify/action.gw-temp.ga-ip-ad._temperature-of-ice.001.jpg) (Accessed: 11 April 2016).

Ill. 5 Go Wireless Temp (2016) [Online image] Available at: [http://www.vernier.com/images/magnify/product.gw-temp.\\_top.001.jpg](http://www.vernier.com/images/magnify/product.gw-temp._top.001.jpg) (Accessed: 11 April 2016).

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## Evaluation:

Two different solutions for measuring temperature with smart-phones and tablets have been found. There are pros and cons regarding both solutions in relation to the practicalities. The pros of both solutions is that they are able to measure the temperature needed and are waterproof on the whole probe. The technology used for both solutions can become compatible with the Team's System of Objects.

The first solution, iCelsius, offers a wireless solution through a transmitter. There still has to be a wire between the transmitter device and probe. The probe i iCelsius can also be connected directly by cable to a smart-phone or tablet. Meaning if choosing a solution like this one there will be a wire across the kitchen table.

For the second solution, the probe is wireless. The cons for a solution like this is that the handle can not withstand a too high temperature and will therefore not be able to stay in the pot for a longer time. Another con is that it has to be charged in between uses which means the user has to remember it and still need a cable placed somewhere for the charging.

## Reflection:

Those are two examples of products on the market that are able to do what is wanted for the System of Objects. They are currently compatible with a specific app and therefore the programming needs to be changed to work in the System of Objects. In relation to choosing a solution, the cons has to be compared to each other with the user- and task-requirements as guideline.

**Activity:****Apps for cooking****Objective:**

Explore existing Cooking apps for people that do not know how to cook (the format of Cookbook).

**Experiment/data:****Look & Cook**

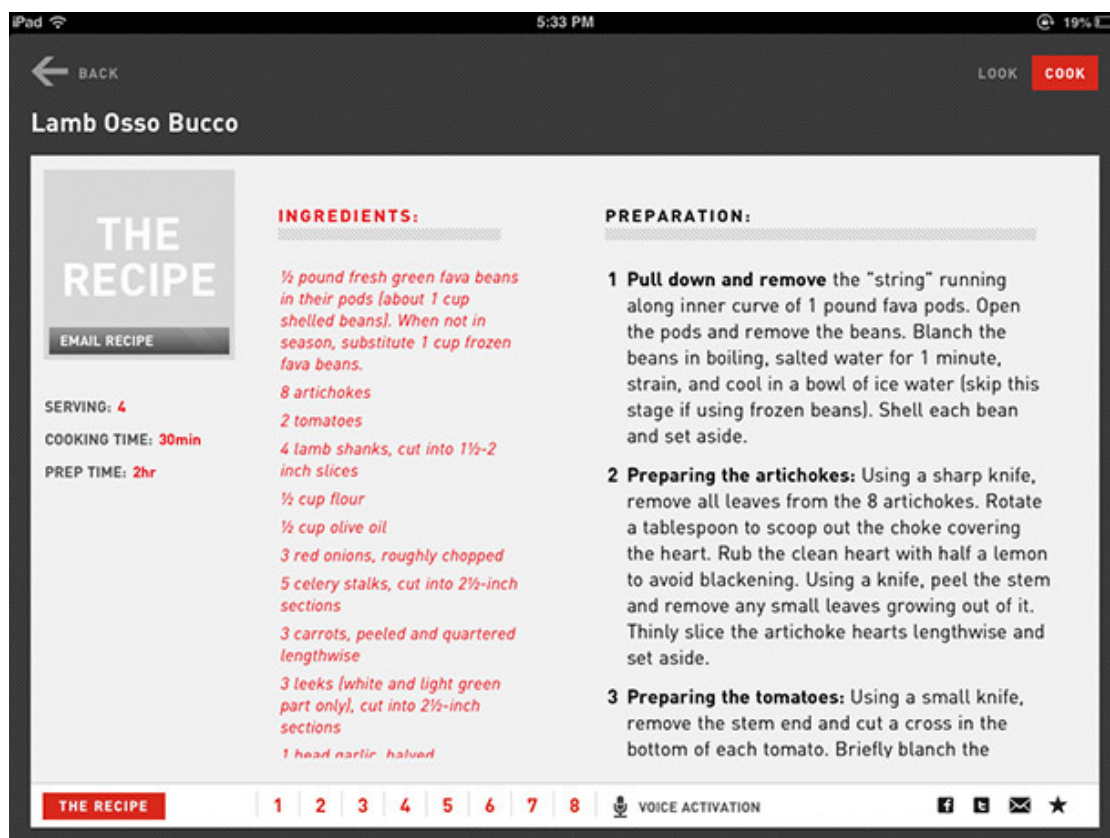
Ill.1. Look &amp; Cook

Developed by Kinetic Art (built for the iPad), it contains:

- 51 recipes
- How-to videos
- Step-by-step instructions along with photos
- It gives facts and information about the dish result
- Divided into seven separate sections (each recipe is divided into two further sections)
- recipe categories (Everyday, Breakfast, With The Guys, Barbecue, Picnic, Romantic, Dinner Party and Vegan Pleasures)
- The Cook section can be controlled by voice commands, making it easy to view and navigate while cooking.

**Observations**

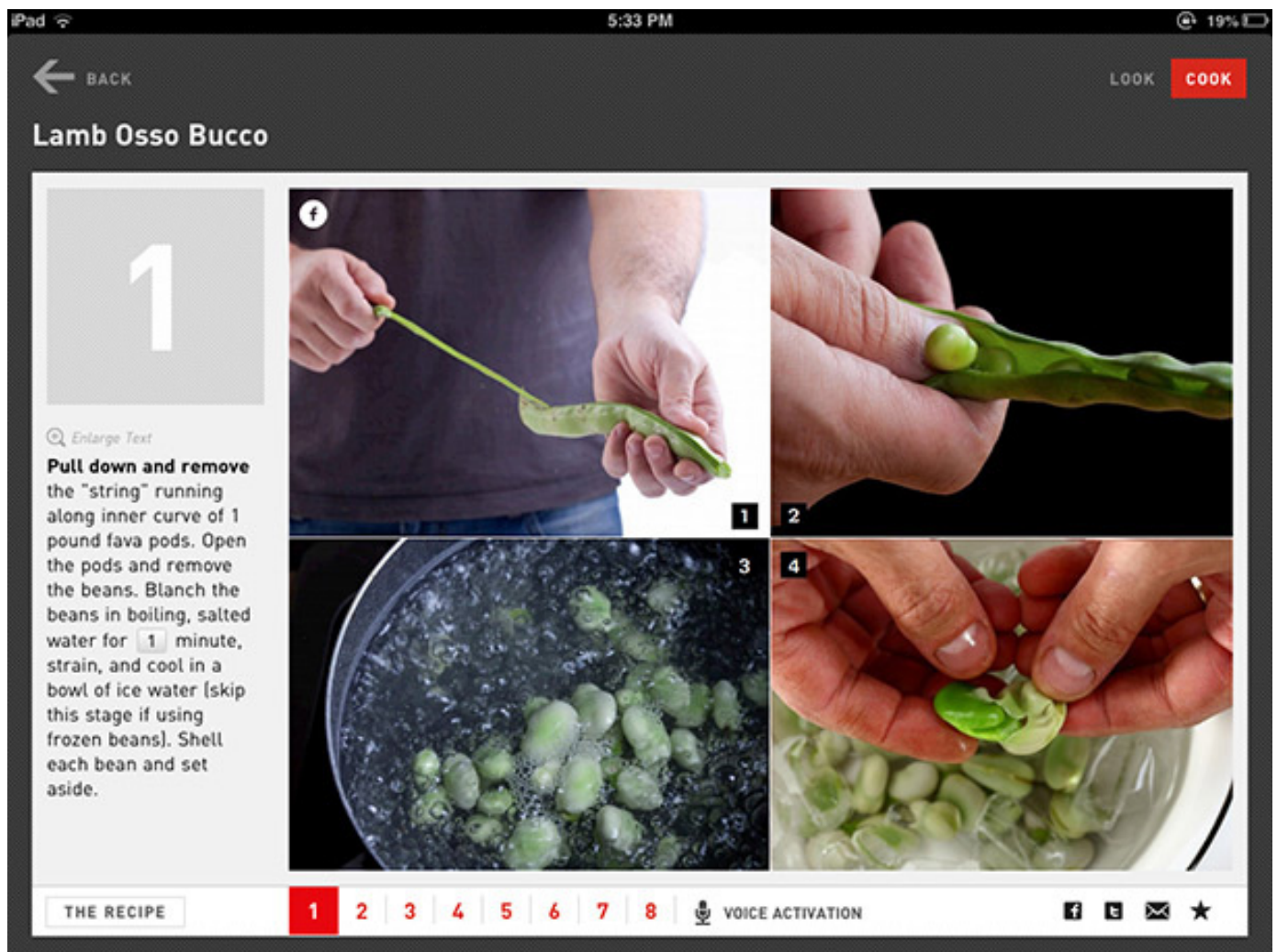
- very visual (always use images and [videos?](#) to explain the steps)
- voice activated recipe navigation solves usability problems (e.g. dirty hands)



Ill.2. Look &amp; Cook recipe

A recipe card lists the ingredients and preparation steps

Each recipe begins with a photo of the ingredients and a chart depicting servings, active cooking time and preparation time. The next screen is a recipe card with an Ingredients list and steps broken down into easy to manage tasks. In Cook mode you can swipe through each step one-by-one, demonstrated in photos and videos depicting techniques like trimming an artichoke or poaching an egg.

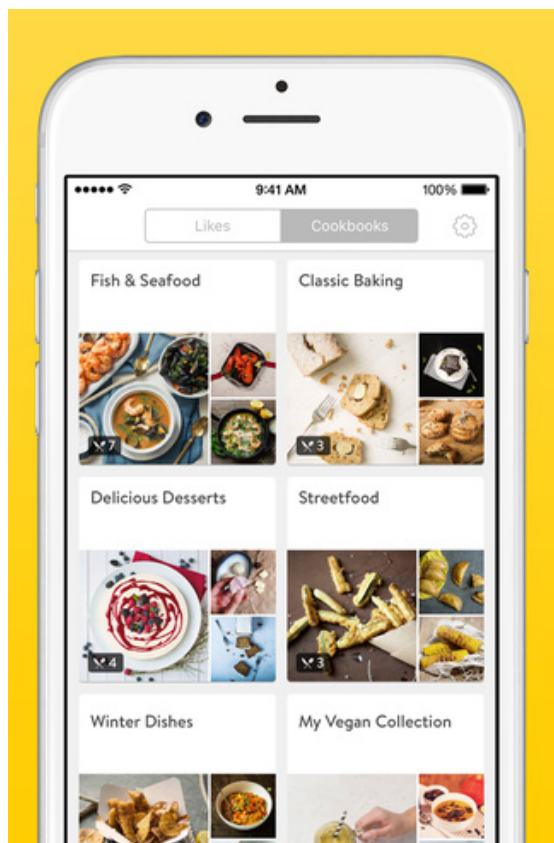


### III.3. Look & Cook step

You can work through the recipe one step at a time with photos and video demonstrations.

Hands-free activation by tapping Voice Activation (the voice commands) at the bottom of the screen and the app instructs to say "next" and "back" to navigate through the recipe (this feature solves an important problem users struggle with: using flour-covered hands or fishy fingers to tap the iPad screen). Is said to work perfectly.

## Kitchen Stories - free video and photo cookbook

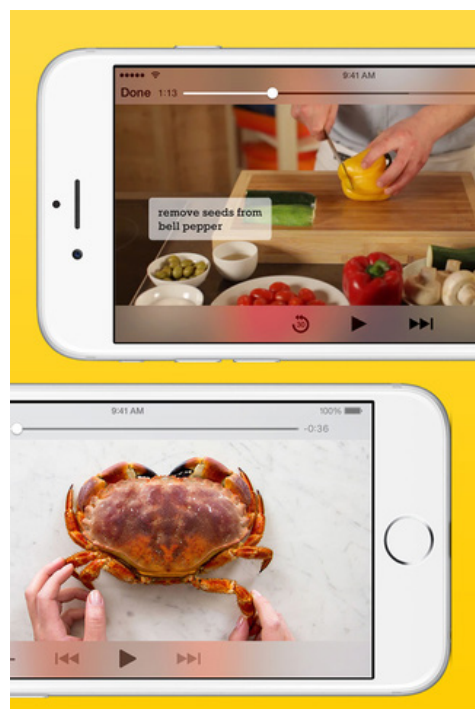


- video recipes with step-by-step cooking instructions
- filter allows you to customize the content in your feed, based on your interests and needs (Vegan, gluten-free, sugar-free).

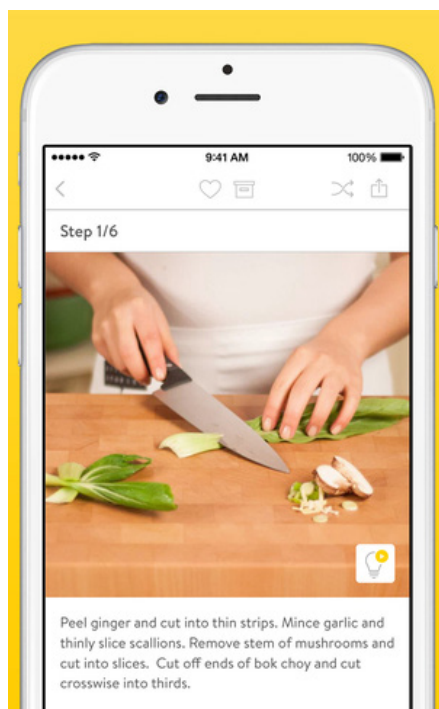
After logging in, a visual list of recipe ideas is showed. Everything has a love heart in the top left corner for 'favourite' which goes in My Kitchen Stories (profile page).

Recipes that have yellow circles with white arrows in them means you can watch the how-to video on how to make it. It is also possible to select 'How To' along the bottom to see more videos about general kitchen practice, such as chopping cauliflower and beating egg whites, etc. Tapping 'More', gives features such as essential store cupboard ingredients and cooking utensils.

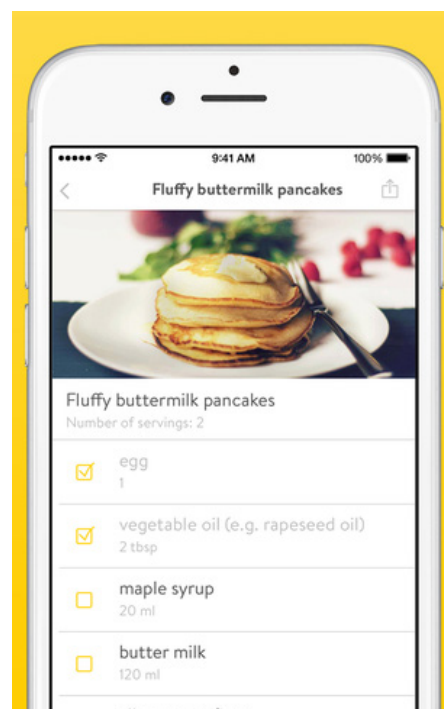
III.4. Kitchen stories



III.5. Kitchen stories-video step

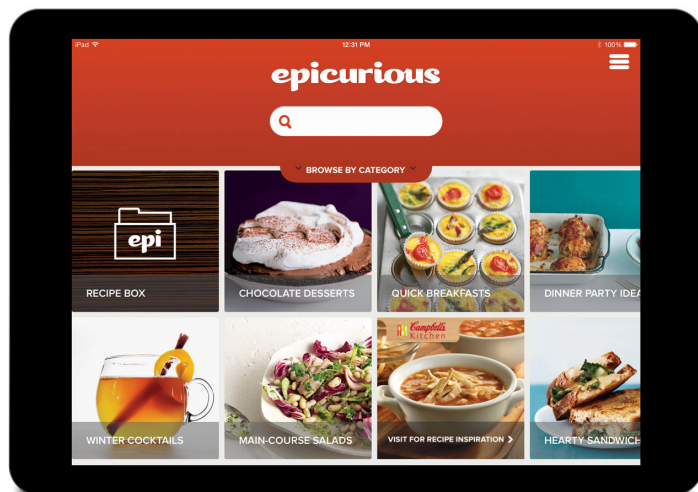


III.6. Kitchen stories-explanation



III.7. Kitchen stories-ingredients

## Epicurious Recipes



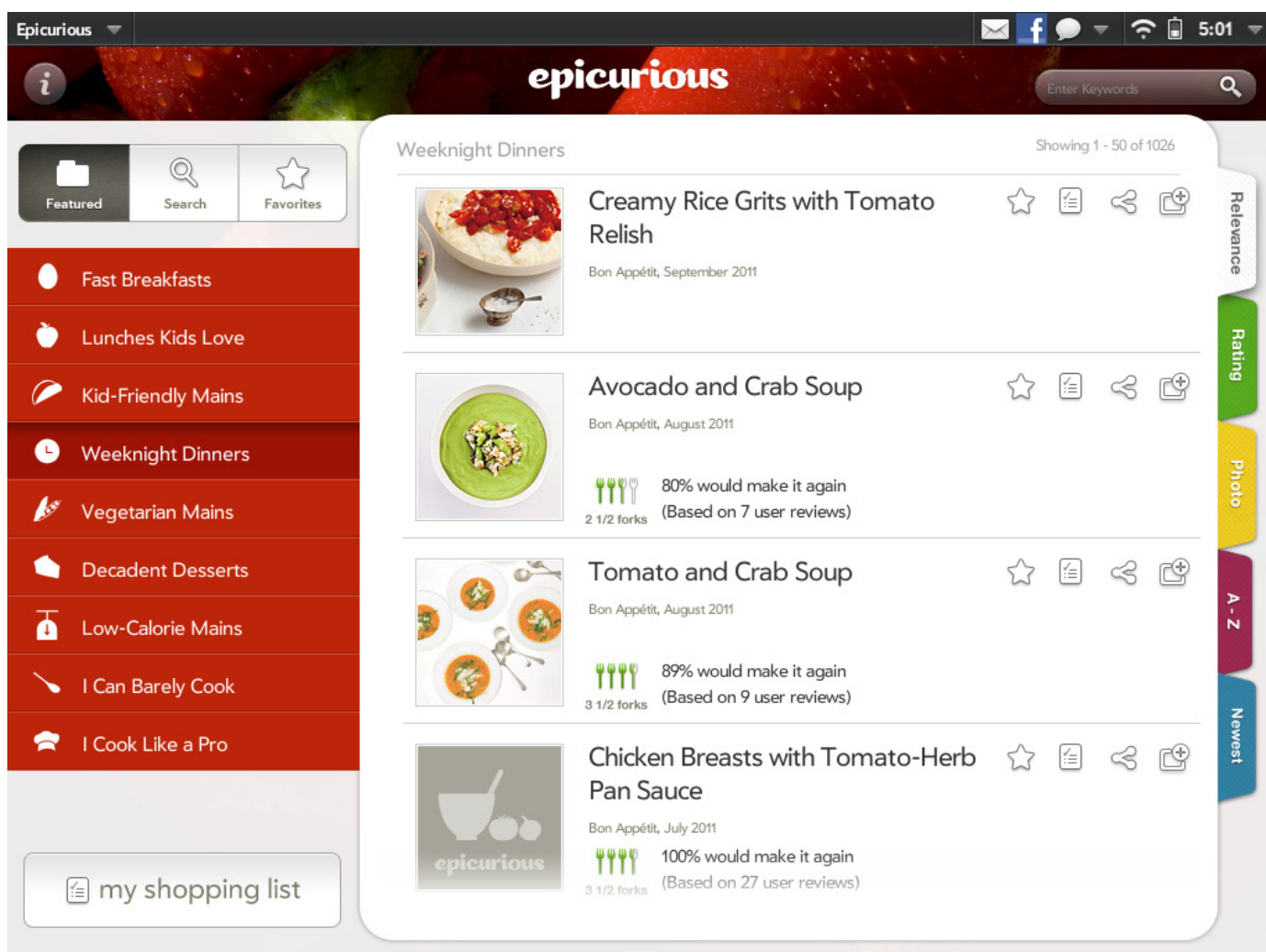
III.8. Epicurious

Three buttons are included next to each recipe:

- star to add the recipe to your favorites list
- list to add the ingredients to your shopping list
- share button to e-mail or share the recipe (via Facebook, Twitter, and other services)

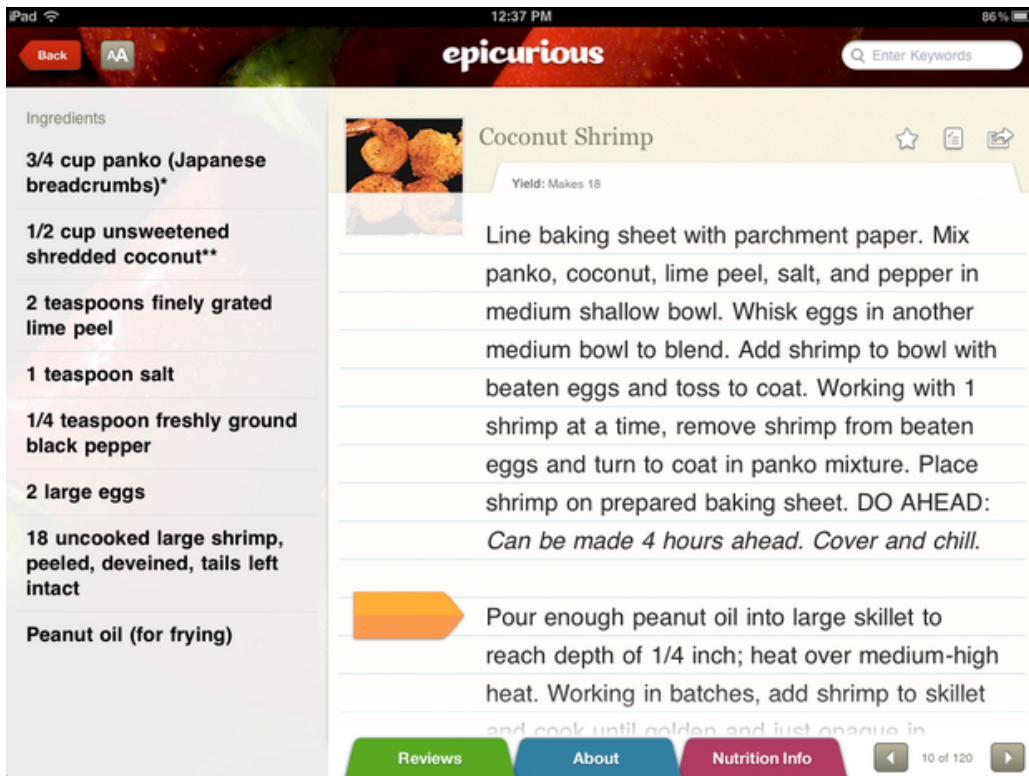
This app is especially useful for beginners because every recipe includes very detailed instructions, and very specific ingredient list (so where a different recipe might say “brown the lamb in a skillet”, Epicurious will include a whole paragraph about how to perform the task correctly)

- When looking for recipes, is possible to search by: category, keyword, by ingredients
- Ability to add a recipe you want to prepare to your shopping list, and automatically get a list of everything you have to buy, divided into categories
- Compatible with Apple Watch: timer function
- Ingredient list on the left side of the screen and instructions on the right
- There are not many picture
- Voice control, so is not needed to touch the iPad with sticky fingers



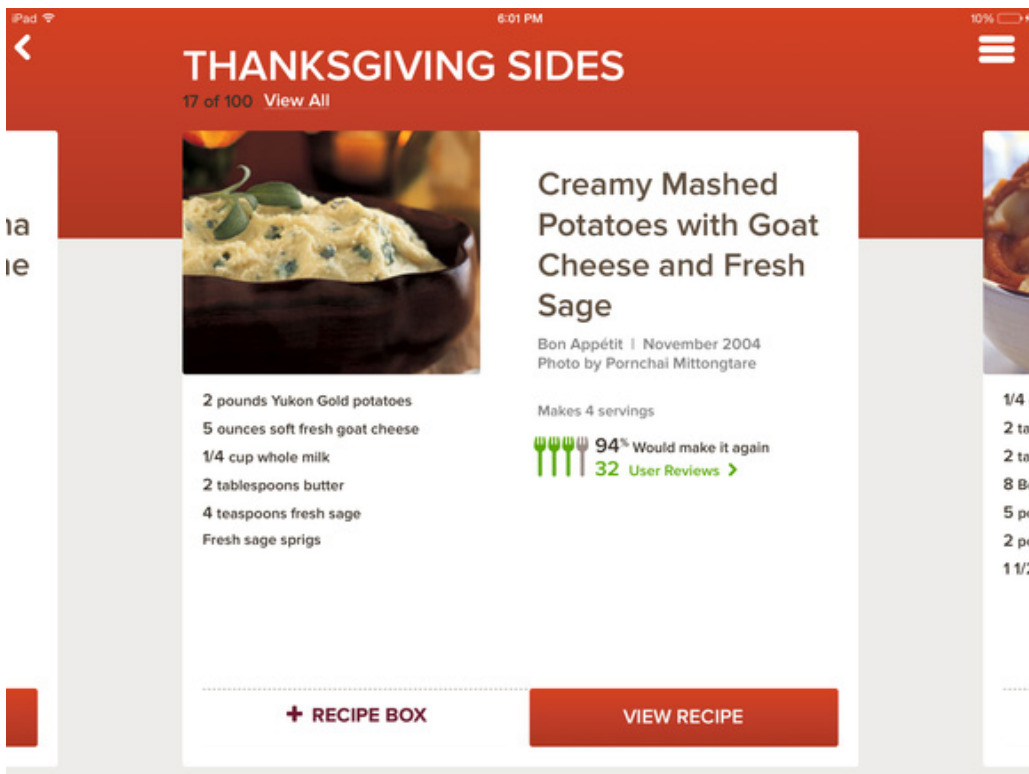
III.9. Epicurious recipes

When viewing a recipe, the ingredients are listed in the left column and the instructions are in the right panel. To mark your place as you follow a recipe, you can slide an orange arrow to the step you are working on. At the bottom of the screen are tabs to read (but not write) user reviews and to read more about the recipe, which typically includes a short introduction to the dish and its source. Sometimes, there is a nutrition tab, but most recipes lack this information.



III.10. Epicurious recipe

To navigate the app, you can tap the Back button in the upper-left corner to jump back from a recipe to your search results. Sometimes, however, this Back button disappears. I found this happened occasionally when I tapped the star or shopping list buttons on a recipe. To escape from a recipe without the back button, just tap the forward or backward button in the lower-right corner to skip to another recipe and the Back button returns.



III.11. Epicurious recipe overview

## Appetites (video cooking app)



III.12. Appetites videoclip 1

The app provides step-by-step videos (shot from the perspective of the chef) which accompany each recipe. This always allows to clearly view what the food should look like when chopped or cooked.



III.13. Appetites videoclip 2

Uses very short GIF videos to explain all the parts of the sub task. E.g. the illustration above shows how to smash garlic.

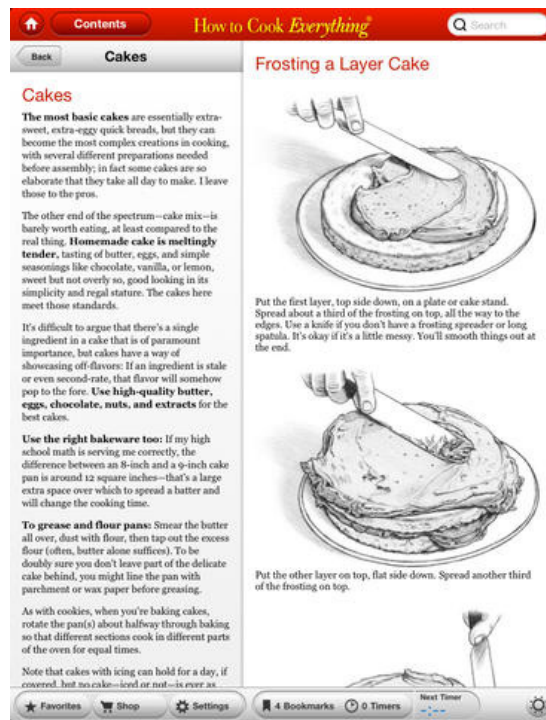
A person can make a dish at his or her own pace by scrolling to the next video step, which starts seamlessly with no extra prompting.

The app is mainly recipe-focused rather than instructing people on basic cooking techniques.

## How to Cook Everything



Ill.14. How to cook home



Ill.15. How to cook explanation

This app contains:

- cooking guidance with how-to illustrations, equipment, techniques, ingredient information and meal-planning ideas
- ability to convert temperatures and quantities to metric
- built-in timers, placed throughout the recipe steps
- All recipes and reference content are embedded in the app so that the content is available even when there is no network connection.

### Cooking Basics

Is a similar app



Ill.16. How to

## Escoffier Cook's Companion

The app is aimed to help people whom are new to the kitchen environment. It is designed to teach the cooking basics, allowing to learn the ins and outs of cooking from the beginning.

The app aims to provide tools to help you before you begin cooking such as:

- Convenient equipment
- Ingredient guides
- Comprehensive glossary defining pivotal cooking terms

And it contains multiple kitchen timers and measurement converters.



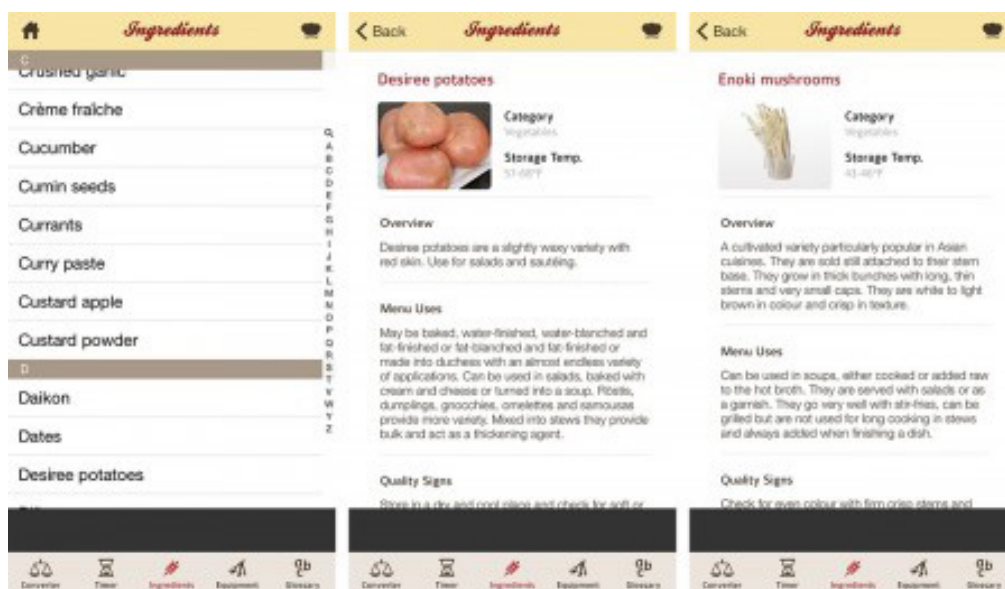
Ill.17. Escoffier timing

The app aims to facilitate the understanding of measurements and suggested cooking utensils, even if the equipment available does not apply to the particular instructions. A built-in converter is able to alter the measurements to work with what you is available in the kitchen.

It also keep track of the multiple timers needed to properly prepare a full-course meal. And it is a guide containing a database of cooking terminology (E.g. “feathering” or “emulsify”).

With pictures and advice on how to identify and prepare different ingredients.

It also has tips for how to handle any of the equipment in the kitchen and advice on how to clean and store them.



Ill.18. Escoffier info on ingredient

## Cooking Timer App

Apps that help people managing cooking timing: both instructing on the appropriate timing for cooking a specific item and for keeping track of several dishes being cooked at the same time.

### KitchenPad Timer

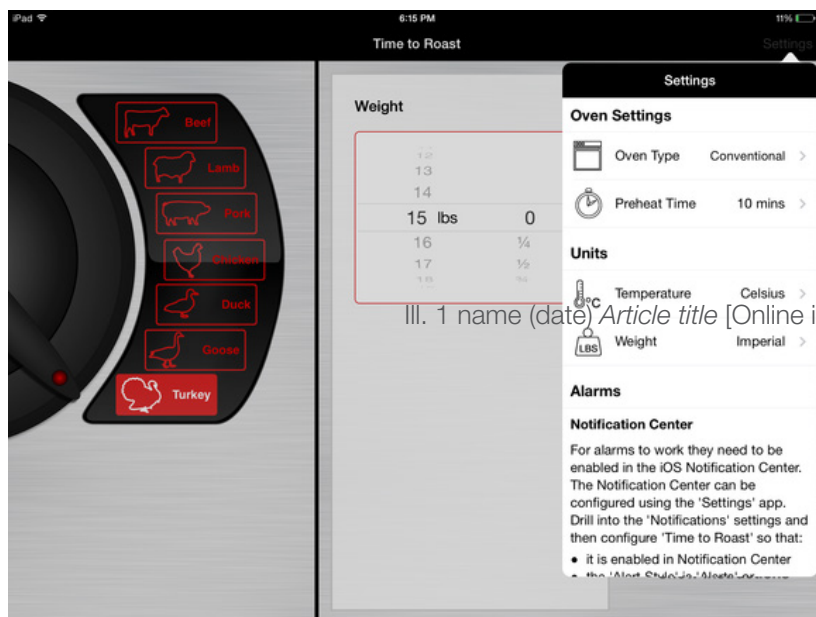


Ill.19. Kitchen pad timer

Useful when cooking multiple dishes at once, each of which requiring its own timer.

- Can customize each time (name the dish, choose the flame height or oven temperature)
- there are five burner timers and four oven timers - and pick a ringtone for the alarm.
- Can save timer presets to your favorites list (e.g. use when making multiple servings of the same dish)
- Allows to time up to nine dishes simultaneously.

### Time to Roast



Ill.20. Time to roast

For beginners cook that are not familiar with cooking timing, this app gives timing about roasting (turkey, beef, pork, chicken, etc.).

- Settings menu: select your oven type (conventional, fan, gas), preheat time (10, 15, or 20 minutes), and units (Celsius/Fahrenheit, pounds/kilograms);
- Select meat type and its weight.

After adjusting all the values, the app will give you a time line of things to do (e.g. from “preheat oven”, ending with “carve and serve”) in order to be ready at that specific time.

An alarm feature allows to choose a time to eat so that the app will present a time line of things to do (e.g. from “preheat oven”, ending with “carve and serve”) in order to be ready at that specific time.

When choose to start cooking right away, you’ll get the same time line that will start immediately.

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## Evaluation:

The activity gave an overview on the app used by unexperienced cooks which are currently available on the market. The research outlined the possibility of use voice recognition for moving forward in the steps of the recipes. Together with the possibility of using short video clips in order to explain small tasks (such as how to smash garlic).

## Reflection:

Use the collected material to develop the UI for the guidance. Evaluate the possibility to use voice recognition and its challenges.

**Activity:****Weighing devices****Objective:**

Investigate existing weighing scales on the market. Get an overview of the design, features and prices. Understand how weighing works.

**Experiment/data:**

Switch Scale (Ill. 1.) is a clever 2-in-1 digital scale that offers two options for weighing ingredients. The user can either place his own bowl on the scale and measure the ingredients, or he can flip the top over and it becomes a measuring bowl itself. It is able to measure both liquids and solids, in the following units: gms, lbs, ozs, fl. ozs, mls. Has auto power-off feature. "Add and weight" function for measuring multiple ingredients at the same time.

Maximum capacity: 5 kg / 176.4 fl.oz / 11 lb / 5000 ml.

Powered by: 3 x AAA batteries (included).

Price: 60€ (Joseph Joseph® 1, 2016).

TriScale (Ill. 2.) is a handy digital scale that helps with saving space in your kitchen by having a gadget feature of folding away perfect for fitting in the cutlery drawer. Has LCD display, touch sensitive buttons and auto power-off feature. "Add and weight" function for measuring multiple ingredients at the same time.

Units to measure: gms, lbs, ozs, fl. ozs, mls.

Maximum capacity: 5kg/176.4 fl.oz/11lb/5000ml.

Powered by 1 x3V CR2032 battery.

Price: 45.50€ (Joseph Joseph® 2, 2016).

Terraillon Quadro Electronic Kitchen Scale (Ill. 3.) is a stainless steel electronic scale perfect for fitting in any modern kitchen.

Maximum capacity: 11 lb/ 5 kg.

Automatic zero function - add and weight multiple ingredients.

Liquid conversion function.

Price: 33.65€ (Amazon, No date).

Kitchen Craft Natural Elements Cast Iron Kitchen Scales (Ill. 4.) is a Natural Elements heavy duty kitchen scale. The body is made of heavy, traditional charcoal black cast iron and the weighing pan / bole is made of stainless steel metal. the base is made of acacia natural wood. It can be used with metric stacking weights (Ill. 5.) or imperial stacking weights (Ill. 6.).

Price for Kitchen Craft Natural Elements Cast Iron Kitchen Scales: 73.57€

Price for metric stacking weights: 36.17€

Price for imperial stacking weights: 36.17€ (Cake stuff, no date).



Ill. 1. Switch Scale (2016)



Ill. 2. TriScale (2016)



Ill. 3. Terraillon Quadro Electronic Kitchen Scale (No date)



Ill. 4. Terraillon Quadro Electronic Kitchen Scale (No date)



Ill. 5. Metric stacking weights  
(No date)



Ill. 6. Imperial stacking weights  
(No date)

Uma Weighing Scales and Timer (Ill. 7.) is a combination of two functions in one product. You can choose between the g/kg and lb/oz weighing system and has a maximum capacity of 3 kg. Has weight resetting system that allows for more ingredients to be placed inside. The bowl is dishwasher safe and can be used as a mixing bowl. The timer included is up to 90 minutes and 59 seconds. Uses AAA batteries of 1.5 V. Price: 104€ (Amara, 2016)



Ill. 7. Uma Weighing Scales and Timer (2016)

Morphy Richards 3 in 1 Digital (Ill. 8.) is a digital jug scale that offers the possibility of weighing, measuring, mixing and serving all in one set of scales. The weight allows for all ingredients to be placed in the same compartment, due to the helpful tare function that measures each ingredient separately. It is made of stainless steel. It has multi volume measurements, volume indicator for oil, milk, water, flour. It requires 2 x AAA (1.5 V) batteries - not included in the price. It has convertible volume / weight function. Price: 27.46€ (Morphy Richards, 2012).

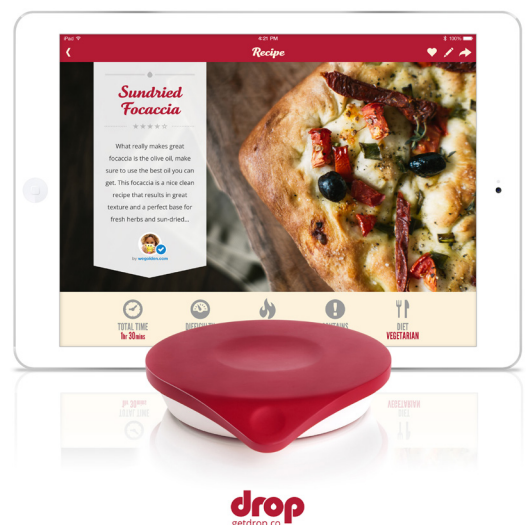


Ill. 8. Morphy Richards 3 in 1 Digital (2012)

### Weigh Scale and App

Drop (Ill. 9.) is an innovative recipe platform that offers a step-by-step guide (with helpful photographic and video tips along the way, handy timers) for people that cook at home, by finding, making and sharing the dishes they plan to make (Ill. 10). The product comprises of the Drop Scale and the Drop Recipes App, that communicate via Bluetooth.

The Drop Scale (Ill. 11) is able to rescale quantities (in case you do not have enough flour, you can press the “scale recipe” button and the recipe will adjust according to the quantity of flour you have), replace ingredients (if you don’t have e.g. strawberry, the app will suggest you possible replacements, like kiwi, bananas), suggest in-recipe tips and share recipes online. It has a wireless button that has to be pressed when you make a task, e.g. heat the oven, so you don’t touch the display of the tablet and dirty it. Capacity: from 6 kg to under a gram. Made of FDA non slip Silicone (Ill. 12). Works with Coin Cell Battery (included), with an expectancy life of



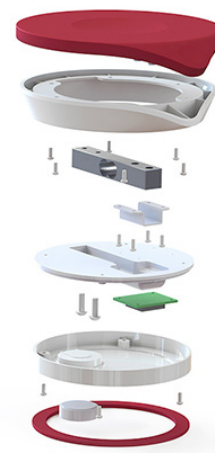
Ill. 9. Drop (2014)



Ill. 10. Drop steps (2014)



Ill. 11. Drop Scale (2014)



Ill. 12. Drop Scale Specs (2014)

one year of normal use. Dimensions: 135 x 160 x 25 mm / 5.5 x 6.5 x 1 inch. Weight: 300 g.  
Price for the Drop Scale: 87.70€

The Drop Recipes App offers a range of hundreds of recipes. It shows what tools and ingredient are needed for the recipe. When taking a look at the ingredients you need, you can send the ingredients list to your mail, so you have it with you when going grocery shopping.

It works with iPad mini, iPad mini 2, iPad mini 3, iPad 3rd generation, iPad 4th generation, iPad Air, iPad Air 2, iPad Pro, iPhone 4s, iPhone 5, iPhone 5s, iPhone 6, iPhone 6 Plus, iPhone 6s, iPhone 6s Plus, iPod touch 5th generation, iPod touch 6th generation. Requires iOS 8 or later (drop, 2014).

SmartConnect Kitchen Scale (Ill. 13) is a kitchen scale with bright black-light display with touch sensitive controls, tare feature and included kitchen timer. It is paired with the SmartConnect App that can be used on Apple or Android mobile devices. The App offers detailed nutrition analysis for creating a food journal or measure in cups and tablespoons. It uses Bluetooth Low Energy wireless communication for transmitting the weight measurements to the App.

Requires 3 x AAA batteries (included), has a capacity of 5 kg.  
Price: 87.59€ (Escali, 2011)

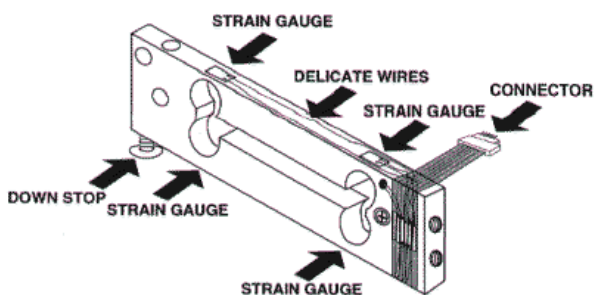


Ill. 13. SmartConnect Kitchen Scale (2011)

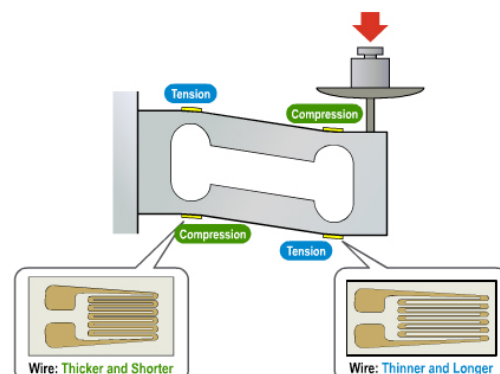
### How does digital weighing machine works?

All digital weights for kitchen use comprise of a load cell (with strain gauges) (Ill. 14), a device used to measure the strain of an object, and load cell sensor, an electric device that converts force into electrical signal (force transducer).

When a weight is placed on the scale, firstly the weight is evenly distributed. By the design of the scale, the force of the weight is applied to one end of the load cell (Ill. 15), which makes the load cell bend downwards. The strain gauges deform, by tension or compression and transform the deformation into an electrical signal. The signal runs through an analog to digital converter and then through a microchip that changes the data so it's possible to be displayed in the LCD display. (eHow, No date).



Ill. 14. Strain gauge load cell diagram (2015)



Ill. 15. More in depth diagram of strain gauges on bar load cells when force is applied (2015)

For a better understanding of the weighing principle and for having a hands-on example, a normal kitchen weight (Ill. 16) has been disassembled and its components analyzed. The weight is turned on by touching the area where “ON/OFF TARE” is written. For taring the weight, the same area is touched again. For shutting down, the same area has to be touched for approximately one second, until it shuts down. The weight measures in grams (g) by default, but the measuring unit can be changed into ounces (oz) by turning the weight and pressing the small button shown in Ill. 18 once. Inside of the weight there are four load cells with strain gauges (Ill. 22, 23), connected to the microprocessor or the main board of the scale (Ill. 19, 21). It also has a digital screen and place for two AAA 1.5V batteries. The weight is evenly distributed on the four gauges, and, according to the stress the weight exerts on the strain gauges, they transmit the information to the microprocessor which transforms the information into readable data, such as grams or ounces.



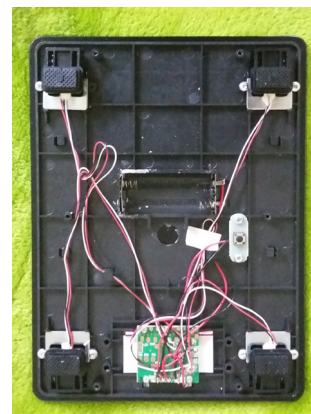
Ill. 16. Front view



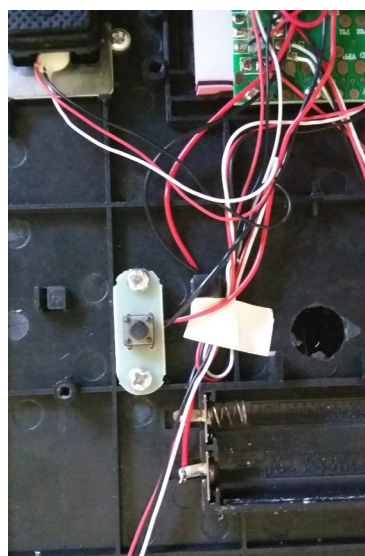
Ill. 17. Back view



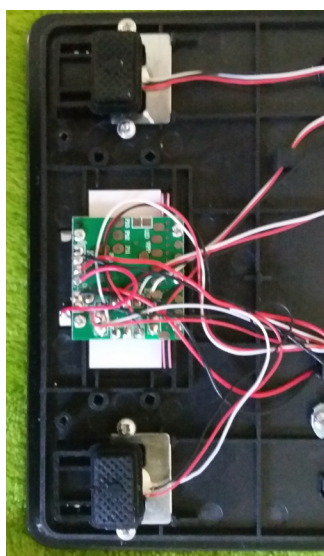
Ill. 18. Button for changing the measuring unit



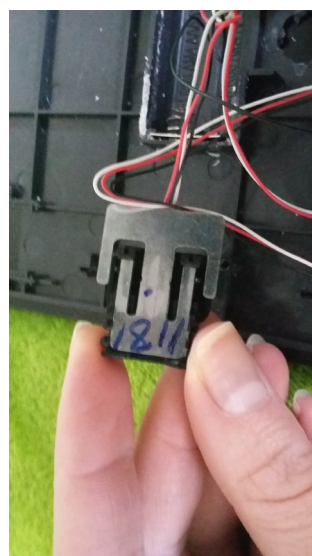
Ill. 19. Arrangement of the components



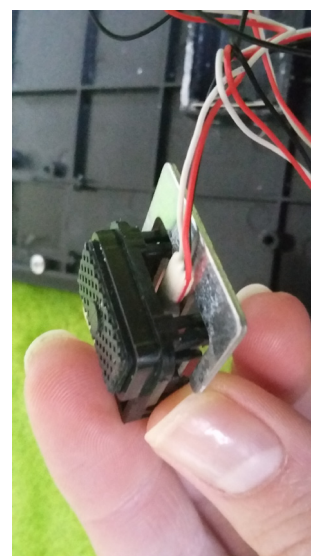
Ill. 20. Connections of the button for changing the measuring unit



Ill. 21. Motherboard, screen and two load cells



Ill. 22. Load cell - front view



Ill. 23. Load cell with strain gauge - side view

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III. 5. Metric stacking weights (No date) [Online image] Available at: <http://www.cake-stuff.com/equipment-c7/scales-measuring-c188/scales-c189/kitchen-craft-imperial-stacking-weights-for-natural-elements-cast-iron-kitchen-scales-p6910> (Accessed: 11 April 2016)

III. 6. Imperial stacking weights (No date) [Online image] Available at: <http://www.cake-stuff.com/equipment-c7/scales-measuring-c188/scales-c189/kitchen-craft-imperial-stacking-weights-for-natural-elements-cast-iron-kitchen-scales-p6910> (Accessed: 11 April 2016)

III. 7. Uma Weighing Scales and Timer (2016) [Online image] Available at: <https://www.amara.com/products/uma-weighing-scales-and-timer> (Accessed: 11 April 2016)

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III. 15. More in depth diagram of strain gauges on bar load cells when force is applied (2015) Available at: [https://cdn.sparkfun.com/assets/learn\\_tutorials/3/8/2/img0054.png](https://cdn.sparkfun.com/assets/learn_tutorials/3/8/2/img0054.png) (Accessed: 12 April 2016)

III. 16. Front view (Own illustration)

III. 17. Back view (Own illustration)

III. 18. Button for changing the measuring unit (Own illustration)

III. 19. Arrangement of the components (Own illustration)

III. 20. Connections of the button for changing the measuring unit (Own illustration)

III. 21. Motherboard, screen and two load cells (Own illustration)

III. 22. Load cell - front view (Own illustration)

III. 23. Load cell with strain gauge - side view (Own illustration)

## **Evaluation:**

The scales on the market vary greatly in shape, depending on the taste, preferences and functionality. The Drop Scale + App is a similar concept to what the Team is aiming to create. It has a stylish interface and a sleek design. It is advisable to consider it as inspiration for the concept development, while keeping in mind the project's target group and the level of complexity for the interface (make it as understandable as possible). The mechanism used for digital measuring usually comprises of load cells with strain gauges, connected to a mother board, that function with the energy from a set of batteries. It also comprises of a screen, sensor and other features, varying from model to model.

## **Reflection:**

The technology behind a weight is not very complex, the best option would be to use load cells with strain gauges. The type and number of load cells needed depends also on the design of the scale. The next step is to investigate the possible load cells suitable for the application and choose accordingly.

**Activity:****Starter-kits with utensils and smart utensils for cooking****Objective:**

To find out what kitchen utensils are included in starter-kits on the market and to find out if there are any “Smart” utensils currently on the market. This will set the basis of what utensils to include in the System of Objects.

**Experiment/data:****IKEA utensils tart-kid**

IKEA is both selling starter-kits with some of the basis utensils found in a kitchen and separately kitchen utensils. The starter-kits both set a limit of what can be cooked, but offer a starter-solution if the costumer is in doubt of what to buy. After buying the starter-kit, it is up to the costumer to buy other utensils needed separately.

When buying a starter-kit, the unit price is lower compared to buying the utensils separately. The utensils sold as starter-kits are only available as starter-kits and the utensils sold separately are only available separately.

This could indicate that the starter-kits are meant for people that are in doubt of which kitchen utensils needed and that have a little interest in having similar kitchen utensils.

It could also indicate that the starter-kits are meant for people that do not care about using exactly the right utensil for a cooking task but are fine with using another utensil the starter-kit offers.

If the costumer knows exactly what utensils to buy and want them all to be from the same series, the costumer has to buy the separate utensils.

**GNARP**

One of the sets are called GNARP and includes 5 utensils:

Spoon 29 cm, Fork 28 cm, turner 31 cm, wok turner 29 cm and a Cooking tongs 29 cm (Ill. 1.).

GNARP has a set price of 29 DKK whereas if buying utensils that are alike the ones in this series, the unit price is 8 DKK, meaning the ending price will be 40 DKK (GNARP, 2016).

**SPECIELL**

Another starter-kit is called SPECIELL (Ill. 2.) and includes 5 utensils:

1 Turner 32 cm, 1 spoon 33 cm, soup ladle 29 cm, pasta server 31 cm and cooking tongs 28 cm.

SPECIELL starter-kit has a price of 39 DKK (SPECIELL, 2016) (KØKKENREDSKABER, 2016).



Ill. 1 GNARP starter-kit from IKEA  
(GNARP, 2016)



Ill. 2 SPECIELL starter-kit from IKEA  
(SPECIELL, 2016)

**Basic cooking utensil starter-kits**

Kitchen starter kit shown in Ill. 3 includes 5 utensils: a wide turner, a narrow turner, a soup ladle, a pasta server and a whisk (Cooking Utensils: Tips on Kitchen Tools, 2015).

Kitchen starter-kit shown in Ill. 4 includes 6 utensils: a whisk, a skimmer, a turner, a spoon, a pasta server and a soup ladle (Cooking Tools and Utensils\_1, 2016).

Kitchen starter-kit shown in Ill. 5 includes 6 utensils: a spoon, a turner, a skimmer, a potato-masher, a fork and a soup ladle (Cooking Tools and Utensils\_2, 2016).



III. 3 Utensil starter-kit (Cooking Utensils: Tips on Kitchen Tools, 2015)



III. 4 Utensil starter-kit (Cooking Tools and Utensils\_1, 2016)



III. 5 Utensil starter-kit (Cooking Tools and Utensils\_2, 2016)

### Expanded cooking utensil starter-kits

Kitchen starter-kit shown in III. 6 includes 12 utensils (Not including measuring cups) : Cooking Tongs, Baking Whisk, Bottle Opener, Can Opener, Potato / Vegetable Peeler, Pizza Cutter, Cheese Grater, Turner, Slotted Turner, Slotted / Spoon, Serving / Basting Spoon and Silicone Spatula (22 Piece Kitchen Utensils Starter Set, 2016).

Kitchen starter-kit shown in III. 7 includes 8 utensils (Not including measuring cups) : Slotted turner, Basting spoon, Slotted spoon, Cooking tongs, Flat grater, Euro peeler, Can opener and Whisk (KitchenAid 17-piece Tools and Gadget Set, 2016).



III. 6 Expanded utensil starter-kit (22 Piece Kitchen Utensils Starter Set, 2016)



III. 7 SPECIELL starter-kit from IKEA (SPECIELL, 2016)

### HAPIfork - Utensils and cutlery connected to smart-devices

HAPIfork is a fork that monitors and tracks eating habits. It alerts the user with help from indicator lights and gentle vibrations when the user is eating too fast. Every time the user is bringing food from the plate to the mouth with the fork (this action is called: a “fork serving”) the HAPIfork measures how long time it took for the user to eat the meal, the amount of fork-servings per minute and intervals in between fork servings (III. 8).

This information is then uploaded via USB or Bluetooth to the user’s Online Dashboard on HAPI.com to track progress. The HAPIfork online dashboard can either be accessed by the web-page or app (III. 9) . Furthermore, a coaching program to help the user improve eating behavior is included.

Dimensions:

Length: 200 mm - Width: 24.5 mm - Height: 15.70 mm - Weight: 65 gr.

Electronic components:

- Micro USB connector.
- Lithium Polymer Battery + 3.7 V (Li-Ion polymer 150 mAh battery).
- Microcontroller: ARM® Cortex®-M0 Processor (memory chip).
- Capacitive detection.



III. 8 HAPIfork (HAPIfork, 2016)



III. 9 HAPIfork web-interface and app (HAPIfork, 2016)

#### User feedback:

HAPIfork has a built-in vibrator to alert of an over-speed fork serving (when the user is eating too fast). The vibration will also be activated in the moment of turning on the HAPIfork. The maximum operating altitude is 9,1 m. Furthermore, it has 2 LEDs that will alert the user when the battery power is low. When it is time for charging, the status light will flash red/orange to alert the user.

2 plastic shell components.

#### Patents:

- The technology is covered by four patents.
- Measure of hand-to-mouth movement.
- Capacitive detection.
- Specific mechanical cooperation between the electronic key and fork.
- Interaction between apps and data platform.

#### Operation system requirements:

- Windows XP, Vista, 7 & 8.
- Mac OS 10.5+.
- iOS 5+.
- Android : 4.2.2.

#### Battery and memory:

- It takes approximately one hour to fully charge the battery through USB and the charging lasts for up to 2 weeks depending on the frequency of uses and how the user uses the fork (vibration uses power).

#### Sensors and motors:

- The HAPIfork uses a capacity sensor to capture fork servings.
- It uses a MEMS 3-axis accelerometer to ensure that the action is a fork serving and not touching the fork with the other hand or the knife.

#### Connection:

- HAPIfork is a USB & wireless device using Bluetooth Low Energy.

#### Environmental conditions:

- Operating Temperature 0°to 40° C.
  - Non-operating Temperature -17°to 54° C.
  - While storing, the HAPIfork needs to stay at a dry place where it is not exposed to direct sun rays and heat.
  - HAPIfork is Splash proof and is IPX4 certified. (An IP Code is the international standard that indicates the factor of protection in electronic devices. The IP indicates the standard, the first number indicates solid particle protection and the second number indicates the liquid ingress protection. If one of the numbers are not relevant, it is replaced with a X).
- In the case of the HAPIfork, it resists splashes and the fork head can be washed in a sink under water. The electronic key inside the fork is not waterproof. Therefore, when putting the HAPIfork in a dishwasher, the electronic key has to be taken out (HAPIfork User Manual, No date).

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III. 5 Cooking Tools and Utensils\_2 (2016) [Online image] Available at: <http://8-ball.xyz/903f391f67b0a95b-kitchen-cooking-utensils.html> (Accessed: 12 April 2016).

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III. 7 KitchenAid 17-piece Tools and Gadget Set (2016) [Online image] Available at: [http://www.ebay.com/itm/KitchenAid-17-piece-Tools-and-Gadget-Set-Black-New/162005469464?\\_trksid=p2047675.c100005.m1851&\\_trkparms=aid%3D222007%26algo%3DSIC.MBE%26ao%3D1%26asc%3D35624%26meid%3D7d709f9f8e8140e885974da89020898e%26pid%3D100005%26rk%3D2%26rkt%3D6%26sd%3D161890918032](http://www.ebay.com/itm/KitchenAid-17-piece-Tools-and-Gadget-Set-Black-New/162005469464?_trksid=p2047675.c100005.m1851&_trkparms=aid%3D222007%26algo%3DSIC.MBE%26ao%3D1%26asc%3D35624%26meid%3D7d709f9f8e8140e885974da89020898e%26pid%3D100005%26rk%3D2%26rkt%3D6%26sd%3D161890918032) (Accessed: 12 April 2016).

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III. 9 HAPIfork (2016) [Online image] Available at: <https://www.hapi.com/product/hapifork> (Accessed: 12 April 2016).

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### Evaluation:

The tool kits found are very different and contain many different utensils used for different tasks. Therefore, the decision on which utensils to include in the starter kit will be based on which ones are found most relevant to include by the Team. The utensils that will be included in the starter-kit are: spoon, turner, soup ladle, pasta server, whisk, euro peeler, cook's knife and vegetable knife.

### Reflection:

We learned that there are many different starter-kits with utensils on the market. Therefore, the decision on which utensils should be included in the system of objects is both based on the utensils that are more or less always included and the wishes from the project team in reflection to the starting-dishes. By researching the HAPIfork, it gave some more considerations regarding the battery and how to manage charging. Likewise it offered considerations about how water-tolerant our utensils in the System of Objects should be. Lastly, it gave an idea of the sizing of the handle. For further investigation, wireless charging has to be investigated and IP coding has to be explored regarding what will be suited for the utensils included in the System of Objects.

**Activity:****Inductive Charging****Objective:**

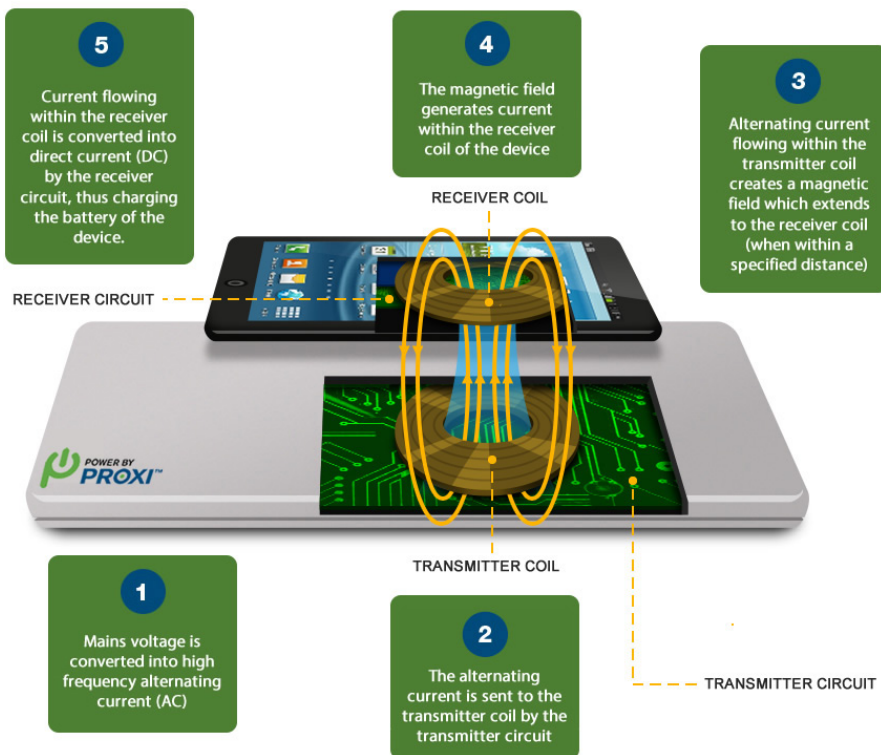
Investigate the principle of inductive (wireless) charging and have an overview on the applications that this technology is used for. Consider if such technology would be suitable for the project.

**Experiment/data:**

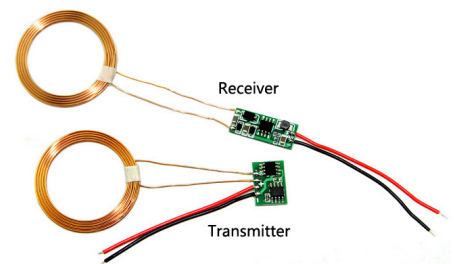
Inductive charging represents a wireless method of charging / recharging and provides power to your electrical devices, be it at home, at work or in industry. It uses electromagnetic fields to transmit power from a transmitter to a receiver. It does not require any kind of physical connection.

The principle on which is working is magnetic resonance, or Inductive Power Transfer (IPT), where electrical current is transferred between two objects through the use of coils to induce an electromagnetic field (Ill. 1).

The power is safely transferred over an air gap or any non-ferrous / non-conductive object, such as wood, plastic or granite.



Ill. 1. The process of wireless charging in five steps (2016)



Ill. 2. Wireless charging module. 2016

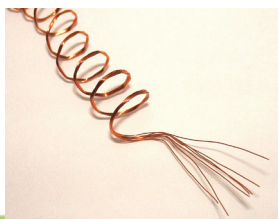
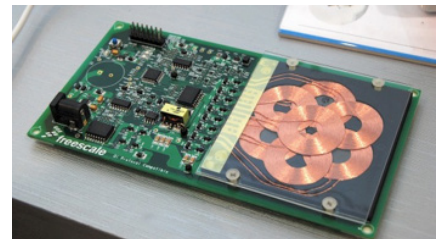
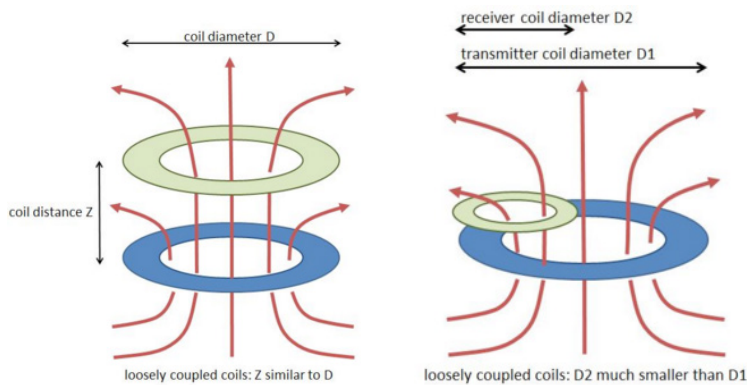
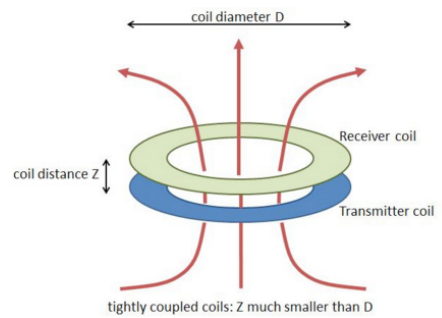
Resonant wireless charging is a type of charging that works in the same way as the conventional inductive charging, but it adds a series of advantages, such as:

- Greater spacial freedom: it is not necessarily to precisely place the receiver right on top of the transmitter coil.
- Charging multiple devices simultaneously - it depends on the coil geometry. It provides with the option of having a larger transmitter surface such as table tops or work benches.
- Charging speeds: the current charging speed for wireless charging is slower than conventional wired charging, but the future promises improvements in its performance.

The components needed for creating inductive charging are: a receiver and a transmitter (Ill. 2.). The copper rings from the two parts have to be placed at a short distance one from another, in order for the energy transfer to work (few mm) (Power by proxi, 2016).

The transmitter coil generates magnetic flux. Depending on the distance between the receiver and the transmitter coils, the receiver coil receives only a portion of the magnetic flux, and therefore transmits power. The coupling between the coils is better when there is more flux received by the receiver. The bigger the coupling factor, the better efficiency transfer,

smaller losses and heating. When the distance between the coils is smaller than the diameter of the coils, the coils are tightly coupled (III. ). Applications can also have loosely coupled coils with different sizes of diameters (III. )When the distance is bigger, the coils are loosely coupled. The loosely coupled have higher electromagnetic emissions, which could make the application not compliable with certain regulations. In applications with tightly coupled coils, the two devices have to be placed exactly one on top of the other. For offering more freedom of placement, multiple coils are used. Having multiple coils also offers the possibility of charging more than one device (III ). A loosely coupled system can also charge multiple devices simultaneously, with the condition that the transmitter coil is much larger than the receiver coil (Wireless Power, No date). The coils can be made from bifilar coil or from witz wire (III )



Witz wire [https://upload.wikimedia.org/wikipedia/commons/e/ed/Litz\\_wire\\_by\\_Zureks.JPG](https://upload.wikimedia.org/wikipedia/commons/e/ed/Litz_wire_by_Zureks.JPG)

TRANSMITTER ARCHITECTURE	EXAMPLE PRODUCT	EFFICIENCY	HORIZONTAL (X-Y) FREEDOM	VERTICAL (Z) FREEDOM	EMI/EMF	MULTI-DEVICE CHARGING
SINGLE COIL, TIGHTLY COUPLED, NON-RESONANT	Qi A1 type, Powermat	+	-	-	+	-
MULTI-COIL, TIGHTLY COUPLED, NON-RESONANT	Most Qi transmitters	+	+	-	+	+
SINGLE COIL, LOOSELY COUPLED, RESONANT	A4WP prototypes, Qi resonant prototypes	-	+	+	-	+
MULTI-COIL, LOOSELY COUPLED, RESONANT	Qi resonant prototypes	-	+	+	+	+

## Existing applications for wireless charging:



III. 3. Wireless charging of mobile devices, 2015



III. 4. Wireless battery charging bowls, 2013



III. 5. Wireless watch charging, 2015



III. 6. Wireless charging for fitness activities. 2015



III. 7. New IKEA furniture with wireless charging, 2015



III. 8. Toothbrush wireless charging, No date



III. 9. JBL PowerUp Wireless Charging Speaker for Nokia, 2013



III. 10. Mionix Concept PX, 2014



III. 11. EasyACC, 2015

### Disadvantages:

(Slow) Performance - it works slower and less efficient than traditional chargers.

Mobility - the charging station has to be plugged in.

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- 

## **Evaluation:**

Inductive charging is starting to be more and more used in everyday applications. It is able to provide power at a relatively small distance, depending on the size of the coils comprised of. Multiple objects can be charged simultaneously as well.

## **Reflection:**

It is relevant to use wireless charging for the current application of the project, since it is used in e.g. toothbrush for several years now.

**Activity:****Ideation and choose the concept****Objective:**

Present the ideas generated so far and outline the desired features for the concept that came out from the ideation sessions.

**Experiment/data:**

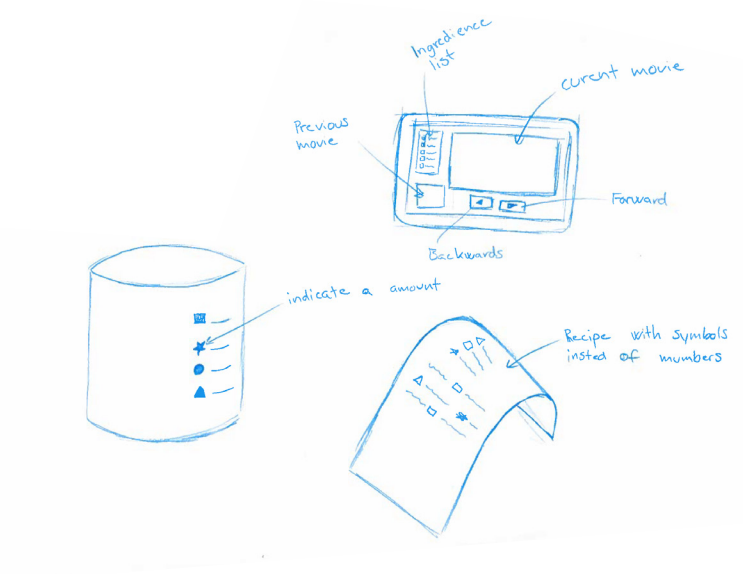
In order for the concept to be generated, the Team made a series of ideation sessions on the 4th, 6th, 7th and 8th of April. The ideas have been afterwards categorized on different themes, with the intention of comparing them and finding the most suitable combination. The method also offers the possibility of coming back to the ideas and choosing another solution, in case the chosen one proves to be not suitable.

The categories are:

1. Measure ingredients;
2. Choose the right utensil;
3. Ensure right consistency;
4. Close the drawers;
5. Have the right temperature.

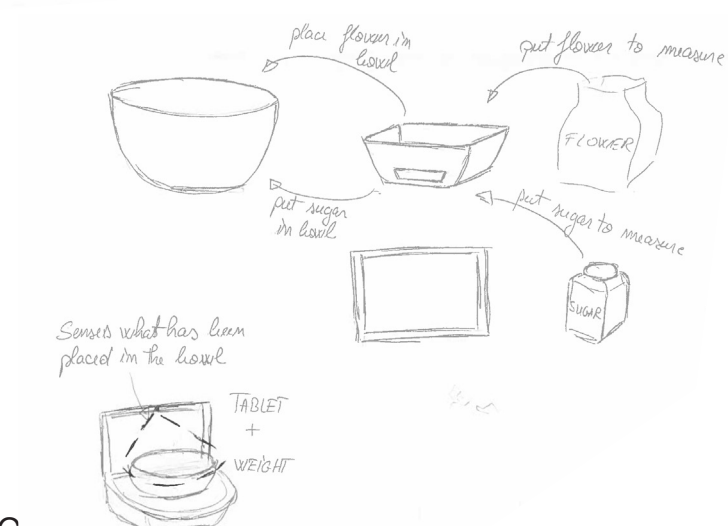
**1. Measure ingredients**

Being a very important part from the cooking process, measuring the ingredients presents a vital focus for the project.

**III. 1. Signs correlation**

The recipe uses signs instead of numbers, so the user has to put the ingredient until the sign that is shown in the recipe, e.g. until the level of the star.

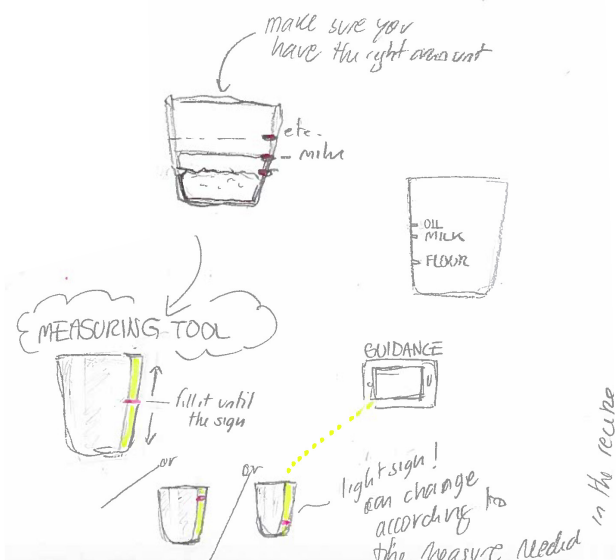
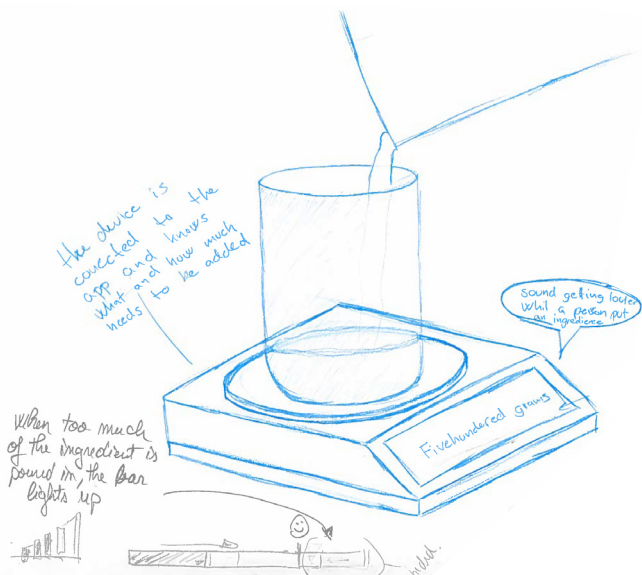
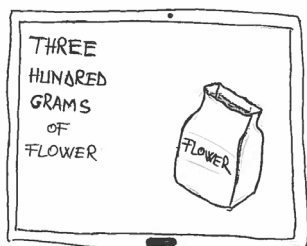
- (-) The user might not be able to connect the signs from the screen to the ones on the tool.

**III. 2. Sensor camera**

The screen and the scale are together as one piece. The camera of the device can sense what ingredient has been added and therefore check if the user has added the correct ingredient.

- (-) It is too expensive.
- (-) The screen can get easily dirty.
- (-) It is hard to see the information from the screen when the bowl is placed on the scale.

many objects to measure the ingredients (the downside is that there will be a need of many tools)



### III. 3. Sensing amounts

The pot can sense how much of the ingredient is inside.

(-) The user might not be able to connect the signs from the screen to the ones on the tool.

### III. 4. Understanding amounts

The guidance spells the amount instead of using numbers.

(-) Takes up a lot of space for big numbers.

(-) Too much text to read.

(+) It can be used for numbers from 1 to 10 (for eggs)

### III. 5. Verbal and visual measurement guidance

The weight spells the amounts that have to be weighed. The device starts making a sound when the person starts pouring, and the sound increases while pouring, until the right amount is reached. The amount is also written with letters instead of numbers.

The weight can also have a bar that fills in with light and indicates how much are you pouring and how much you have to put more. If you go over the limit, the device will let you know that you put too much and that you have to take some out.

### III. 6. Light measurer of ingredients

The container that is placed on the weight has a light on the side that is connected with the tablet. When the person has to put e.g. 300 g milk, the light will go up until the level of 300 g milk. In this way, the person knows that he/ she has to pour until that level.

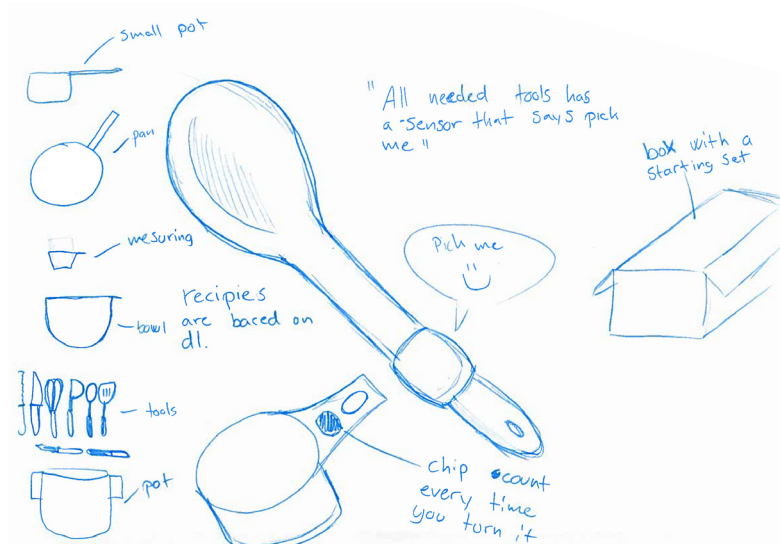
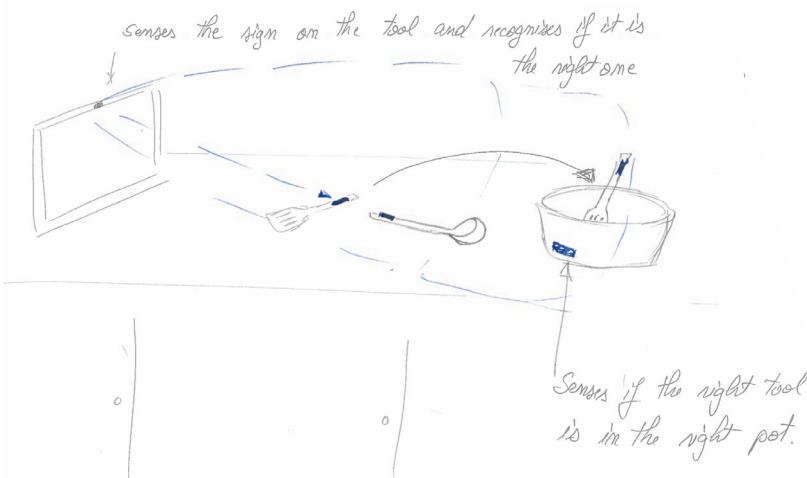
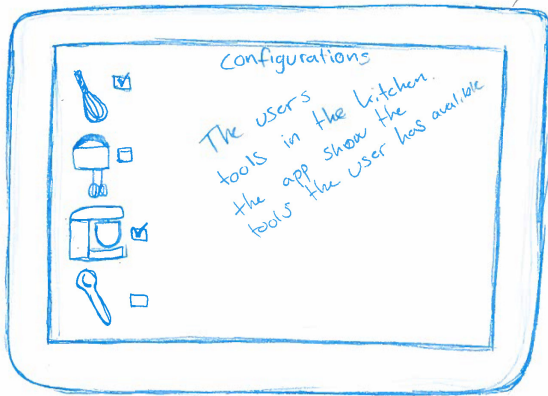
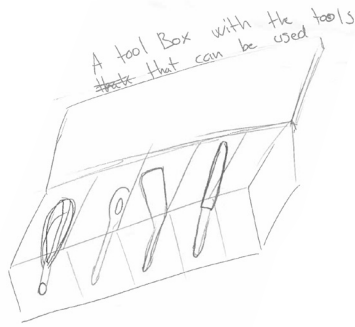
(-) It can not measure solid, non pourable ingredients, e.g. butter, eggs.

(-) it has a limited capacity.

(+) Visual view of the sign.

## 2. Choose the right utensil

The user has to use certain utensils while cooking. The following ideation involves methods of ensuring that the right utensil is used:



### III. 7. Toolbox

Have a toolbox included in the package, with the utensils needed for the recipes.

(-) Solves only the problem of knowing what utensil to use.

### III. 8. Configuration possibility

When buying the package, the app has to be configured according to the utensils available, either with the ones you already used to have in the kitchen or with the ones received in the package. The configuration is made with a family member or a caretaker.

(-) The instructions have to be made with all possible options & tools.

(+) Have a start package with the utensils you need.

### III. 9. Communicative tools

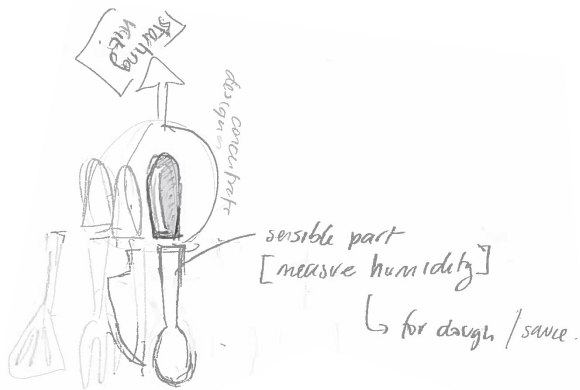
The utensils and pots have a sticker placed on them. The camera of the tablet senses if the right utensil is being used, and if it's placed in the right pot.

(-) The tablet has to be placed always in a favorable place for sensing all the stickers.

### III. 10. Smart utensils 1

The utensils have a chip on the handle that lights up when they have to be used. They also count every time they are turned.

(-) The stickers might fall from the handles when washing or after multiple use.



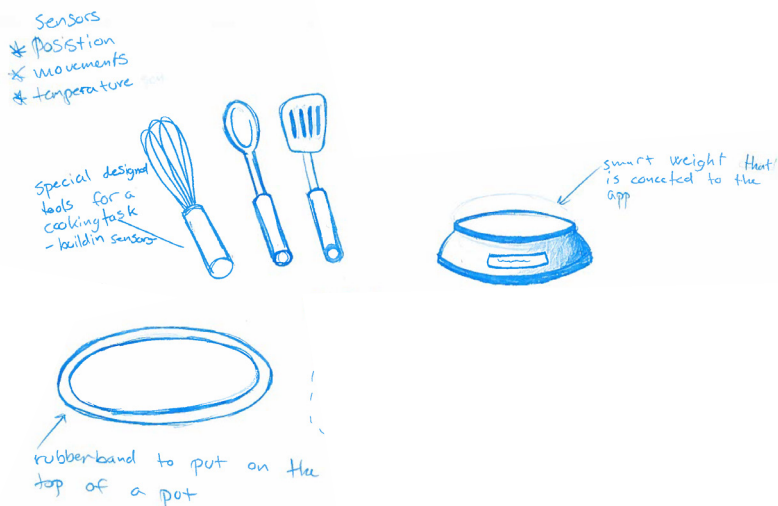
### III. 11. Smart utensils 2

The utensils have the top part with electronics. The bottom part is able to sense humidity, for when making the dough or sauce.

### III. 12. System with different devices

The devices are connected to the app. The weight is connected with the app and knows the quantity of the ingredients needed. The utensils have built-in sensors. A rubber band is placed on the top of the pots, which senses the temperature and if the liquid inside is boiling over.

(-) The rubber band has to fit too many sizes of pots.



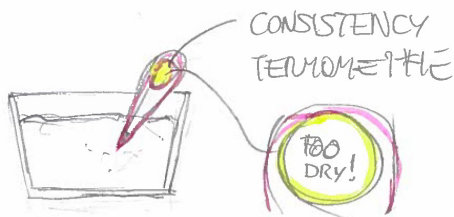
### 3. Ensure right consistency

The consistency of the meal that is being prepared plays an important factor when deciding how much does the pot have to stay on the stove.

### III. 13. Thermometer

The thermometer is placed in the food and it measures its temperature. It communicates with the app. It can measure if the food is too dry.

(-) The components have to be heat resistant.



### 4. Close the drawers

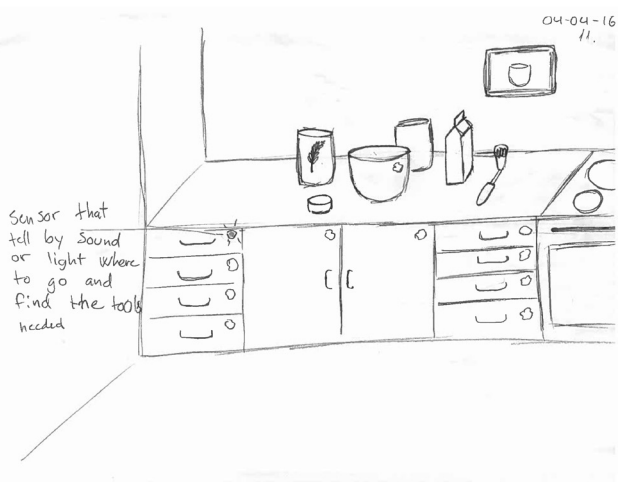
The user might forget to close the drawers when taking something from them. The problem can be solved with:

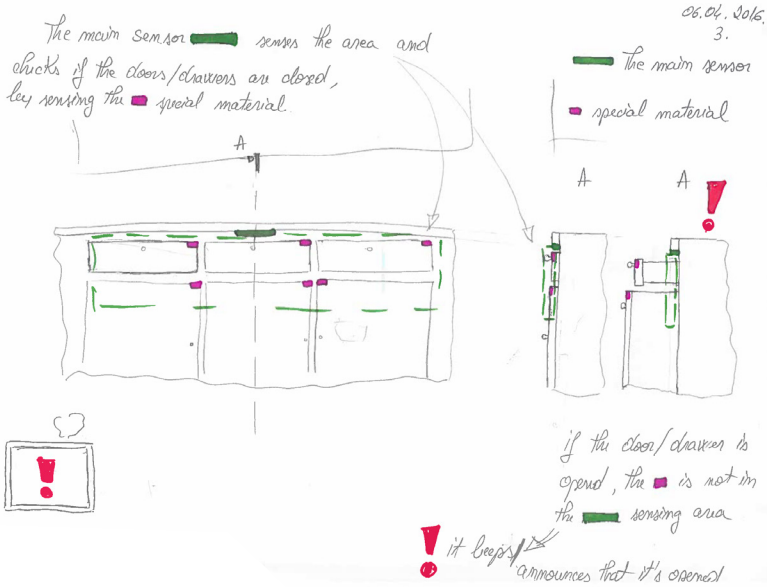
### III. 14. Smart beacons

The smart beacons are placed on every drawer door and know what kind of utensils and tools are inside each of them. When an utensil or a pot is needed for the recipe, the beacon from the specific drawer will light up, letting for the person to know where should he/ she look.

(-) Many beacons have to be placed around the house.

(-) The person might move the pots or utensils in another place than original.





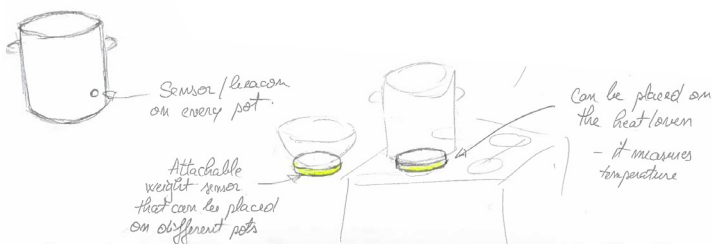
### III. 15. Closing the drawers sensors

The drawers have a smart chip that can sense when a drawer is opened for too long (left opened by mistake) and will light up and let the person know he/she has to close it.

(-) It is a very complex system just for solving one problem.

## 5. Have the right temperature

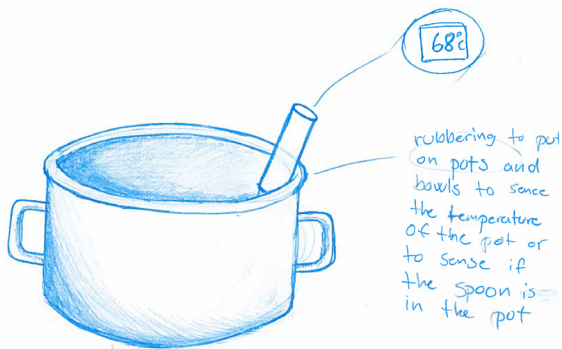
Knowing at all times the temperature of the food that is being cooked is an important part of making a dish. The following ideas have been generated regarding sensing the temperature:



### III. 16. Temperature sensors

The system could include a temperature sensor, that can either be like a beacon placed on the used pot or like a plate that can be placed underneath the pot, when used on the stove. It also has the weighing function.

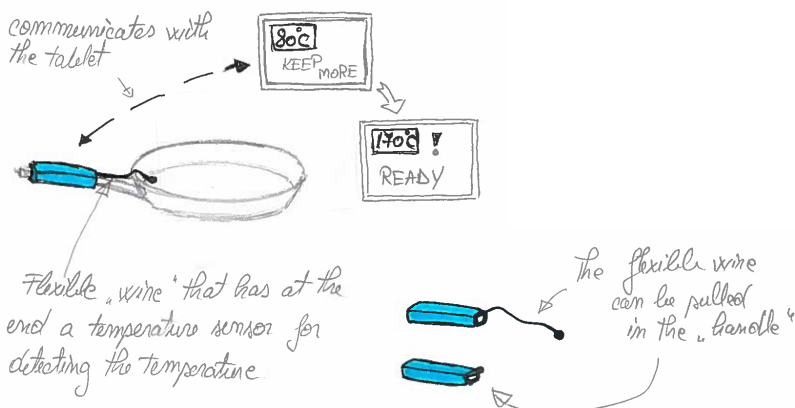
(-) The electronics are exposed to heat and they might get damaged.



### III. 17. Smart rubber band

The rubber band is placed on top of the pot. It senses the temperature and if the utensil is forgotten in the pot.

(-) The rubber band has to fit to all sizes of pots.

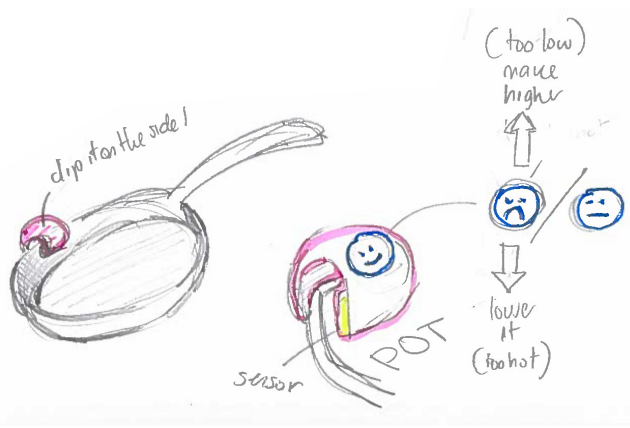


### III. 18. Flexible wire

The flexible wire has at the end a temperature sensor that, when placed in the food measures its temperature. It has a flexible wire that can be extended or made shorter, to fit all sizes of pots.

(-) When mixing, the flexible wire can be moved from its position.

(-) Not placed in the middle of the pot.

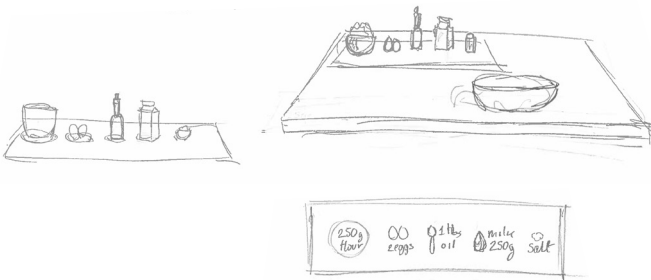


### III. 19. Temperature gadget

The gadget is placed on the lip of the pot. It senses the temperature of the food and when it needs to be higher or lower, an emoticon appears, according to the command needed.

- (-) The gadget might fall from the pot in the food or outside of the pot.
- (-) The components have to be resistant to very high temperature.

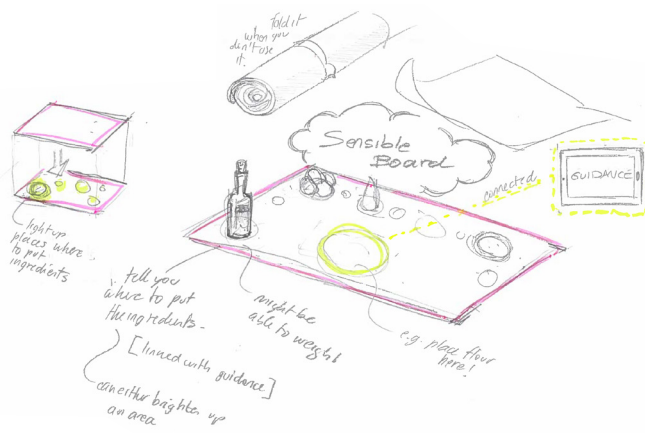
### Other ideas



### III. 20. Ensure to add all ingredients

A platform with screen that shows how much and what to place on it.

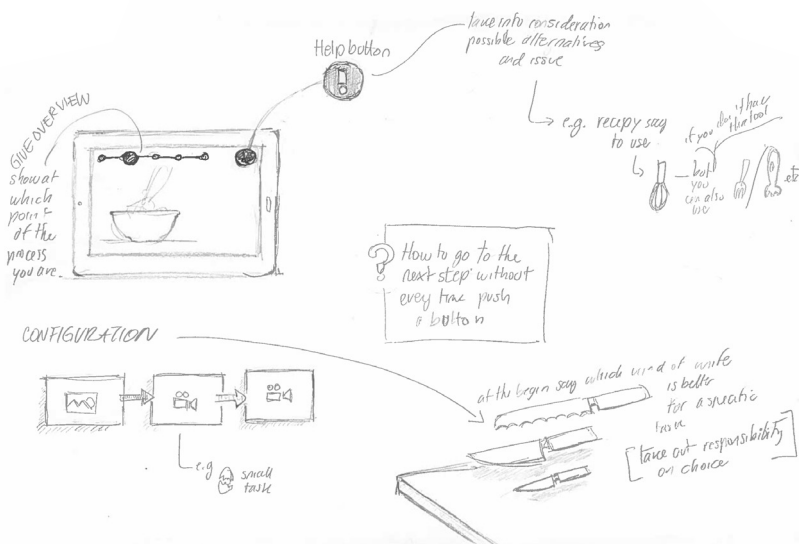
- (-) Big investment in technology, but solves just the problem of collecting ingredients.



### III. 21. Collect all ingredients

A flexible platform that communicates with the tablet and that shows what ingredients are needed, and shows the place where to put them. It can also weight the ingredients.

- (-) Too big investment in developing the technology.



### III. 22. Guidance specifications

The guidance has a bar where the overview of the cooking task is visible. A help button on the side is also needed. The guidance is done by photos or videos, depending on the scene. The utensils used in the guidance are configured according to what utensils does the user have in the house.

The ideas generated are listed in Table 1., where the blue, italic written features are chosen as relevant for the desired concept.

<b>1. Measure ingredients</b>	<b>2. Choose the right utensil</b>	<b>3. Ensure right consistency</b>	<b>4. Close the drawers</b>	<b>5. Have the right temperature</b>	<b>Other ideas</b>
<i>Signs correlation</i>	<i>Toolbox</i>	Thermometer	Smart beacons	Temperature sensors	Ensure to add all ingredients
Sensor camera	<i>Configuration possibility</i>		Closing the drawers sensors	Smart rubber band	Collect all ingredients
Sensing amounts	Communicative tools			Flexible wire	<i>Guidance specifications</i>
Understanding amounts	Smart utensils 1			<i>Temperature gadget</i>	
<i>Verbal and visual measurement guidance</i>	<i>Smart utensils 2</i>				
Light measurer of ingredients	<i>System with different devices</i>				

Table 1. Features of the concept

### Illustration list:

- III. 1. Signs correlation (Own illustration)
- III. 2. Sensor camera (Own illustration)
- III. 3. Sensing amounts (Own illustration)
- III. 4. Understanding amounts (Own illustration)
- III. 5. Verbal and visual measurement guidance (Own illustration)
- III. 6. Light measurer of ingredients (Own illustration)
- III. 7. Toolbox (Own illustration)
- III. 8. Configuration possibility (Own illustration)
- III. 9. Communicative tools (Own illustration)
- III. 10. Smart utensils 1 (Own illustration)
- III. 11. Smart utensils 2 (Own illustration)
- III. 12. System with different devices (Own illustration)
- III. 13. Thermometer (Own illustration)
- III. 14. Smart beacons (Own illustration)
- III. 15. Closing the drawers sensors (Own illustration)
- III. 16. Temperature sensors (Own illustration)
- III. 17. Smart rubber band (Own illustration)
- III. 18. Flexible wire (Own illustration)
- III. 19. Temperature gadget (Own illustration)
- III. 20. Ensure to add all ingredients (Own illustration)
- III. 21. Collect all ingredients (Own illustration)
- III. 22. Guidance specifications (Own illustration)

Table 1. Features of the concept (Own table)

### Evaluation:

The ideas generated cover a wide range of functionalities. The most relevant ones for the concept were chosen according to what is most feasible to be combined together.

### Reflection:

Discussing all the ideas in clusters and then deciding which ones would be most suitable to work further on proved to be a good method, that also made clarifications in the Team regarding what is considered for each idea.

**Activity:****First test with the System of Objects****Objective:**

In order to test the interaction and overall understanding of the system of objects, a test has been made with Stefan Tandrup. The test is made with Version no. 1 of the Recipe, which can be found in [Appendix X](#). The steps in the recipe are moved back and forth when the testing person says next.

**Experiment/data:**

Stefan is 21 years old and moved away from his parents 1,5 years ago. While Stefan was living at home, his parents did all the cooking. He started to learn how to cook when he moved away from home. He has a basic understanding of cooking but is very depended on a cookbook or other cooking instructions. If a recipe does not give very exact instructions on measurements he will be in doubt of what to do. As an example, if a recipe says add a little salt, Stefan will not know how much to add in relation to the dish. A little salt could both be a teaspoon or less and depending on his understanding the dish might end up too salty.

**Testing the System of Objects**

In the beginning, the slides tell Stefan to gather all the ingredients and kitchen tools that he needs for peeling the potatoes. He has a little trouble finding all the things needed since he is not in his own kitchen.

In the guidance, he is told to plug the sink, as the first step, but he automatically turns on the water at first which is not until the next step. Therefore he turns off the water and plugs the sink. He then turns on the water again as the guide tells him to do so in the next step. After the sink has been filled up with water he finds out that he filled it up with hot water and therefore has to do the task again with cold water (He is not used to the kitchen-sink).

*Observation: A slide with opening up the bag of potatoes might need to be added before the peeling.*

*Observation: Slide number 5 and 6 can be combined.*

In the next step he is told to start peeling the potatoes. In this step he put all the potatoes into the measuring cup from the beginning to see how much he needs. His argument is that he wants to know how much it is before he starts. This way he has a feeling of how many he still has to peel.

While talking a little about knowing the amount of an ingredient on forehand, he suggested that a pre-made food-box could be included in the package.

Further on, Stefan got to the slide that tells him to cut the potatoes in more or less the same sizes. In this part he struggled a little since he is used to use a big knife and a cutting board for this task; the guidance shows cutting the potatoes in the hand.

*Observation: Slide number 15 should be divided into two parts.*

The potatoes started boiling at slide number 20 and the slide with turning down the potatoes should be moved to this part instead.

He did not have big problems in the part of cooking the potatoes and had understood the instructions very clearly.

When starting the part with the pork, he did not put the ingredients and utensils from the potato-part away and suddenly he had a lot of stuff on the kitchen-table which made it harder for him to do the cooking.

In the slide with seasoning the pork, Stefan struggled a little with understanding how much salt and pepper to put on the pork. He needed to know if the teaspoon of salt was with or without top.

At the slide that told him to put the pork on the hot pan he tried to make all the pieces fit into the pan at the same time. Therefore the observer had to step in and tell him to just make a second portion.

Shortly after, the kitchen was filled with fog and he therefore asked for the kitchen extractor fan to be turned on.

*Observation: A slide with turning on the kitchen extractor fan should be added before starting the pork-part.*

Throughout the part of frying of the pork, Stefan had a hard time figuring out the slides because they were very similar. He knew that he had to turn the pork slices once in a while, but he did not know how long time they should stay on the pan

and how brown they should be. He needed some kind of reference to decide if they were done or not. While frying the pork, Stefan left the turner on the hot frying-pan and was often also moving it around without doing any specific action.

While frying the pork he was likewise in doubt of where all the fat came from and if he had added too much butter in the beginning of frying the pork. The butter does not have an exact measurement.

When he started the second round of pork, the pan was very hot and he therefore had to be very careful while putting on the pork. Therefore he had to turn down the heat a little.

*Observation: In the part of frying the pork there is a slide where the lit is taken away from the potato-pot. This slide can be deleted.*

*Observation: Add a slide where the pan is taken from the heated stove.*

The last part is preparing the sauce. For this part, he again does not put away the ingredients and tools used for the previous parts and ends up with a lot of stuff on the table.

*Observation: The picking parsley-slide is missing.*

Since the picking parsley-slide is missing he has to be told how to do this action.

*Observation: The potatoes are done right after the parsley has been picked. Move the slide with taking the water from the potatoes to this part. ( At this part in the task a cutting-board is placed in the sink which he has to move before he can continue.)*

In the slide where he was guided to cut the parsley he was a little in doubt if the parsley was cut enough.

He did not have any trouble measuring the butter since it is very clear in the instructions, but in the next slide when having to add the flour he is in doubt of if the table spoon should be with or without top. Therefore he ends up adding too little flour.

Afterwards the slides tell him to add a third of the milk, but he has no idea of how much that is. He adds what he thinks is right and the sauce gets thick very fast. He waits for the next slide which tells him to add a little more milk. Again he is in doubt of how much milk to add. In the last slide he is asked to add the rest of the milk which he does and he ends up having a thin consistency of the sauce and with a lot of lumps. It was clear that it was very hard for him to understand the right amount of milk to add.

Afterwards, he was told to add salt and pepper to the sauce. He asked for specific measurements because he did not know how much to add when just saying a little salt and a little pepper.

His overall comments on the guide was that he needed more specific guidance regarding the measuring. He considered that it was a little confusing when the guidance sometimes moved to the next slide by itself (this action happens when he used the utensil and, because it sensed that it has been moved, it transmits to the guidance that it can move on to the next step). Most of the time he had to say next by himself and when the slide just changed by itself he did not pay attention to it. The part with making the pork meat was hard to follow since the slides were so similar.

He was very proud of himself that he did the recipe all by himself and did not care that the sauce had few lumps.

---

## **Evaluation:**

The guidance needs more specific measurements to show the small amounts such as salt, pepper and flour. Stefan suggested that it can be combined with a food, box that comes with the right amounts or that the amount of the potatoes is the first part shown because he would like to know how far he is with the peeling. The guide needs to show to clear the working area, to move the ingredients and tools used for the previous part away, before starting a new part. Otherwise all the tools and ingredients might end up taking all the table-space. Stefan thought that it was confusing that the slides sometimes moved by themselves and other times he had to say next. Most of the times he had to say next. When the slide moved by itself, he did not always notice and had to have it repeated.

Some of the parts were very hard to follow because the slides were very similar and it was hard to tell if it was a new instruction. Lastly, he was very proud of himself for doing the dish even though it was not perfect.

## **Reflection:**

The test went very well and it gave a good understanding of where the changes have to be made. Since this test was only made by one person, it was only possible to control the guidance and take notes. Therefore, for the next text it would be preferable to be at least two people, having the second person for taking pictures.

**Activity:****Duty Cycle of the products****Objective:**

Make the Duty cycle for each component and explain how do the components work.

**Experiment/data:**

The Duty Cycle (Table 1) has been made for one day, considering that the user prepares three recipes in one day, with the help of the System of Objects: in the morning, in the afternoon and in the evening. By having an overview on which components function when in use and when on standby, the components can be chosen accordingly, in order for the system to function.

It is expected for the products to be able to function for maximum four hours of continuous use. This means that the utensils' battery has to supply electricity for all the components for four hours.

**The utensils**

When on stand-by / charging mode, the accelerometer is on, in order to sense when it is being picked up / moved. For the accelerometer to function, the microprocessor also has to be on. When the utensil is moved, the accelerometer senses the movement and it activates the Bluetooth, that transmits signal to the guidance and begins the exchange of information. The utensils should be placed back in the charging platform after every use, to ensure that they are ready to use / charged for the next use.

- The exemplary dive - the whisk and the turner:

Since it is desired to go in depth with the functionality of the whisk and the turner, a gyroscope is needed to be added. When the accelerometer senses movement, the gyroscope is also activated. The accelerometer determines the acceleration of the utensil, while the gyroscope detects the exact position of the utensil, in relation with a reference point. Therefore, the pattern of the utensil when moved can be detected.

**The scale**

The scale is switched OFF all the time, until the ON/OFF button is pressed.

When the scale is activated, by the push of the ON/OFF button, the Bluetooth senses if the guidance is turned on. If yes, then the light-bar-mode of the scaling function is used. If the Bluetooth doesn't sense the guidance, it means that it is off, and therefore, that the user wants to use the scale for other purposes that for preparing recipes with the guidance. In this case, the numbers-mode is activated, and the user can see the value of the weight in numbers.

**The charging platform**

The charging platform is plugged at the power supply 24/7.

**Tables**

Table 1. (Own illustration)

# Duty cycle of the products

The products should be able to function for **4 hours** continuously, after which they need to be recharged.

One day of usage

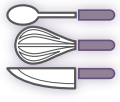


	Morning	Afternoon	Evening	Night
<b>WIRELESS CHARGING COMPONENTS</b>  Utensils	use for ½ h accelerometer is ON bluetooth is ON microprocessor is ON receiver is ON gyroscope is ON	use for 1+½ h accelerometer is ON bluetooth is ON microprocessor is ON receiver is ON gyroscope is ON	use for 2 h accelerometer is ON bluetooth is ON microprocessor is ON receiver is ON gyroscope is OFF	charging / stand-by accelerometer is ON bluetooth is OFF microprocessor is ON receiver is ON gyroscope is OFF
<b>BATTERY BASED COMPONENTS</b>  Scale	use for 10 min sensor is ON bluetooth is ON Screen is ON microprocessor is ON transmitter is ON button is ON	use for 10 min sensor is ON bluetooth is ON Screen is ON microprocessor is ON transmitter is ON button is ON	use for 10 min sensor is ON bluetooth is ON Screen is ON microprocessor is ON transmitter is ON button is ON	OFF sensor is OFF bluetooth is OFF Screen is OFF microprocessor is OFF transmitter is OFF button is OFF
<b>PLUG-IN COMPONENTS</b>  Charging platform	charging transmitter is ON transformer is ON	charging transmitter is ON transformer is ON	charging transmitter is ON transformer is ON	charging transmitter is ON transformer is ON

Table 1. Duty cycle for the System of Objects

**Evaluation:**

The duty cycle of the components offers an overview on which are the components that function when on standby. It is also important to be aware on the span of hours for which the components should function. This information sets the base for choosing the electronics accordingly.

**Reflection:**

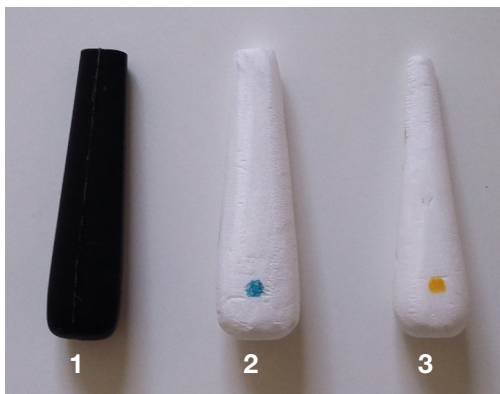
The method proved to be a good tool for having an overview over the electronics and the more detailed principle of the System of Objects.

**Activity:****Utensils tests****Objective:**

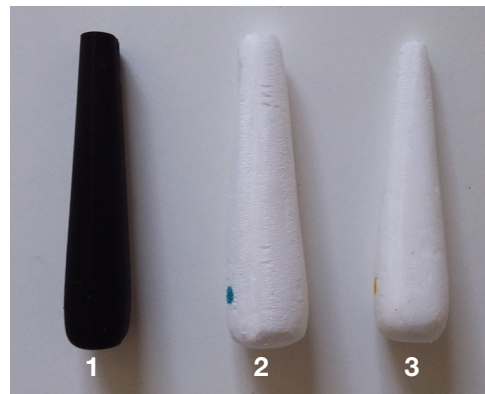
Finding out what is the shape of the handle for each utensil and what is the pattern when using the whisk and the turner.

**Experiment/data:**

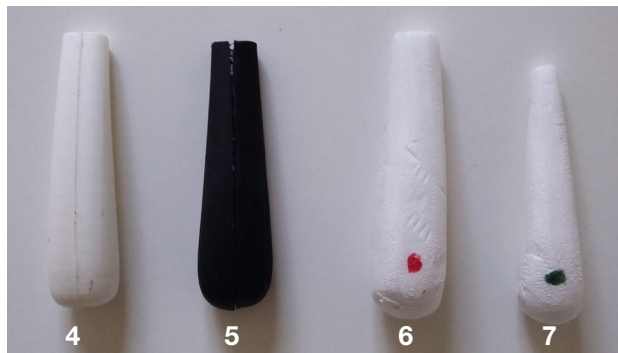
For finding the shape of the utensils' handle, a series of tests have been performed. The tests involved asking each participant to try out the models prepared (Ill. 1, 2, 3, 4) and choose the one suitable for the specific utensil.



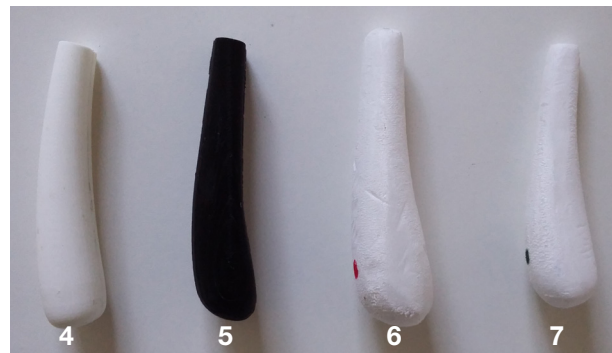
Ill. 1. Conic handles - front view
















Ill. 2. Conic handles - side view










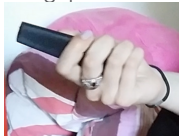




Ill. 3. Curved handles - front view





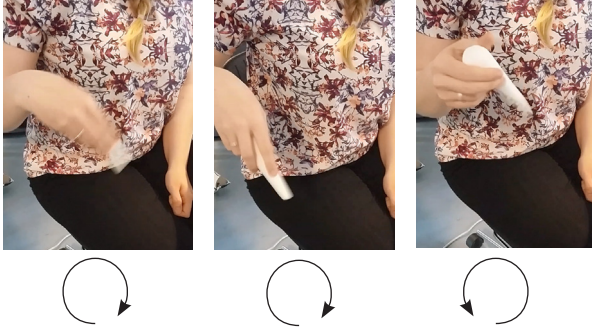
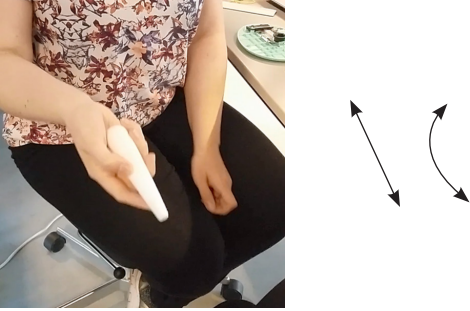
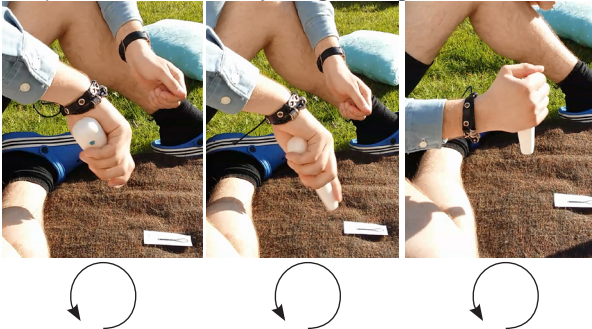
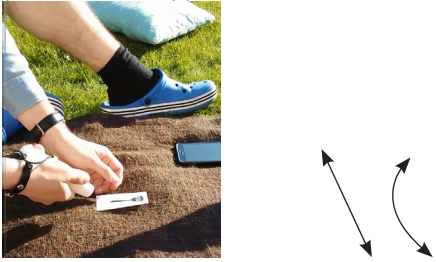
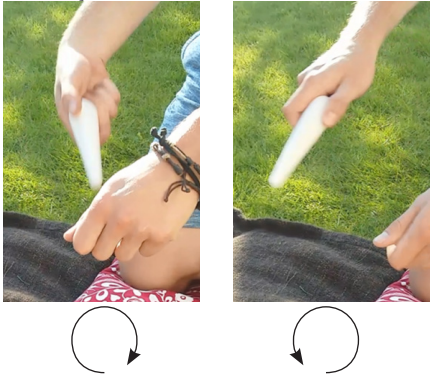
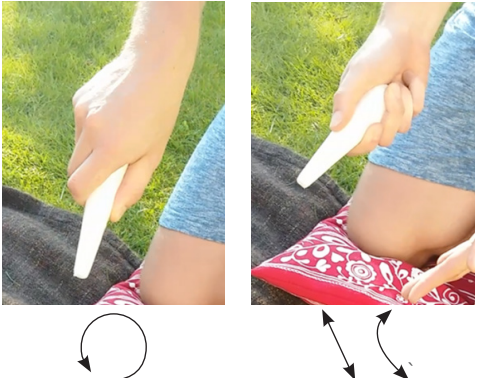
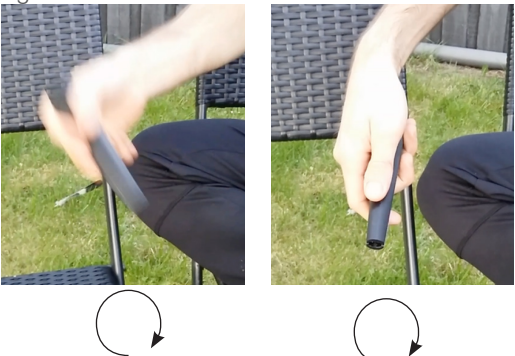
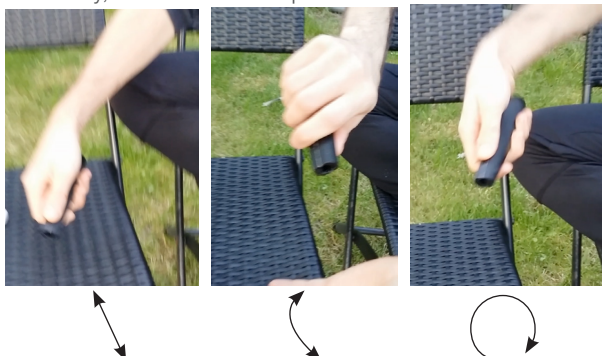
Ill. 4. Curved handles - side view



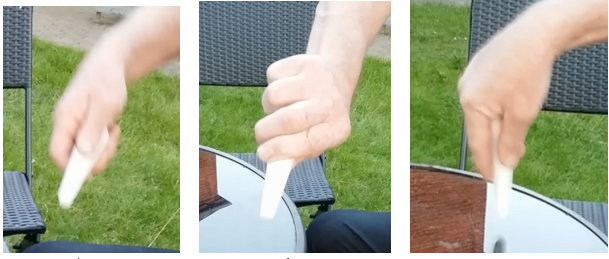



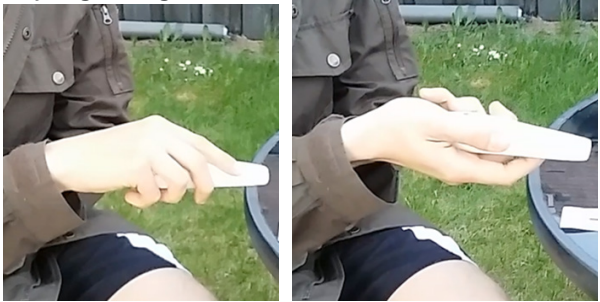

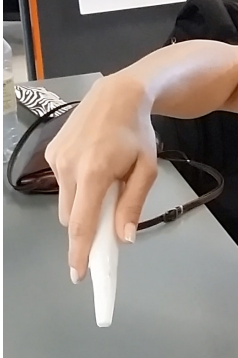

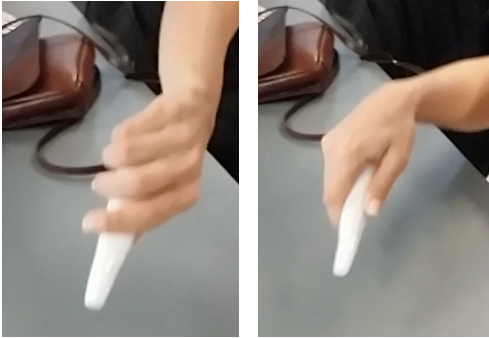

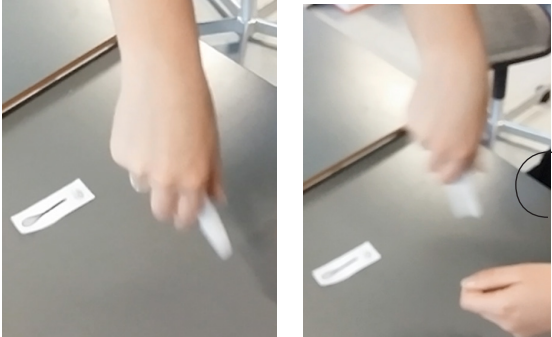



Test no.	 The Spoon	 The Whisk	 The Turner	 The Peeler	 The Cook's Knife	 The Vegetable Knife
1.	A combination between the bended shape of no. 4 combined with the rounded top of no. 5.	No. 7 gives a nice feeling when holding in the palm, because it is round	A combination between the bended shape of no. 4 combined with the rounded top of no. 5.	None, they are too big.	None, they are too big.	None, they are too big.
2.	No. 7. The shape of the handle fits the shape of the hand.	No. 2. The material of the handle should not be slippery, like the 3D material. The shape should be round, easy to grasp in any way.	No. 5. The person held the handle with the convex side up, so not as imagined by the Team. 	No. 1.	No. 1, on vertical. The shape should give a stable grip.	No. 1 on vertical. The handle should be the same for all types of knives, because the blade changes, but the grip / hand is the same.
3.	No. 2.	The tip of no. 6 and the ending of no. 7.	No. 5. The handle should have a flat side.	No. 2 but smaller.	No. 1.	No. 7.
4.	No. 5.	No. 1. The diameter of the ending is too big for most of the models.	No. 4.	No. 7. This was chosen because it goes better with the shape of the hand. 	No. 1. The shape has to follow the hand's shape, with a stopping area where the knife blade begins. 	No. 7. The models of the handle are too big for such a small knife. It should follow the hand's shape, with a stopping area where the knife blade begins.
5.	No. 1.	No. 1.	No. 4. or no. 1.	No.1 but much smaller. It has to fit the size of the vegetable.	None of them because it has to fit your hand. The handle has to lay in the hand and not slip.	None of them because they are too big. The handle has to lay in the hand and not slip. 
6.	No. 4. 	No. 6. It fits good to the size of the hand, that it fills in the hand. 	No. 1 but more round. Or no. 3, but he was not very convinced.	No. 1 but more rounded.	No. 1. but more ergonomic, so it's easy to sense when to stop, how to grab it.	No. 1. but smaller. The handle should have a bump that stops the finger slide into the blade. 

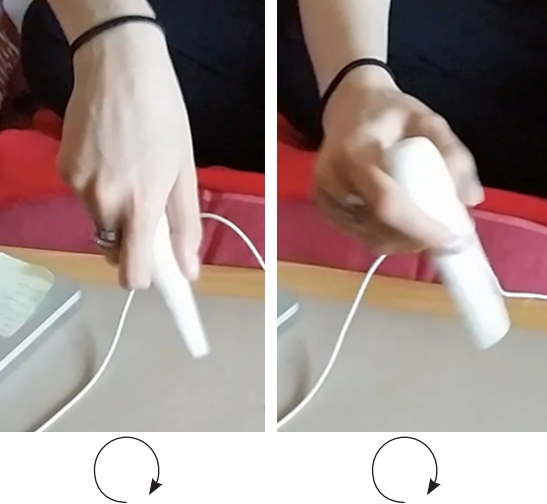
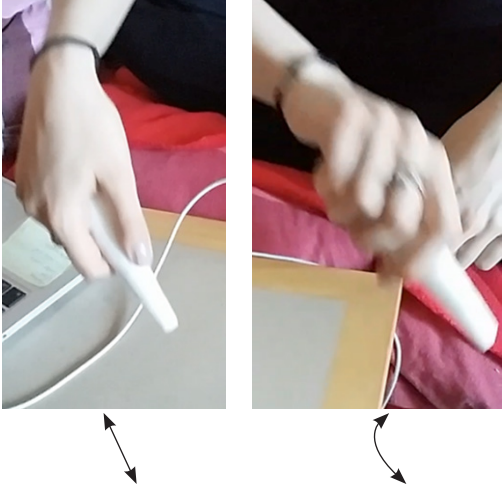




Test no.	 The Spoon	 The Whisk	 The Turner	 The Peeler	 The Cook's Knife	 The Vegetable Knife
7.	No. 4.	No.1. It should be the opposite as the one for the Turner.	No. 4.	No. 7 but for the handle to be shorter, so the blade begins as shown in the picture. 	No. 1 but placed vertically.	No. 1 but scaled down. 
8.	Combination between no. 5 and 7.	No. 3.	No. 4 because it gives an indication of how to hold it, what is up and down.	No. 1.	No. 2, because it gives a good grip.	No. 1 but smaller. She likes that the difference between the top and the end is not very big, as in no. 3.
9.	No. 4, with the convex part up. 	No. 1, because it has a straight shape.	No. 4.	No. 5.	No. 1, placed vertically, but with more ergonomic shape, suitable for the grip. 	No. 1 but smaller and thinner.
10.	No. 1.	No. 1.	No. 4, but held with the convex side up. 	No. 1.	No. 1, held vertically. It is too thick though, for a knife. 	No. 3 but straight instead of conical.
<b>Sum up</b>	No. 1. - 2 choices No. 2. - 0 choices No. 3. - 0 choices <b>No. 4. - 4 choices</b> No. 5. - 3 choices No. 6. - 0 choices No. 7. - 2 choices  Most of the testing persons chose the curved shape as no. 4 has, but with the end more rounded as in no. 5.	<b>No. 1. - 5 choices</b> No. 2. - 1 choices No. 3. - 1 choices No. 4. - 0 choices No. 5. - 0 choices No. 6. - 2 choices No. 7. - 2 choices  Most of the testing persons chose a straight organic shape, like no. 1. The shape should have an organic end.	No. 1. - 2 choices No. 2. - 0 choices No. 3. - 1 choices <b>No. 4. - 7 choices</b> No. 5. - 3 choices No. 6. - 0 choices No. 7. - 0 choices  Most of the testing persons chose a curved organic shape, like no. 4. The end could be more rounded, as in no. 5.	<b>No. 1. -5 choices</b> <b>No. 2. -1 choices</b> No. 3. - 0 choices No. 4. - 0 choices No. 5. - 1 choices No. 6. - 0 choices <b>No. 7. -2 choices</b>  Most of the testing persons chose the straight shape as no. 1 has, but it should have smaller dimensions.	<b>No. 1. - 7 choices</b> No. 2. - 1 choices No. 3. - 0 choices No. 4. - 0 choices No. 5. - 0 choices No. 6. - 0 choices No. 7. - 0 choices  Most of the testing persons chose a straight organic shape, like no. 1 placed vertically, but it should also have a stopper for where the blade begins. It should be more organic.	<b>No. 1. - 5 choices</b> No. 2. - 0 choices No. 3. - 1 choices No. 4. - 0 choices No. 5. - 0 choices No. 6. - 0 choices No. 7. - 2 choices  Most of the testing persons chose a straight organic shape, like no. 1 placed vertically, but is should have smaller dimensions and it should have a stopper for where the blade begins. It should be more organic.

## Exemplary Dive

The second round of tests involved detecting if there is a specific type of movement pattern when using the Whisk and the Turner. Those two utensils are in focus since they represent the exemplary dive among the utensils of the project. The purpose is to understand if there is a specific pattern that the use of those utensils implies, and if yes, how can we make use of the pattern during the cooking process.

Test no.	 <b>The Whisk</b>	 <b>The Turner</b>
<p><b>1.</b></p>	<p>The whisk was turned in a circular move, in both directions. The person changed the way of holding the handle according to the direction of spinning.</p> 	<p>The Turner was moved back and forth and flipped, as if the in the pan has to be flipped.</p> 
<p><b>2.</b></p>	<p>The whisk was turned in a circular move in one direction. The person had three ways of grabbing the handle.</p> 	<p>The turner was moved back and forth and flipped, as if the food in the pan has to be flipped.</p> 
<p><b>3.</b></p>	<p>The whisk is turned in both directions. The person grabs it just in one way.</p> 	<p>The turner is used for mixing in food or for turning the meat in the pan.</p> 
<p><b>4.</b></p>	<p>The whisk is turned in one direction with two ways of holding it.</p> 	<p>The turner is used for flipping or turning food. It is held in the same way, with the thumb up.</p> 

<p>5.</p>	<p>The whisk was turned in the same direction, with two different ways of grabbing it.</p>  	<p>The turner was used for flipping the food or for mixing in the pan, by having two ways of grabbing.</p>  
<p>6.</p>	<p>The whisk was used for stringing in one direction.</p>  	<p>The turner was used for flipping the food, by having one way of grabbing.</p>  
<p>7.</p>	<p>The whisk was held in one way, and moved in one direction.</p>  	<p>The turner was used for flipping food, by grabbing it in one way.</p>  
<p>8.</p>	<p>The whisk was grabbed in one way and turned in both directions.</p>  	<p>The turner was used for flipping the food, with one way of grabbing it.</p>  

<p>9.</p>	<p>The whisk was used for mixing, being held in two ways, with one spinning direction.</p> 	<p>The turner was used for flipping the food.</p> 
<p>10.</p>	<p>The whisk was held in one way and turned in one direction.</p> 	<p>The turner was used for</p> 
<p><b>Sum up</b></p>	<p>The whisk is held in many ways, differing from person to person. It is moved in a circular pattern, in both directions.</p> 	<p>The turner is held in many ways, differing from person to person. It can be moved in a back-forth action, flipping action or in a circular move. The direction of the circular move can be done in both directions, depending on how is the person used.</p> 

**Evaluation:**

The tests outlined that the desired shapes for the handles should have an organic, ergonomic grip. The shape of the handle depends on the utensil. The spoon and the turner should have a bended handle. The whisk should have a straight handle. The peeler should have a straight handle, in smaller version than the whisk. The vegetable knife and the cook's knife should have an ergonomic handle, that prevents for the user to get injured , by the hand sliding in the blade.

**Reflection:**

In this test only people with normally functioning hands was tested, therefore it will be hard to state if the utensils also works well for a person with a withered hand, which some people with brain injuries has. Furthermore the test would have been more accurate if the heads of the utensils had been placed on the of the handles. In this test the test-subjects had to imagine how to use the utensils without the right head. lastly for further testing the size of hands tested will be taken into consideration.



**Activity:****Scale tests****Objective:**

Test the light/bar system for replacing the numbers indication when measuring. Choose the appropriate size of the screen.

**Experiment/data:**

Since the target group for the System of Objects is consisting of people with dyscalculia (have troubles understanding numbers), a different method of making understand amounts has to be used. This can be done with the help of a light bar that reacts to the amount poured in the weight (Worksheet X).

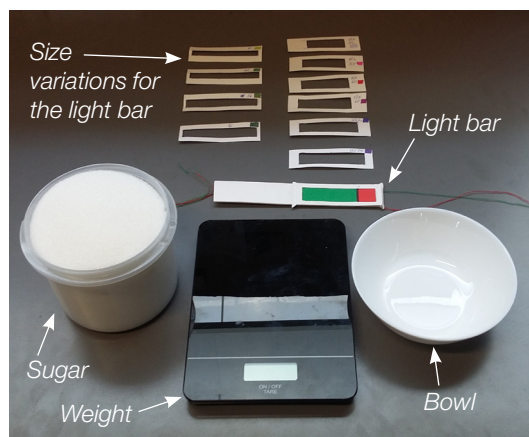
The following tests were performed with ten different persons:

- The functionality of the light bar;
- The feature of having a sound when reaching the desired amount;
- The use of having both light bar and numbers.

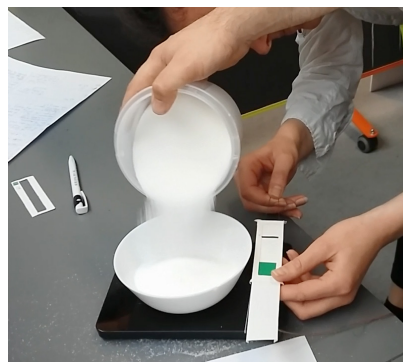
For defining the appropriate size of the light bar, a series of variations were prepared for the testing persons to choose from. For the height, the possible options were: 10 mm, 12 mm, 14 mm, 16 mm or 18 mm. For width, the possible options were: 55 mm, 60 mm, 65 mm, 70 mm, 75 mm and 80 mm (Ill. 1).

The results are found in Table 2.

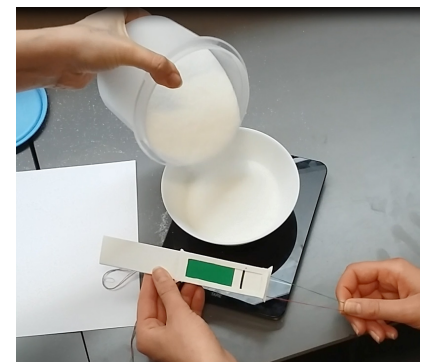
NOTE: The tests were made with regular people, with no kind of cognitive impairments or any other kind.



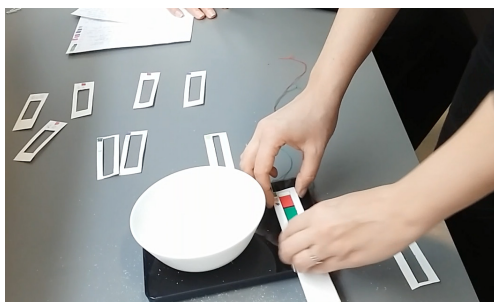
III. 1. Testing equipment



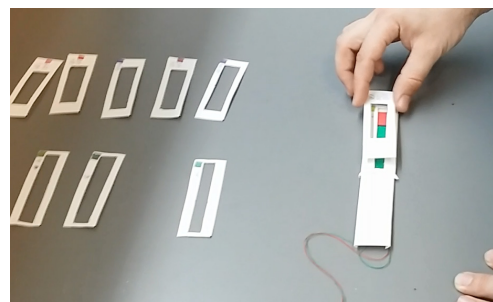
III. 2. Testing just with the light bar



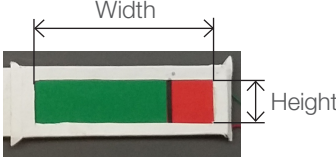
III. 3. Testing with the light bar and numbers



III. 4. Choosing the size of screen, 1



III. 5. Choosing the size of screen, 2

Test no.	Test just with the light bar	Test with the light bar and sound	Test with the light bar and numbers	Size of the screen 
1.	Test went OK. The person knew that when there was red, it was too much sugar and had to take out. The person wouldn't care if it was 5 grams extra or in minus, because it wouldn't influence that much the recipe.	The sound is a good indicator that the limit has been reached.	The attention was only on the numbers because she understood the numbers and they were more precise than the moving lighted bar. The lighted bar could be interesting for when children are using the weight.	Width: 75 mm or 80 mm Height: 14 mm or 16 mm
2.	Test went OK. The black bar should be more clear, in order to be more aware that it has been reached.	The sound is a good indicator that the limit has been reached.	The attention was only at the numbers because she was used with looking at the numbers, not at both of the reference points.	Width: 80 mm Height: 14 mm
3.	Test went OK. He was not sure what to do when he poured over the limit and the red color popped out. Red indicates danger, like a bad thing happened. He would be more worried if he saw red instead of seeing 1 gram extra. The color when passing the limit could be orange or something less alarming, since is not such a big deal if it's just 2 grams extra, compared to 50 grams extra.	The sound is a good indicator that the limit has been reached. The sound could also indicate that it has been poured too much.	Attention was on the numbers because he is used with them. Having numbers would be enough. The functionality of the prototype might impact the testing, since the light bar does not react as sensible as the numbers.	Width: the longer, the better Height: 10 mm It can be thin and long all the way. The mapping of placing the light bar horizontally seems wrong, because the motion of pouring the ingredient is vertically. The light bar could be on the side, and the more you pour down, the light goes up, as in the balance principle.
4.	Test went OK.	The sound is a good indicator that the limit has been reached.	The attention was only at the numbers because she was used with looking at them.	Width: 75 mm Height: 16 mm The light bar could be just one color and when reaching the limit, to have a big line that indicates so. The longer the light bar is, the more sensitive the moving light is.
5.	Test went OK.	The sound is a good indicator that the limit has been reached. It can also be used when pouring too much.	He was a little confused where does he have to look. The two displays could be combined in some way so you can look at both of them in the same time.	Width: 65 mm or 70 mm Height: 12 mm
6.	Test went OK.	The sound didn't matter that much, she didn't really hear it.	She focused more on the numbers but at some point she got confused because she didn't know where to look. She was focusing on the numbers more because she could see exactly how much she has to take out.	Width: 75 mm Height: 12 mm

7.	Test went OK. It was hard to understand the amounts, how much it means in the green part, how much on the red part.	He was a little confused of when is the task done. The sound is nice to have when reaching the right amount.	He was looking at the numbers. It was not confusing to have both reference points.	Width: 80 mm Height: 10 mm The bar's size is depending on the volume of the ingredient.
8.	Test went OK. It is nice to have the light bar showing the light go up as you pour, because with the normal weight, you might not see the numbers, because of the reflections of the glass.	She didn't pay attention on the sound because she was paying attention at the light-ed bar that was moving. The sound is like a double check. It could be even nicer to have only the sound, without the bar with light, and the sound would just go up the more you pour. She thought that the sound was made when the amount was exceeded.	She was looking just at the numbers, because they are more accurate. It is a little confusing that you have two reference points and they are not in the same place. Maybe the numbers can move as the light moves, so you have the attention in the same place.	Width: 75 mm Height: 16 mm The size depends on how much can it measure.
9.	Test went OK. The movement of the light could be indicated by arrows, and when pouring too much of the ingredient, there could be an arrow pointing to the left, indicating that it has to be removed.	The sound is a good indicator that the level has been reached. It can also have a sound when going over the limit. The scale should have a margin of error of few grams, so it doesn't start making sound when is just with one gram extra.	The person paid attention only to the numbers. The bar light and the numbers should be in the same screen. The numbers can be on the green area and the light of the bar could go up as the numbers increase. The numbers can also be placed at the beginning of the light, and be pushed as the light moves to the right (as the person keeps pouring).	Width: 55 mm Height: 10 mm
10.	Test went OK. The light can be shown with some arrows as it goes to the right, and when pouring too much of the ingredient, there could be an arrow pointing to the left, indicating that it has to be removed.	The sound is a good indicator that the goal has been reached. It can also make sound when is over limit.	The person paid attention just to the numbers because he was used with them. He doesn't see the point of having the light if you understand numbers. For people that have problems understanding amounts, it can be a learning process to have both numbers and light at the same time, that maybe in time the person will learn how much 200 g means.	Width: 80 mm Height: 10 mm The longer the light bar is, the more accurate and precise it gets.
<b>Sum up</b>	The testing just with the light bar were performed correctly. It is difficult to understand how much of the ingredient has to be taken out, since there is no correlation with amounts. Further considerations have to be made on the colors used for the indication and for the illustration of the limit bar. Visual feedback can also be considered (arrows).	The sound proved to be a good indicator in most of the cases. The sound can either be used when reaching the right amount or/and when going over the limit, to indicate that it has been added too much.	The persons are used to rely on the numbers. The fact that the movement of the light bar was not as accurate as the numbers displayed influenced the decision of where to look from the two options. The placing of the numbers has to be further developed.	Width: 55 mm - 1 choices 60 mm - 0 choices 65 mm - 1 choices 70 mm - 1 choices 75 mm - 4 choices <b>80 mm - 5 choices</b>  Height: <b>10 mm - 4 choices</b> 12 mm - 2 choices 14 mm - 2 choices 16 mm - 2 choices 18 mm - 0 choices

General observations from the person that controlled the tests:

- In the case when the testing person went over the limit, he/she could not know how much extra they went over, therefore they could not know how much they have to take out.
- The quality of the tests were influenced by the not-very-accurate response from the light bar, since the light bar was maneuvered manually.

### Dimensions of the numbers

The numbers visible on kitchen scales should ensure a proper visibility from a distance of maximum 130 mm - the distance between the scale placed on the counter-top and the visual sight of the user, standing up (Ill. 6).

The height of the numbers on one of the scales is of 14,4 mm (Ill. 7) and on the other one is (Ill. 8).

### Final dimensions of the screen

The results from the tests showed that the dimensions of 10 x 80 mm for the screen are desired.

By combining those dimensions with the dimensions of the numbers, the size of 16 x 80 mm is considered as optimal.

### Illustration list:

Ill. 1 to 8. Own illustrations



Ill. 6. Distance between eyes and scale



Ill. 7. Size of numbers, 1

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### Evaluation:

The tests proved that the system of the light/bar is understandable and functional.

The size of the screen is chosen as a combination from the tests and the size of numbers: 16 x 80 mm

### Reflection:

Further refinements and tests need to be performed with a functional model to create a more appropriate test scenario.

**Activity:****Second test with the System of Objects****Objective:**

In the second test with the system of objects, the interaction and overall understanding of the system of objects has been tested with Jeanette Gadegaard. This test is made with Version no. 2 of the recipe, which can be found in Appendix folder 8. In Version no. 2, some of the steps has been edited in relation to errors in Version no. 1 and some of the steps has been defined more specific and detailed. The steps in this recipe are moved forth and back when Jeanette says next and back. One of the focus-points in this test, is the see if Jeanette remember what to say in order to make the app move forward and backwards. Likewise to write down which words she uses. Second focus is to see if she understands the instructions. Both written instructions, videos and spoken instructions as well as what she prefer.

The steps that are pointed out in the following worksheet are the once where she needed a little more help than the guidance provided.

After the test it is the intention for her to try the handle suggestions created for the utensils in the system of objects and pointed out her preference. Furthermore the goal is for her to evaluate on text-size and overall structure for the app.

**Experiment/data:****Potatoes:**

In this test there are videos showing each step together with a written text. See appendix 8.1

**Step 1 (this part starts at 00:00:00 in Appendix 8.7)**

*In this step she is told to gather all the ingredients and utensils shown in the picture.*

It is hard for her to see and understand the picture. What needs to be found and how much. The items on the picture are simply too small and too complex.

She starts taking a pot, which is too small to contain all the potatoes. It is much smaller than the one in the picture. The pot in the picture is relatively big in relation to the rest of the items.

- A better explanation of the size of the pot is needed.
- Furthermore, another way of showing the items needed.

**Step 2**

*In this step she is told to open the bag of potatoes and uses a scissor to open up the bag.*

- A scissor might need to be included in the starting guidance for what is needed.

**Step 3**

*In this step she is told to measure the potatoes on the scale (see ill. 1).*

She measures the potatoes and is good at understanding the scale-system. She is in doubt of how many potatoes she needs and is only adding one at the time because she does not know how much is needed.

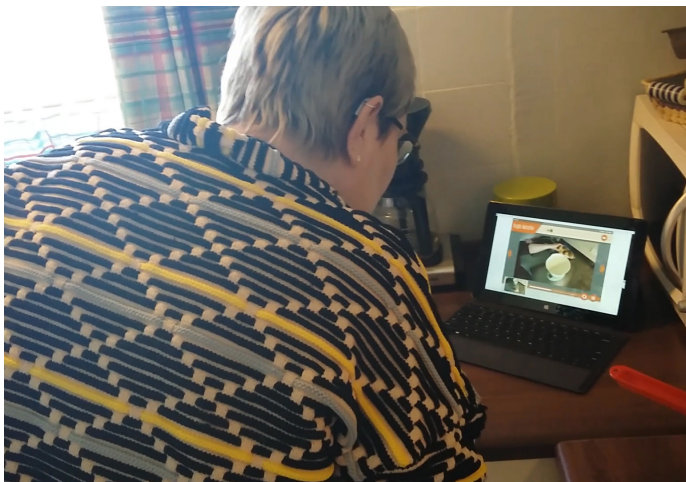
- A better indication of how many potatoes are needed.

**Step 5**

*In this step she is asked to plug the sink (see ill. 2).*

She plugs the sink, but the water will not stay in the sink. Therefore, she lets the water to run while peeling.

- In this step a washtub could be added to peel the potatoes in.
- Or the system of objects could suggest different ways of doing the task and the user could chose the preferred way.



Ill. 1 - Jeanette looking at the guidance and reading out loud



Ill. 2 - Jeanette having problems plugging the sink.

### Step 7

In this step she is asked to start peeling the potatoes and put them in the pot.

She takes the measuring bowl away from the scale and starts peeling (see ill. 3). At the same time as peeling, she wants to cut the potatoes and asks if it is okay (see ill. 4). She also wants to put water in the pot because she remembers that she used to do that.

- It is clear that she is affected by old habits in relation to peeling the potatoes. The intension was that she should not cut the potatoes until the next step.
- She does not know the system yet and will not know that it will guide her through.
- In this step the intension was also for the scale to know when the bowl is empty, but since she has taken the bowl away from the scale, it will not know.

Right after finishing this step, she wants to throw away the potato peels and does so.

- She does not know that the guide will tell her to do this in a later step
- She is in doubt of if the guide will guide her to do it or not.
- She might benefit from an overview of the whole task from the beginning. This way she will have a change of knowing what steps are included
- By knowing the steps she might trust and rely more on the guide to take her through everything.



Ill. 3 - Jeanette peeling potatoes.



Ill. 4 - Jeanette cutting the potatoes right after peeling them.

### Step 9

In this step she is asked to cut the potatoes in half, which she did already. She knows that she did it and just skip this step.

- If the system would know that she did this already it would just skip this step by itself.
- If it could recognize a pattern where there is a change between movement with peeler and knife in this step it would know that the step has been met.

### Step 11

In this step she has to measure the salt and is in doubt of she should fill up the spoon (see ill. 5).

- This indicates that she needs to have a more detailed introduction to the system of objects. She needs to become familiar with the system of objects which will not just happen by using it one time.

### Step 13

She has to set the stove to highest temperature, but has another stove than the one filmed. She has a gas stove.

- In order to help users with different stoves an investigation of stoves has to be made. The user could simply let the system of objects know the type of stove in the configuration and then the system would adjust according to the type of stove.
- This will also affect the cooking-time.

### Step 17-18

In these steps she is told to clean up the items used for the cooking.

She cleaned them and pointed out that it is easier to clean up while cooking in order to avoid a lot of cleaning in the end.

### Step 21

In this step she has to check if the potatoes are boiling. This step will appear 5 minutes after previous step and interrupt the pork-part. It asks her to answer yes or no to if the potatoes are boiling. If yes she will be taken to the next step in the potato-part, If no she will go back to the pork part and will be reminded again 2 minutes later to check again.

- If the guide did not remind her of checking, she would not notice if they were boiling.
- It took much longer to get the potatoes to a boil and she therefore went through this step many times.
- It took 13 minutes to reach a boil.
- Instead of setting a timer this could be solved with a thermometer to tell her that it is boiling.
- It might also be solved if the system knows the type of stove, pot and amount of water used.
- She kept checking many times before the potatoes were boiling (3-4 times)



Ill. 5 - Jeanette adding salt to the potatoes.



Ill. 6 - Jeanette getting help with checking the potatoes.

### Step 24

In this step she is asked to check the potatoes. This step will appear 20 minutes after previous step and interrupt the next part. She is asked to answer yes or no to if the potatoes are boiled. If yes she will be taken to the next step in the potato-part, If no she will be taken back to the pork-part and be reminded again 5 minutes later.

- She went through this step twice and needed help to define if the potatoes are done (see ill. 6).
- She need some kind of indication if the potatoes are done.
- It is more important for her that they are cooked enough than undercooked.

### Overall

She is a little confused at first and starts reading out loud what she needs to do.

She follows the steps and is a little ahead of the guidance in some of the steps. She does not get confused when she gets ahead and is good at continuing quickly to the next step. She is reading out loud what she has to do all the way through and does not pay attention to the videos (see ill. 7). She says that it is hard for her to pay attention to two things at the same time. She is very fast at reading and just does so. Maybe the videos should be optional?

She says that she did not pay attention to the picture in the corner that shows that previous step and she did not pay attention to the top-bar indicating how far she is in the process either. She cannot focus on more than one step at the time. Also she kept forgetting what to say in order to make it move forward.

The words used to make the app move forward is:

Next (Næste)

Continue (videre)

Yes (Ja)

Yes Continue (Ja så videre)

Yes, Next (Ja næste)

### Pork - part

In this test there are videos showing each step together with a written text and voiceover. See appendix 8.2

#### Step 1 (this part starts at 00:20:41 in Appendix 8.7)

In this step there is a picture with the ingredients and utensils needed for the task.

She has same challenges in this part as in the first one with the potatoes (See step 1 in the potato-part). It is hard for her to see all the items shown.



Ill. 7 - Jeanette looking at the guidance and reading out loud



Ill. 8 - Jeanette adding pepper to the pork.

### Step 3

She measures the pork and seems to be more familiar with the scale this time. She ends up with two pieces of pork left.

### Step 7

In this step she is told to put the rest of the pork in the fridge, but since she only has two pieces left it does not make sense.

- If the guidance would start by making her type in the amount of meat she has, it might be able to adjust according to it.
- The system of objects could have a percentage that allows it to decide what happens to the rest of the meat.
- The user should not have to peel more potatoes or add more salt and pepper, it would just allow for the last two pieces to be a part of the recipe.

### Step 9

In this step she is asked to measure pepper in a measuring spoon.

- She cannot put pepper in the measuring spoon and end up put putting pepper on the pork from the pepper shaker (see ill. 8). (This way the pepper adding can not be controlled)
- Another solution for adding pepper has to be found.
- The user need help to know how much pepper to add.
- Maybe a smart-pepper-shaker? or Pepper dispenser.

### Step 10

In this step she has just put all the pork on the cutting board and added salt and pepper. She asks if the guidance will tell her to turn them and put salt and pepper on the other side as well. I answer yes and she wait for the guidance to take her through it.

- Again it is confirmed that she need some kind of help understand and know that all the steps she has to go through on forehand. Or simply get more familiar with the system of objects in order to trust and rely on it.

### Step 14

In this step she was asked to put two pieces of paper towel on a plate and put it close to the pan.

- She got a little confused and read it wrong. She thought at first the paper towel should go on the pan.
- This step could be divided in two.
  - o Putting the paper on the plate
  - o Putting the plate next to the pan



Ill. 9 - Jeanette measuring butter.



Ill 10 - Jeanette looking at the guidance and reading out loud

### Step 16

In this step she was asked to put butter on the pan. Since it does not tell how much butter she needs, she was in doubt of how much (see ill. 9).

- Maybe the butter should also be measured on the scale in this step.

### Step 19-36

In these steps she was asked to turn the pork every time a green circle was finished. This did not work and she told that she would prefer to just keep track on the pork on her own. Maybe with some kind of reference to when they had to be turned. She was standing and looking at the circle all the time, but tried to keep track on the pork also (see ill. 11-14).

- She did not trust the guidance that the pork was done when the timing was over and was not satisfied with the result because the pork was not crispy. She wanted the pork to be crisp and the guidance did not make it crisp.
- A solution could be for the system to keep track on the movement of the turner and remind her of using it if she did not moved it for 2 or 3 minutes. The step would then only show the action and tell to keep frying until the pork has the desired crisp and color.
- In reflection to knowing when the pork is done a reference picture might be the solution or the turner would need some kind of sensor to know the color or crisp?



III 11 - Jeanette looking at the green circle.



III 12 - Jeanette checking the pork.



III 13 - Jeanette looking at the green circle.



III 14 - Jeanette looking at the green circle.

### Overall

This time she was more relaxed and trusted the guidance more to take her through all the steps.

In this part the intension was for the guidance to have voiceover, but because she keep reading out loud what to do it is decided to silence the voiceover. The guide would not be able to do this without some kind of artificial intelligence, knowing when it is interrupting.

Making the pork went very well, but she was very disappointed that she did not get the pork crisp, because her husband is able to make it crisp. When she finished the first half of the pork she put silver paper on it to keep it hot which was not included in the guide.

### Sauce - part

In this part there are videos showing each step together with voiceover. See appendix 8.3

#### Step 1 (this part starts at 00:31:39 in Appendix 8.7)

In this step she is asked to find all the ingredients and utensils needed

- She starts finding the items, but does not see the cutting-board and knife.

#### Step 4

In this step she is asked to wash the parsley. She is in doubt of how to wash it and asks how to do it.

- A more specific and detailed description of how to do this is needed.

#### Step 5

In this step she is told to cut the parsley (see ill. 15).

- She has a hard time doing it with the knife. It is simply not sharp enough.
- She tells that she would have preferred to do it with a parsley-cutter, but she is not sure if they have one.
- If the system knows exactly everything the user has in the kitchen it could be able to adapt and use the tools from the kitchen.
- This means that more movies of the same action have to be made, with different approaches.
- Likewise the user might have a harder time finding all the tools needed if it is tools not used very often.

#### Step 6

In this step she is asked to measure the butter.

- She does not have any idea of how much to add she asks for a reference. She tells that she would be able to use the numbers on the package as a reference.



Ill. 15 - Jeanette cutting a checking parsley size.



Ill. 16 - Jeanette adding milk to the butter-mix.

### Step 15

In this step she is told that it is time to put the milk in (see ill. 16).

She is almost about to put all the milk in but it was not the intention yet. This step should be deleted.

### Step 22

This step tells her to keep stirring until the sauce has a nice thickness.

- She is in doubt of if the sauce should boil or not.

### Overall

She ends up with a very nice sauce. Depending on preference the parsley could have been cut smaller and she could have added more. The success in this part was that there was no lumps in the sauce, but it was still more important for her that she did not get the pork crisp.

In this part she was told what to do instead of her having to read it every time. She told that she preferred it this way.

### Test - reflection and evaluation:

The guide-type she preferred was the one where she was told what to do instead of having to read what to do every time. She used many different words for going forward and did not go backwards. She simply did not remember what to say. She told that she would prefer to find all the things needed for all the three recipes at the same time in the beginning and put them somewhere from the beginning.

Likewise, she said that she would prefer if the first step in each recipe was to measure everything in bowls and have them ready.

A few times she asked if the guidance would help her to do something. This indicate that she would need to build up trust and get familiar with the system of objects before relying completely on it.

This could be done by using the system of objects many times or it could maybe be achieved if the system of objects gave her a quick review of the task every time before starting. Likewise a button could be added in the steps where she could push if she wants to know or see the whole structure of the task again.

She liked the scale-system a lot, but would like to get some kind of indicator to understand the amount before starting adding it to the scale. Likewise the scale should maybe be able to accept a little more or a little less than the recipe say.

In most of the steps she did only listen or read the instructions and did not look at the videos. She told that it was very hard for her to concentrate both at reading, listening and watch the video.

In general she did very well and it was not visible at all that she had difficulties understanding the system in a cooking-task. She said that she would never have been able to do it without the guidance. Likewise, she said that if she was alone with the cooking she would maybe need some kind of reminding regarding doing the steps (Only if she would loose track of time).

In order for her to have a successful experience she would like the pork to be crisp, it did not matter if the potatoes was boiled too much, but they should not be undercooked. She was happy that the sauce had no lumps, but it was not as important as the pork being crisp.

In the end she wanted to clean up and the intension was for her to put the utensils in a charging bowl. We did not test this, but after ending the test she was helped to clean up the kitchen where she actually forgot the measuring spoons in the salt and flour bowls, when putting them away. This indicates that she would need help to remember to put the smart utensils back into a charging bowl.

If the system helped her to clean up the kitchen, it would also help her to put the utensils back into the charging bowl.

After the test ended, it was shortly revised and the handles of the utensils were tested.

She was told about the idea with the measuring bowl to light up in order to show how much she would need. This idea she liked because she has troubles understanding how much to measure in a normal measuring cup.

It should though not be combined with the scale because she would not be able to refer to two measurements and would expect the scale to tell her the amount if she was using it.

## Revising the test and interface.

Listen to appendix 8.4 for whole conversation (Danish)

**Ulla:**

How did you like that you had to say next in order to go to the next step? I noted that you used many different words in order to move on.

**Jeanette:**

I could not remember what to say.

**Ulla:**

Would you prefer to just push a button?

*(Before the test started she thought that is was a good idea with voice-recognition )*

**Jeanette:**

Yes, I think I would like that better.

**Ulla:**

I ask because we want you to feel in control of the system.

**Jeanette:**

But couldn't it just have both features? For those that remember what to say.

**Ulla:**

Yes of course.

**Ulla:**

It seemed like the system sometimes was running away from you. Is that right?

**Jeanette:**

Yes, It was definitely hard to remember to say something every time.

**Jeanette:**

In a lot of the steps I remembered what to do and then I was in doubt of if I would come in one of the next steps or not. As an example when the step about peeling the potatoes came I was i doubt of if I should put water in the pot or not. The step did not tell me to, but I was not sure if I had to do it anyway or if the guide would tell me to.

**Ulla:**

Yes because the guide took you to that step later.

**Jeanette:**

I think if you got more used to using the app, it would be much easier. You have to get familiar with it. Because by just using it once you still have to get used to it no matter if you have a brain injury or not.

But with this system I could differently make the meal and that would not be possible without it.

**Ulla:**

Good. I guess we have succeed in deepening the steps.

**Jeanette:**

Yes I think so, but the part with frying the pork and the 3 minutes was not working for me. I was waiting for it all the time. I would prefer just to keep track on the frying myself. Of course I would be in doubt of how long time it would take to fry the pork and when it would be done, but it did not work for me with the green circle. The picture was also misleading I think.

**Ulla:**

Okay. At the moment we are trying to find out how to lead every step to success and are trying to find out where the difficulties arise.

For example would it be okay for you if the pork is done, but not crisp or would you prefer to have it crisp, but risk that it would burn. Likewise what is the criteria for success in the other two parts?

**Jeanette:**

I don't know, but I did not know when the pork was done. I would though have liked it to be crisp. The sauce went very well and I know that it is hard to get a sauce without lumps. The idea with the cup to add milk was very smart. In relation to the potatoes I was also in doubt of if they were ready or not. It is really hard for me to find out if they are ready or not by using a fork.

**Ulla:**

That is also very hard to explain by words.

**Jeanette:**

Yes and some people like them boiled less or more than others. Maybe if you put a fork in the potato they should fall apart? Is that right?

**Ulla:**

Yes then they are definitely done and maybe a little too done.

**Jeanette:**

Yes but I would prefer them to be a little too done than raw though.

**Anca:**

What do you think about it overall? is it precise enough?

**Jeanette:**

I think it all went very well. The Sauce went very well.

**Anca:**

Should the scale maybe have some kind of sound to tell when the measurement was reached?

**Jeanette:**

Yes that would be smart.

**Anca:**

Yes because I forgot to say “ding“ but you managed to measure right anyway.

**Jeanette:**

Yes but I think it would be a good idea with a sound.

**Jeanette:**

Can I reheat the sauce? It is okay when it contains parsley?

**Ulla:**

Yes that is not a problem.

**Ulla:**

I want to ask you another question. It is because we also consider to have a measuring bowl with a light that lights up to the point where you have to put milk. It should be placed on the scale and then just light up to the point where you have to pour milk.

Would it be confusing for you if the measuring bowl was standing on the scale. The scale will not light but the measuring bowl will instead.

**Jeanette:**

It would confuse me a lot. When the bowl is on the scale I would expect to use it and I would definitely not be able to refer to both the measuring bowl and the scale at the same time.

**Anca:**

So which one do you think you would prefer?

**Jeanette:**

I think the scale worked very well so I see no reason for not choosing that one. It was used for everything so that was easy.

**Anca:**

I guess it will be hard for you to focus on two measurements at the same time.

**Jeanette:**

Yes that would be too hard and confusing, but it is best with the scale. When it is used for all the other steps.

**Anca:**

Would it be confusing if we placed numbers also on the same screen?

**Jeanette:**

I think so, but I don't know. Maybe it would be confusing for a person with a brain damage. You can not overcome too many things at the same time.

**Ulla:**

What if you use another bowl on the scale. Would you need help to remember to reset it?

**Jeanette:**

Yes I would need that. I was in doubt myself in the guide if I had to reset or if it did it automatically.

**Ulla:**

The first idea was that you would always use the same bowl with the scale and it would automatically know the weight of the bowl.

**Jeanette:**

Yes that would be smart, but I think I would like to use other bowls and plates on it as well. For measuring smaller amounts.

**Ulla:**

I noted that you also had a little troubles cutting the parsley. Is that right? Did you consider that they were cut in the right size?

**Jeanette:**

No I did not really consider that. I was a little confused about why the guide did not tell me to use a parsley-cutter, but on the other hand I actually don't know if we have one.

**Ulla:**

That is because we want to make sure that the utensils used in the guidance can be found in most kitchens.

**Jeanette:**

Okay, but normally I would use a parsley-cutter, because it is not that easy to cut it with a knife.

**Ulla:**

If you saw the video and followed the guidance, would you then be able to think in alternatives and just decide to cut the parsley in your own way?

**Jeanette:**

I think so, but I know that many other with a brain injury would not be able to. I still remember a little from my cooking-assistance education.

**Ulla:**

Yes.

**Jeanette:**

I think it was really hard to cut the parsley this way, but it is the same with onion and other things I have to cut like that. The action is difficult, but I managed to make the food anyway.

The knife and cutting-board were not in the first picture was it?

**Ulla:**

Yes they were.

**Jeanette:**

Okay then I just did not see them.

**Ulla:**

I think the start pictures we have to revise.

**Jeanette:**

Yes it was very confusing and hard to understand. Especially when there is no words telling what the items are. When you have a brain injury you have a hard time dealing with too many things at the same time.

**Ulla:**

Okay.

**Anca:**

Would it be easier to just have one thing shown at the time?

**Jeanette:**

Yes that would be much easier. I will also suggest that everything is found from the beginning. Just have it placed on a table somewhere.

**Ulla:**

Okay.

**Jeanette:**

I think if I was alone and I had to find everything on my own while cooking, I would not be able to keep track on it.

**Ulla:**

Our only concern in relation to finding all the ingredients and utensils from the beginning is the space in the kitchen. But of course you have space enough.

**Ulla:**

I have another question.

One of our main ideas is to track the utensils used in the cooking. This mean that they have to be charged. This will happen in a bowl where you have to place all the utensils after use. Would you remember to put them in a specific place after use?

**Jeanette:**

Yes if the guide helped me to clean up the kitchen after cooking and help me putting the stuff back in the right spots. Another thing is also that the user would have an easier time finding all the utensils next time if they were all in the same place on the table top.

**Ulla:**

Thank you so much for helping us.

Next up I have some handles I would ask you to try and evaluate. Which one feels nice in your hand.

### Test with the utensil handles

Jeanette was shown seven different handles, in order for her to choose which one would be best suitable (Ill. 17). She started pointing out that all the utensil handles had a good size in reflection to the target-group. It is not unusual for people with brain injuries to have difficulties holding small handles.

Her comments are as follows:

This one - no. 5 - is very wide and has a good size (Ill. 18). This one - no. 4 - is also good (Ill. 19). Some people with brain injuries have a withered hand and would therefore benefit from a big handle. It is actually really good the one I a, holding right know (Ill. 19) From these two I prefer the white one. That one is lighter.

From the printed handles (No. 1, 4, 5) she prefers no. 4. Afterwards she tried to imagine that the utensil is other utensil (Ill. 20) and says that handle 4 - bend is still her preference.

Afterwards she tried the foam handles (No. 2, 3, 6, 7) and was asked to try different grips (Ill. 21). From those she liked no. 3 the most and also liked the lightness of them a lot.



Ill. 17. The handle versions



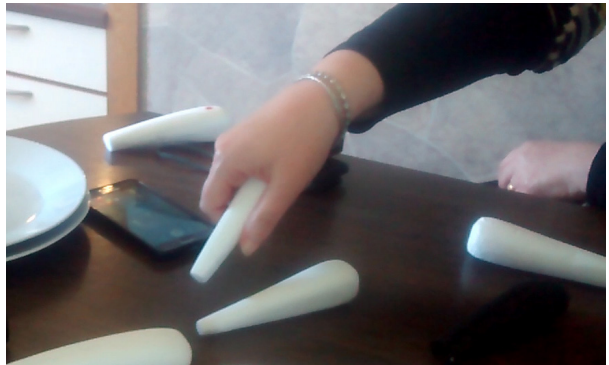
III. 18. Handle 5



III. 19. Handle 4



III. 20. Imagining that the utensil is another type of utensil - a whisk and a knife.



III. 21. Jeanette holding the foam handles with different grips. Her preference is the yellow one

### Test with text size (Appendix 8.8)

In this test she was shortly asked to pick out the text size that she preferred. She was able to read all the text sizes, but preferred size 22 or bigger. The bigger the better she said. The font chosen for this test was Helvetica Neue LT Std. The sizes tested are as follows:

Helvetica Neue LT Std (12 pt)

Helvetica Neue LT Std (14 pt)

Helvetica Neue LT Std (16 pt)

Helvetica Neue LT Std (18 pt)

Helvetica Neue LT Std (20 pt)

Helvetica Neue LT Std (22 pt)

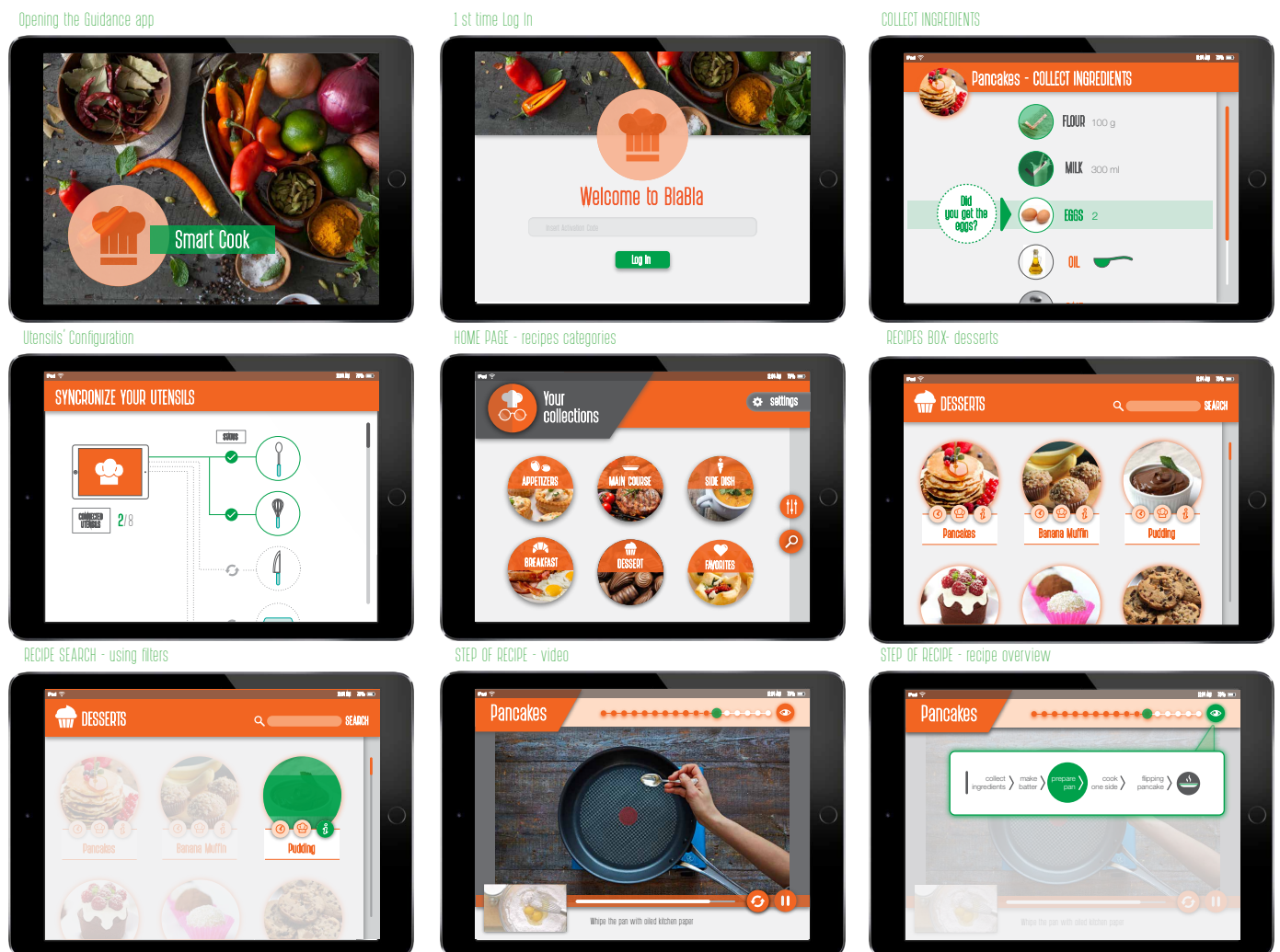
### Review of the app

At the end of the tests, a quick review of the app interfaces was made (Ill. 22, Appendix 8.6). In this, she liked that the colors used were very different. It was easy for her to distinguish between the colors used.

The interface was simple and easy to overcome, but she also pointed out that she did not pay attention to all the details of the interface while testing. After using it more than once she would probably get used with it.

In the app interface there was another suggestion of finding all the ingredients that she thought would be easier than the one in the test. In this part the ingredients and utensils are shown one at the time and should be checked in order to continue.

All videos filmed while testing can be found in Appendix folder 8.7.



Ill. 22. App guidance shown to Jeanette

## Illustration list:

III. 1 - 22 own illustrations

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## Evaluation:

Throughout the test it was discovered that the starting picture with all the ingredients and utensils was too difficult for Jeanette to handle. After the test another suggestion was shown to her with all the ingredients and utensils shown separately. This she thought would be easier.

It was discovered that she had a hard time understanding the size of the pot used for boiling the potatoes and therefore a way of showing or explaining sizes has to be found. For other parts of the recipe she also needed a better indication of sizes and amounts before measuring it on the scale.

When opening up the potatoes, she used a scissor and that might need to be included in the starting guidance.

In some parts of the guidance she was told to perform an action in a different way than she is used to. Therefore it has to be decided whether the system should have more different guidance-videos to perform a task. In this case, the system would need to know user preferences and tools found in the user's kitchen. Few times it was made clear that she was very affected by old habits which made her perform some tasks before the guidance got to them. She was also often in doubt of if the system would tell her to do something or if she should do it on her own. This might be solved with an overview of the whole cooking task before starting cooking. The user might not remember all the steps, but might remember that everything was included.

Another solution could be to track the movement of the utensils and thereby let the system of objects know that if the user is using the utensils in this pattern, it can skip a step.

The guidance made for this test is based on a specific stove and while testing it with Jeanette the timing set for boiling the potatoes did not fit. Therefore a solution regarding keeping track on the boiling potatoes has to be found. Maybe by including a thermometer as earlier suggested.

In the test it was tested if she would remember what word to say and also which words she would use. She used many different words such as: Next (Næste), Continue (videre), Yes (Ja), Yes Continue (Ja så videre), Yes, Next (Ja næste). Mostly she just said yes while looking at the tablet as a indication to move on.

In the pork-part she was asked to measure the meat and after scaling it she had two pieces left. Because it does not make sense only put those two pieces back into the fridge a solution has to be found. In general the scale will need some kind of acceptance of a difference in the measurement. For example if the measurement was meant to be 200 g the scale would also accept 189 g and 206 g.

In the part where she was asked to add pepper she was not able to put pepper into the measuring spoon. Therefore another way of indication amount of pepper has to be found.

She also had troubles defining if the potatoes and pork was done. For this a solution has to be found.

In general the test went very well and many areas of further work has been found to make the guidance even more suitable for the target-group. With this guidance she would be able to make the dish.

After the test the criteria of success was discussed. The perfect dish would end up with crisp pork, which did not happen. She was pleased with the potatoes and the gravy. Therefore it is very important to further state the criteria for success for each meal created with the system of objects.

Furthermore the handles for the utensils was tested. From the handles she likes handle 9 bend the most both because it was wide and light.

Likewise she evaluated the app and pointed out that both the colors and simpleness worked very well.

## Reflection:

This test went very well and a lot of important feedback was given. Jeanette was really good at giving constructive feedback and was not afraid to speak her mind. If possible it would be great to have another test with another test subject.

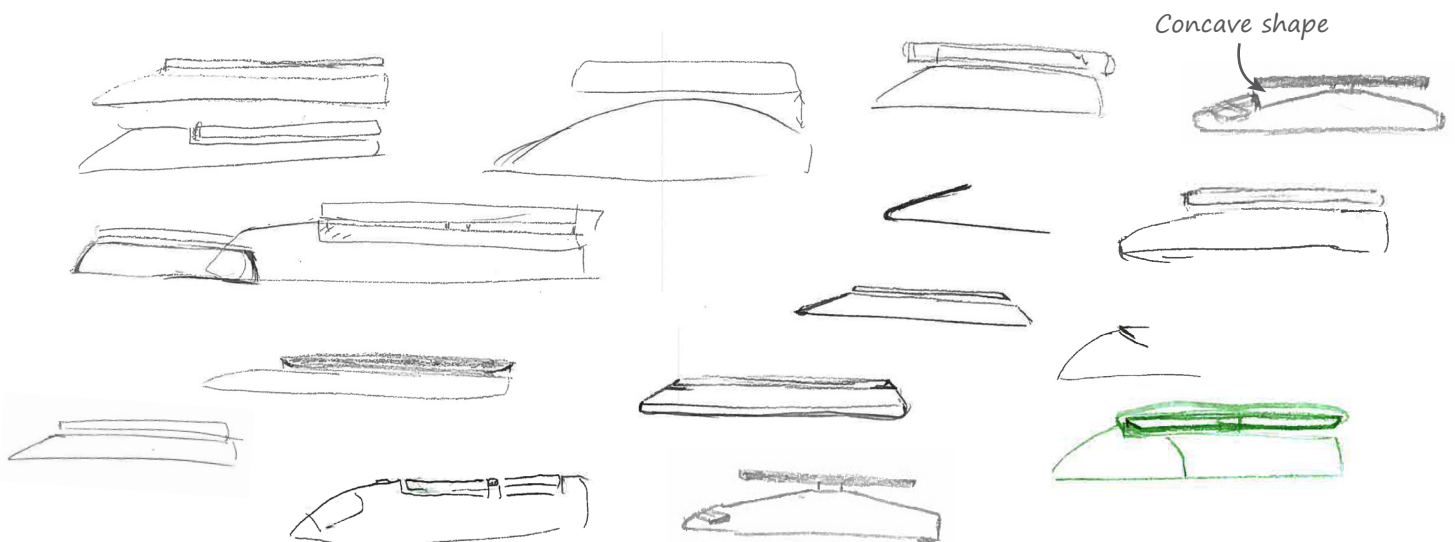
**Activity:****Shape and color of the scale****Objective:**

Find the right shape for the smart-scale by considering and analyzing different proposals.

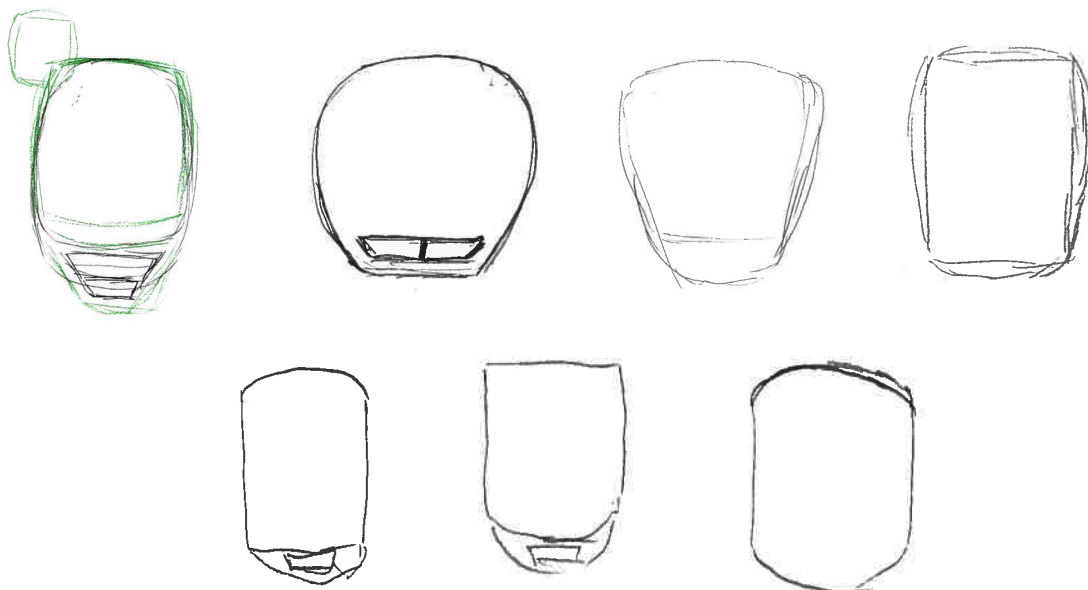
**Experiment/data:****Scale ideation**

For determining the shape of the scale, a series of ideas have been proposed and analyzed (Ill. 1, 2, 3, 4). The existing scales are used as starting point for the dimensions of the scale.

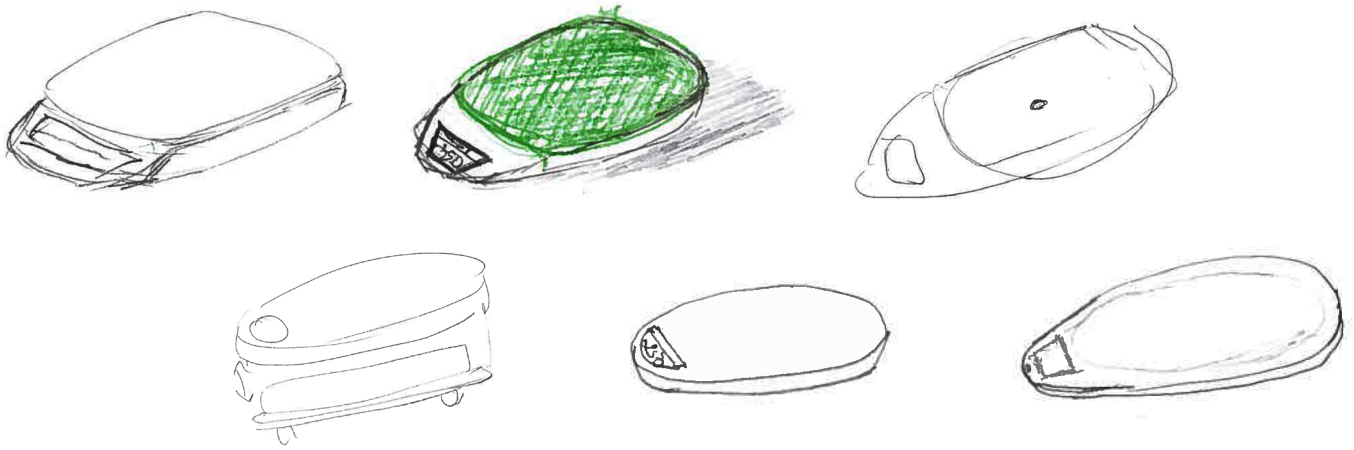
The shape should ensure that the electrical components are not easily exposed to liquids, in case of pouring from the top, on the top-part of the scale. This can be solved by having a concave shape underneath the round top-part, that would direct the liquid go on the sides and not in the center. The position of the screen also plays an important role for the experience of the user while using the scale. The inclined screen is considered as most comprehensive.



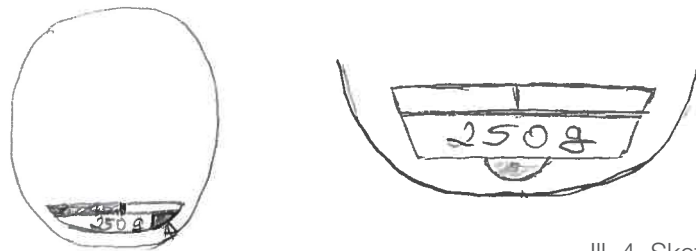
Ill. 1. Sketches of the scale from the side



Ill. 2. Sketches of the scale from the top



III. 3. Sketches of the scale, isometric view



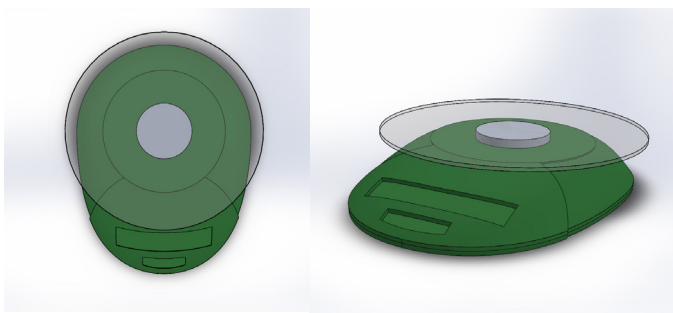
III. 4. Sketches of the screen interface

### Scale suggestions 1-3

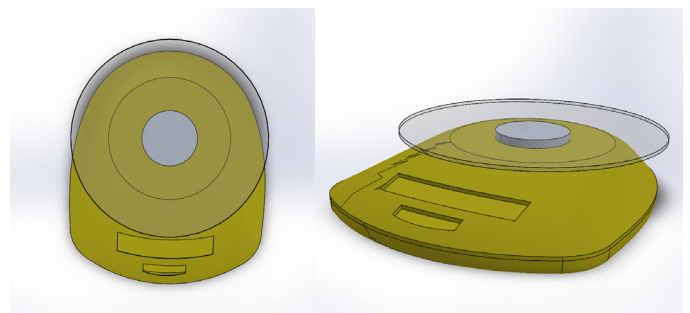
Three scale-suggestions (III. 5, 6, 7) are created to explore different shapes with the same ground principle. The ground principle for these scales are a highlighting of the scaling effect, by separating the top-part from the scale-body. Likewise, they are inspired by scales currently found on the market to make a scale that is recognizable. The top-part is transparent and could be made either from plastic or glass. The scale-body is opaque and could be made from either plastic or metal.

The display part is stretched from the scale-body in order to create easy asses to the display for the user.

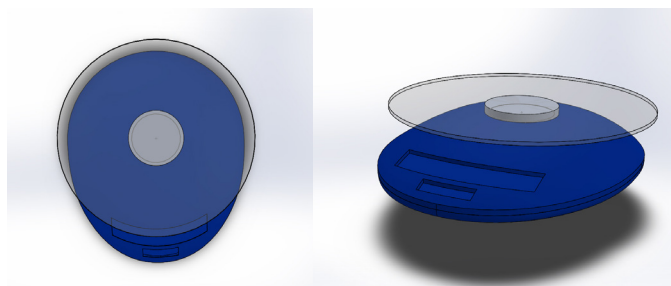
Note: The colors are just to distinguish between the different scales.



III. 5. Scale suggestion 1



III. 6. Scale suggestion 2



III. 7. Scale suggestion 3

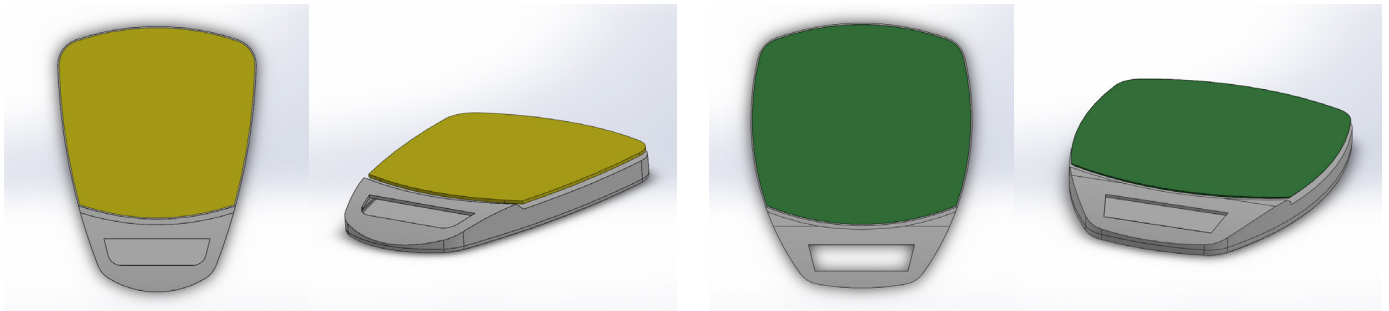
### Scale suggestions 4-5

The ground principle explored for these scale-suggestions (III. 8, 9) is to make the top-part an integrated part of the scale-body. Likewise, a more edgy expression has been explored.

Both the top-part and scale-body are made from an opaque material such as plastic or metal.

In these suggestions, the display-part is likewise stretched from the scale-body in order to make easy access for the user.

Note: The colors are just to distinguish between the different scales.



III.8. Scale suggestion 4

III.9. Scale suggestion 4

### Scale suggestions 6-8

After exploring the expressions shown in III. 5 - 9, a combination has been made.

The edgy display-part has been combined with a rounded scale-body in order to both keep the illusion of an old-fashioned scale, and to make it recognizable.

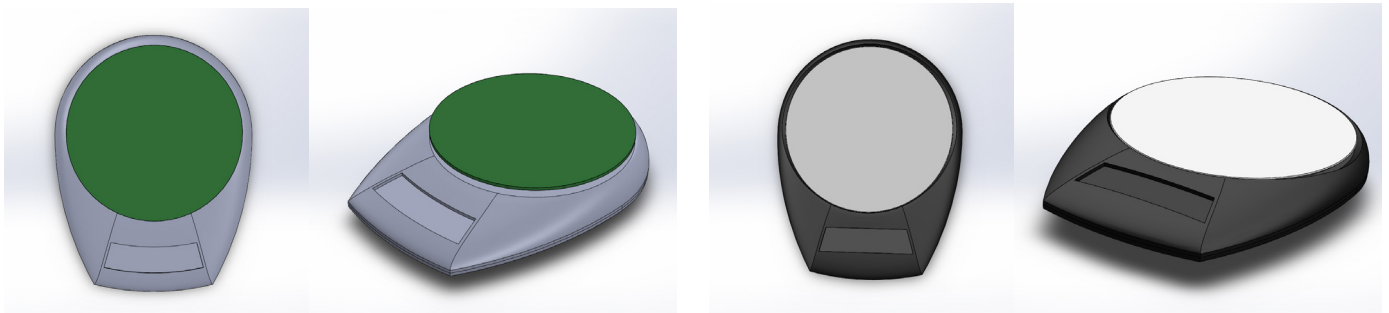
It is a criteria that the top-part should be able to be separated from the scale-body. One of the easiest ways to do so is by unscrewing it.

Therefore the top-part has to be in a shape / size where no corners interfere with the scale-body. Likewise, the placement of the top-part is important in order to avoid interference with the scale-body, so .

Another criteria for the top-part is to make it in a shape that distributes the measurement evenly across the plate.

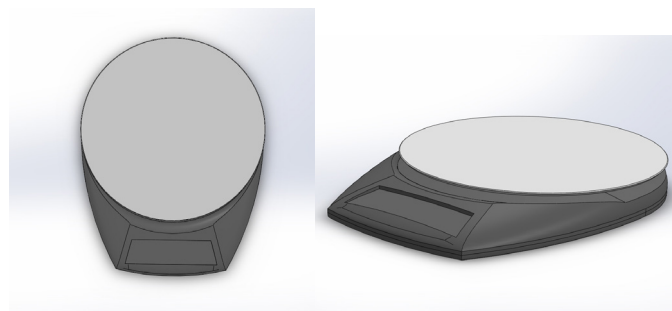
Therefore the shape for the top-part has been chosen to be circular.

In illustration 6 and 8. the top-part is elevated above the scale-body which make it easily accessible in order to unscrew it.

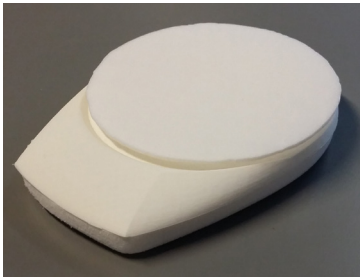


III.10. Scale suggestion 6

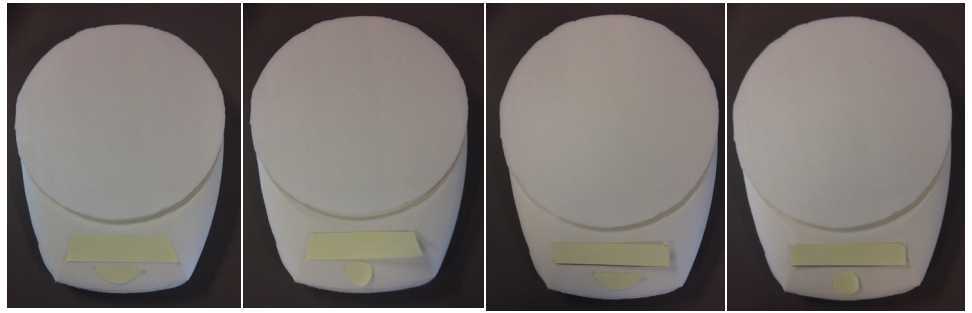
III.11. Scale suggestion 7



III. 12. Scale suggestion 8



III.13. 3D model



III.14. Types of screens and buttons

### Scale 3D printed

The version presented in III. 12 is 3D printed (III. 13), in order to get a tangible feeling of the scale's shape and to make several versions for the screen and the power / tare button (III. 14).

The screen should have straight margins, so when the light bar appears, it is visible all over the height.

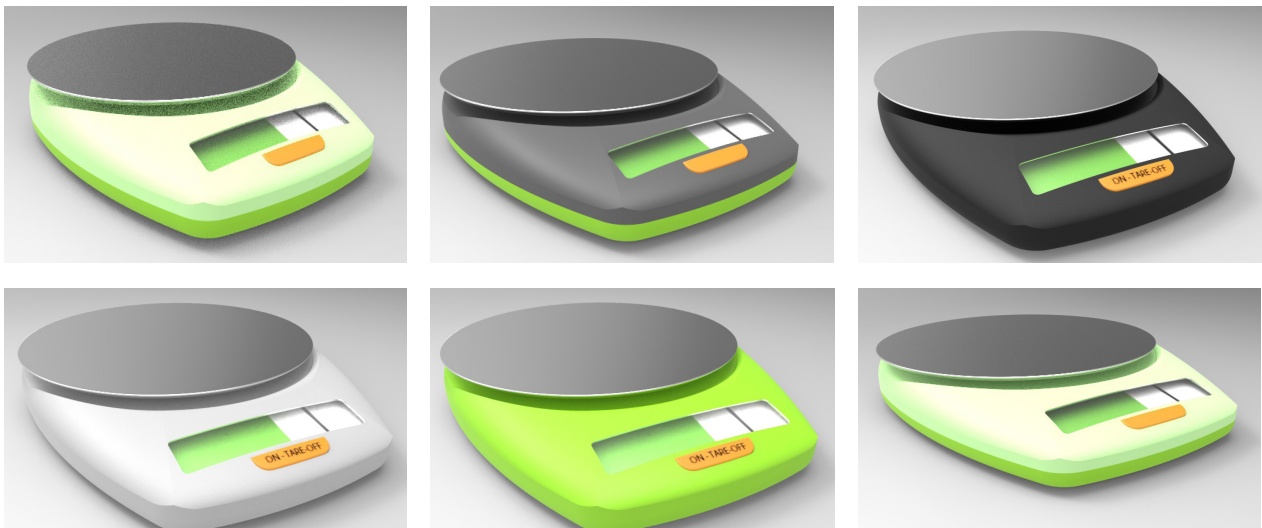
The scale should be powered by the user. The button's shape is explored, with the desire of merging the shape of the button in the overall shape of the scale.

Having a separate button for the TARE function is considered, since it might make the interaction of the user with the scale more comprehensible. Having one functionality per button eases the interaction.

### Colors for the Scale

Different combinations of the colors used in the guidance have been tried out.

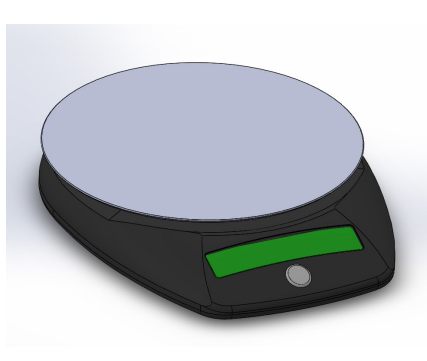
It is desired to have shape and color assimilation between the scale, the utensils and the guidance.



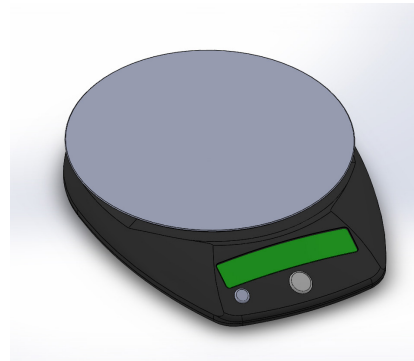
III.15. Color versions for the scale

### Buttons

The scale is activated by the press of a button. Also, when the TARE function is needed, a button needs to be pressed again. The versions of having one button for both functions or having one button for each function are analyzed. For minimizing the risk of error and of misleading the user, the use of a button per function has been considered the best option (III. 16, 17). The placement of the ON / OFF button is strategic, in the center. The TARE button is placed on the left side, under the screen, for offering the understanding that, by pressing it, the green line will move to the left, will disappear.



III.16. Scale with one button



III.17. Scale with one button

**Illustration list:**

Ill. 1 to 17. Own illustrations

---

**Evaluation:**

The following conclusions have been drawn:

- The shape of the scale should ensure an intuitive interaction and purpose.
- The shape of the scale should ensure that the inner components are not easily exposed to liquids, in case of pouring from above.
- The screen's position and dimensions should ensure maximum visibility both of the light bar and of the numbers.
- The top part should be easily removable by unscrewing, allowing for an easy grasp.
- The scale should have two buttons, one for ON / OFF and one for TARE function.
- The measuring unit of the scale can be changed from grams to pounds in the Settings of the Guidance.
- The identity of the product should be recognized in the scale and the utensils
- The scale should indicate by sound when the limit has been reached and when the limit has been exceeded.

**Reflection:**

Further work needs to be done in relation with the understanding of the buttons' functionality, the placement and aesthetics of the limit line and the types of sounds used when reaching and exceeding the limit.

**Activity:****Utensils components****Objective:**

Choose what are the components of the utensils.

**Experiment/data:**

The Utensils have to communicate with the Guidance, in order to inform the Guidance when and how the Utensils have been moved. For this, Bluetooth Low Energy (BLE) is used, for performing the exchange of information between the two devices. The chosen **Bluetooth** is STBLC01 (ST life augmented, 2016).

The moment when the utensil is moved, the accelerometer senses the movement and the guidance will be informed that the utensil has been moved. The **accelerometer** chosen is a BMA255 (acalbf, 2015).

The guidance is also informed on the speed and positioning of the utensil's movement. For this, a gyroscope is required to work in parallel with the accelerometer. The chosen **gyroscope** is L3GD20HTR (Mouser electronics, 2016)

The components use the electricity from a wireless rechargeable battery. For this, a coil and a rechargeable platform receiver are needed. A **microprocessor** is used to make the connections between all the components. The Pro Mini atmega328 Board 5V 16M Arduino Compatible Nano NEW Z3 (ebay, 2016) has been chosen. The **rechargeable platform receiver** is 732-6205-ND (digi-key, 2016). Table 1 illustrates the components together with their specifications. The specifications are used for determining the suitable Rechargeable Battery.

The battery should be able to provide a total supply current in nominal mode equal to the sum of the total supply current in nominal mode from all the components.

$$I_{\text{battery}} = I_{\text{bluetooth}} + I_{\text{accelerometer}} + I_{\text{gyroscope}} + I_{\text{receiver}} + I_{\text{microprocessor}} = 13 + 0,13 + 5 + 17 = 35,13 \text{ mA}$$

The battery should provide the voltage for all the components to operate. This should range between the minimum and the maximum voltage required by each component.

$$U_{\text{battery}} = 5 \dots 12 \text{ V}$$

For determining the battery required for the utensils components to function, the duty cycle is used as reference point [Worksheet 50]. The utensils are expected to function for 4 hours continuously, when in Normal mode.

$$t = 4 \text{ hours}$$

Therefore, the total capacity that the battery should be able to provide for the components of the utensils to function for four hours is:

$$\text{Capacity in mAh} = I_{\text{battery}} * t = 35,13 * 4 = 140,52 \text{ mAh}$$

The **battery** chosen is CR2450HR (Maxell for Business, 2016), which provides a voltage of 3 V. Since the required voltage for the utensils to work is  $U_{\text{battery}} = 5 \dots 12 \text{ V}$ , there is a need of placing two batteries in series. In this way, the provided voltage will be of 6 V and the total supply current in nominal mode will be of 280 mAh. Therefore, the actual hours for the utensils to function is:

$$t = \text{Capacity in mAh} / I_{\text{battery}} = 280 / 35,13 = 8 \text{ hours}$$

For determining how long is the battery lasting when the utensil is not in use, the Duty Cycle is used as reference for understanding which are the components that function when the utensil is not moved / used.

$$I_{\text{battery\_standby}} = I_{\text{accelerometer}} + I_{\text{receiver}} + I_{\text{microprocessor}} = 0,062 + 0,476 = 0,538 \text{ mA}$$

The amount of time that the battery will last, when the utensil is on stand-by is:

$$t_{\text{battery\_standby}} = \text{Capacity in mAh} / I_{\text{battery\_standby}} = 280 / 0,538 = 520 \text{ hours} \sim 21 \text{ days}$$

	Bluetooth Low Energy	Accelerometer	Gyroscope	Rechargeable Platform Receiver	Microprocessor	Rechargeable Battery x 2
Name	STBLC01	BMA255	L3GD20HTR	732-6205-ND	Mini atmega328	CLB2032
Total supply Current in Normal mode	13 mA	130 µA	5mA	-	17 mA	140 mAh
Total supply Current in Standby mode	450 µA	62 µA	-	-	476 µA	-
Supply Voltage Operating	1.9 ... 3.6 V	1.62 ... 3.6 V	2.2 ... 3.6 V		5 ... 12 V	3 V
Temperature range	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C	-20 to 105 °C	-	-20 to 60 °C
Dimensions	5 x 5 x 1 mm	2 x 2 x 0.95 mm	3 x 3 x 1 mm	10 x 10 x 2 mm	33 x 18 x 6 mm	20 x 20 x 3,45 mm
Weight						2,9 g
Price	16.40 DKK when ordering 500 pcs	10.45 DKK when ordering 10.000 pcs	11.68 DKK when ordering 1000 pcs	19.61 DKK when ordering 500 pcs	10.79 DKK per pcs	31.24 DKK per pcs
						2 pcs

#### Reference list:

ST life augmented (2016) *STBLC01 Bluetooth® low energy controller* Available at: [http://www2.st.com/content/st\\_com/en/products/wireless-connectivity/bluetooth-bluetooth-low-energy/stblc01.html](http://www2.st.com/content/st_com/en/products/wireless-connectivity/bluetooth-bluetooth-low-energy/stblc01.html) (Accessed: 03 May 2016)

acalbf (2015) *Accelerometer BMA255* Available at: <http://www.acalbf.com/se/Sensors/Acceleration/Accelerometer/p/2-4--8--16g--Digital--3-axis-Accelerometer--150g-Hz--LGA-12/0000003KYQ> (Accessed: 04 May 2016)

Mouser electronics (2016) *STMicroelectronics L3GD20HTR* Available at: <http://www.mouser.dk/ProductDetail/STMicroelectronics/L3GD20HTR/?qs=sGAEpiMZZMuKDbbCTfAPp58BerTgHBXz0JX5j%2fot6TI%3d> (Accessed: 03 May 2016)

ebay (2016) *New Pro Mini atmega328 Board 5V 16M Arduino Compatible Nano NEW Z3* Available at: <http://www.ebay.com/itm/New-Pro-Mini-atmega328-Board-5V-16M-Arduino-Compatible-Nano-NEW-Z3-/252067263517?hash=item-3ab061341d:g:8QYAAOSwBLIVcqjP> (Accessed: 03 May 2016)

digi-key (2016) *Würth-Electronics-Inc 760308101208* <http://www.digikey.dk/product-detail/en/wurth-electronics-inc/760308101208/732-6205-ND/5050815> (Accessed: 12 May 2016)

Maxell for Business (2016) *CR (Heat Resistant Coin Type Lithium Manganese Dioxide Battery)* Available at: [http://biz.maxell.com/en/primary\\_batteries/cr\\_heat-resisting.html](http://biz.maxell.com/en/primary_batteries/cr_heat-resisting.html) (Accessed: 12 May 2016)

#### Evaluation:

The chosen components play a crucial role in the functionality, shape and life-span of the utensils.

The utensils are able to function for 8 hours continuously, and when on stand-by mode, for 21 days, after which they have to be recharged.

#### Reflection:

Other options for the chosen components can be found, with the help of experts, testing and custom-made production. This aspect is kept into consideration for the further work.

**Activity:****Scale components****Objective:**

Choosing the components for the scale.

**Experiment/data:**

The Food Weight communicates with the Guidance through bluetooth. The chosen **Bluetooth** is STBLC01 (ST life augmented, 2016). For making the sound when the limit has been reached or exceeded, the **speaker** 490-CDM-10008 (Mouser electronics, 2016) is chosen. The **Microprocessor** Pro Mini atmega328 Board 5V 16M Arduino Compatible Nano NEW Z3 (ebay, 2016) is used also for the scale, the same as for the utensils. For measuring the weight placed on the scale, the **Load cell** 3133\_0 CZL635 (Phidgets, 2012) is chosen. For powering the scale, **Button** COM-00097 (Spark fun, No date) is chosen. **Screen** NHD-0220CW-AG3-ND (RS, No date) is able to display both numbers and the coloured light bar.

The battery should be able to provide a total supply current in nominal mode equal to the sum of the total supply current in nominal mode from all the components.

$$I_{\text{battery}} = I_{\text{speaker}} + I_{\text{microprocessor}} + I_{\text{loadcell}} + I_{\text{button}} + I_{\text{screen}} + I_{\text{bluetooth}} = 2,5 + 150 + 50 + 70 + 13 = 285,5 \text{ mA}$$

The battery should provide the voltage for all the components to operate. This should range between the minimum and the maximum voltage required by each component.

$$U_{\text{battery}} = 3,6 \dots 12 \text{ V}$$

The **battery** chosen is NCR18500 (Panasonic batteries, 2011), which provides a voltage of 3 V. Since the required voltage for the scale to work is  $U_{\text{battery}} = 3,6 \dots 12 \text{ V}$ , there is a need of placing two batteries in series. In this way, the provided voltage will be of 7,2 V and the total supply current in nominal mode will be of 4000 mAh. Therefore, the actual hours for the scale to function is:

$$4 \text{ batteries} = 1000 \cdot 4 = 4000$$

$$t = \text{Capacity in mAh} / I_{\text{battery}} = 4000 / 285,5 = 14 \text{ hours} = 840 \text{ minutes}$$

If considering that the scale is used for 10 minutes at every recipe prepared, the battery can provide power for 84 recipes, after which the batteries have to be changed.

For determining how long is the battery lasting when the utensil is not in use, the Duty Cycle [Worksheet 50] is used as reference for understanding which are the components that function when the utensil is not moved / used.

	Speaker	Microprocessor	Load Cell	Button	Screen	Bluetooth	Battery
Name	490-CDM-10008	Mini atmega328	3133_0 CZL635	COM-00097	NHD-0220CW-AG3-ND	STBLC01	Duracell Plus AAA/MN2400
Supply Current	2,5 mA	150 mA	-	50 mA	70 mA	13 mA	1000 mAh
Supply Voltage Operating	8 V	5 ... 12 V	5 V	-	2,4 V ~ 5,5 V	1,9 ... 3,6 V	1,5 V
Dimensions	10 x 10 x 2,9 mm	33 x 18 x 6 mm	55,25 x 12,70 x 12.70 mm	6 x 6 x 8,50 mm	6,5 x 92 x 23,3mm	5 x 5 x 1 mm	10,5 x 44,5 mm
Price	15 DKK	10,79 DKK per pcs	45,56 DKK per pcs	2,30 DKK	129.43 DKK when ordering 500 pcs	16,40 DKK when ordering 500 pcs	29,00 DKK when buying a pack of 4
Additional information	91 dBA	-	5 kg Weight Capacity Max	-	-	-	Amount: 4

## Reference list:

ST life augmented (2016) *STBLC01 Bluetooth® low energy controller* Available at: [http://www2.st.com/content/st\\_com/en/products/wireless-connectivity/bluetooth/bluetooth-low-energy/stblc01.html](http://www2.st.com/content/st_com/en/products/wireless-connectivity/bluetooth/bluetooth-low-energy/stblc01.html) (Accessed: 03 May 2016)

Mouser electronics (2016) Available at: <http://www.mouser.dk/ProductDetail/CUI/CDM-10008/?qs=sGAEpiMZZMs-8jstQXqv0ySm1FDymZ%2fnTZdiRTfp572Q%3d> (Accessed: 05 MAY 2016)

ebay (2016) *New Pro Mini atmega328 Board 5V 16M Arduino Compatible Nano NEW Z3* Available at: <http://www.ebay.com/itm/New-Pro-Mini-atmega328-Board-5V-16M-Arduino-Compatible-Nano-NEW-Z3-/252067263517?hash=item-3ab061341d:g:8QYAAOSwBLIVcqjP> (Accessed: 03 May 2016)

Spark fun (No date) *Mini push Button* Available at: <https://www.sparkfun.com/products/97> (Accessed: 05 May 2016)

Phidgets (2012) *3133\_0 - Micro Load Cell (0-5kg) - CZL635* Available at: [http://www.phidgets.com/products.php?product\\_id=3133](http://www.phidgets.com/products.php?product_id=3133) (Accessed: 05 MAY 2016)

RS (No date) *NewNEWHAVEN DISPLAY INTERNATIONAL NHD-0220CW-AG3 LCD Colour Display* Available at: <http://uk.rs-online.com/web/p/lcd-colour-displays/9091954/> (Accessed: 13 May 2016)

Panasonic batteries (2011) Available at: [https://na.industrial.panasonic.com/sites/default/pidsa/files/downloads/files/battery\\_energy\\_catalog.pdf](https://na.industrial.panasonic.com/sites/default/pidsa/files/downloads/files/battery_energy_catalog.pdf) (Accessed: 13 May 2016)

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## Evaluation:

The components of the scale are chosen according to factors such as price, size and effectiveness.

## Reflection:

Other options for the chosen components can be found, with the help of experts, testing and custom-made production. This aspect is kept into consideration for the further work.

# Technical Drawings

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# KeeCo

- Assistive Technology -  
*cooking with cognitive impairments*

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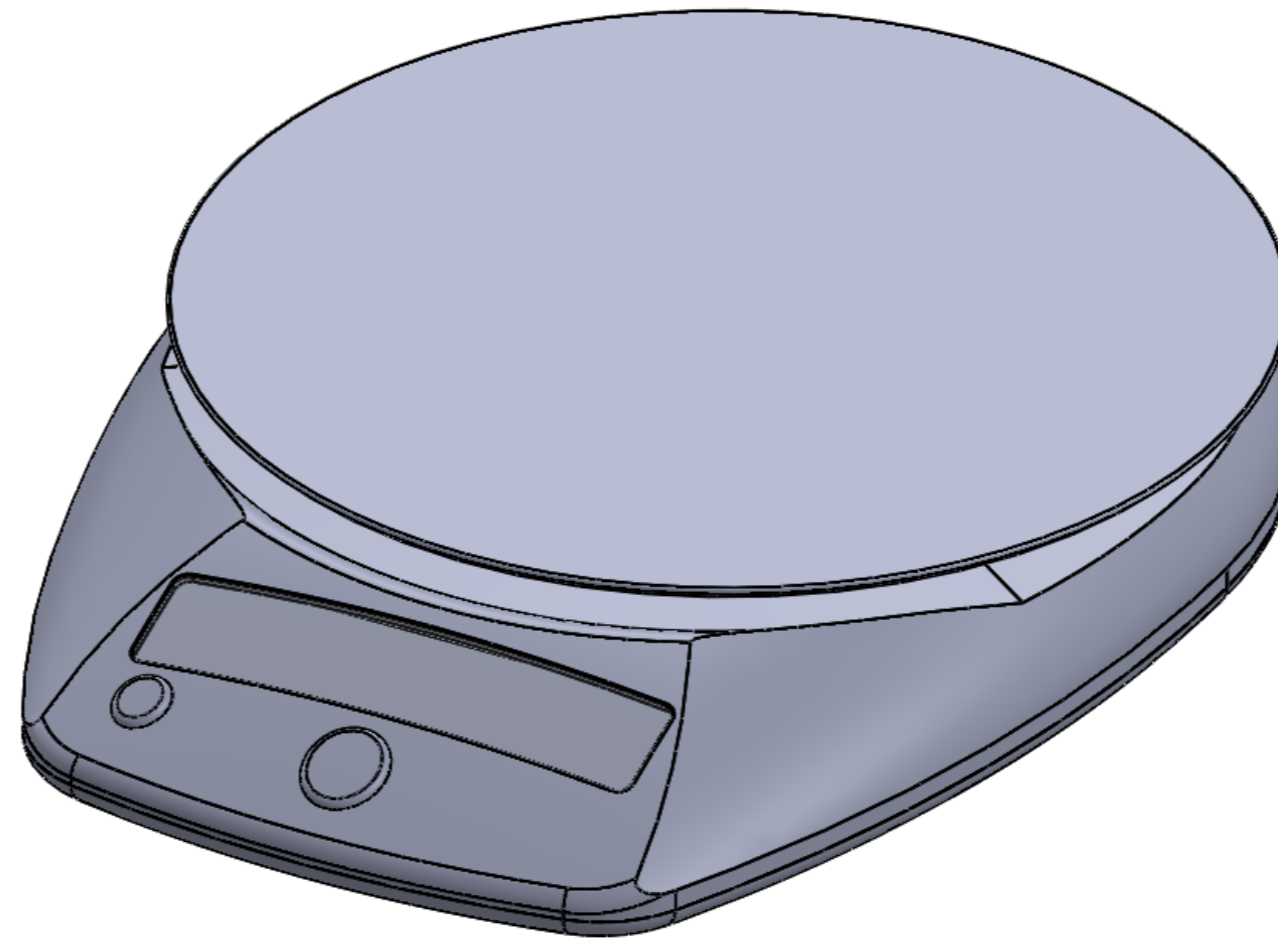
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**MSC04 - 03 INDUSTRIAL DESIGN**  
Aalborg University, may 2016

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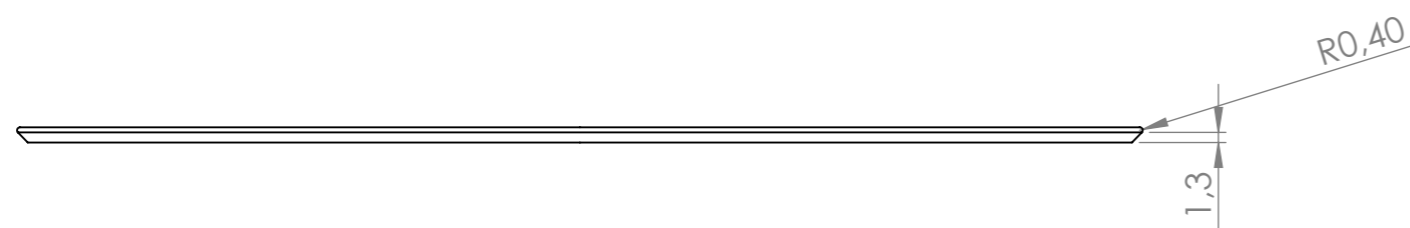
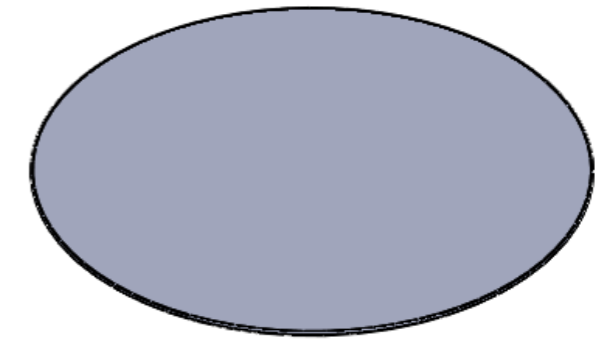
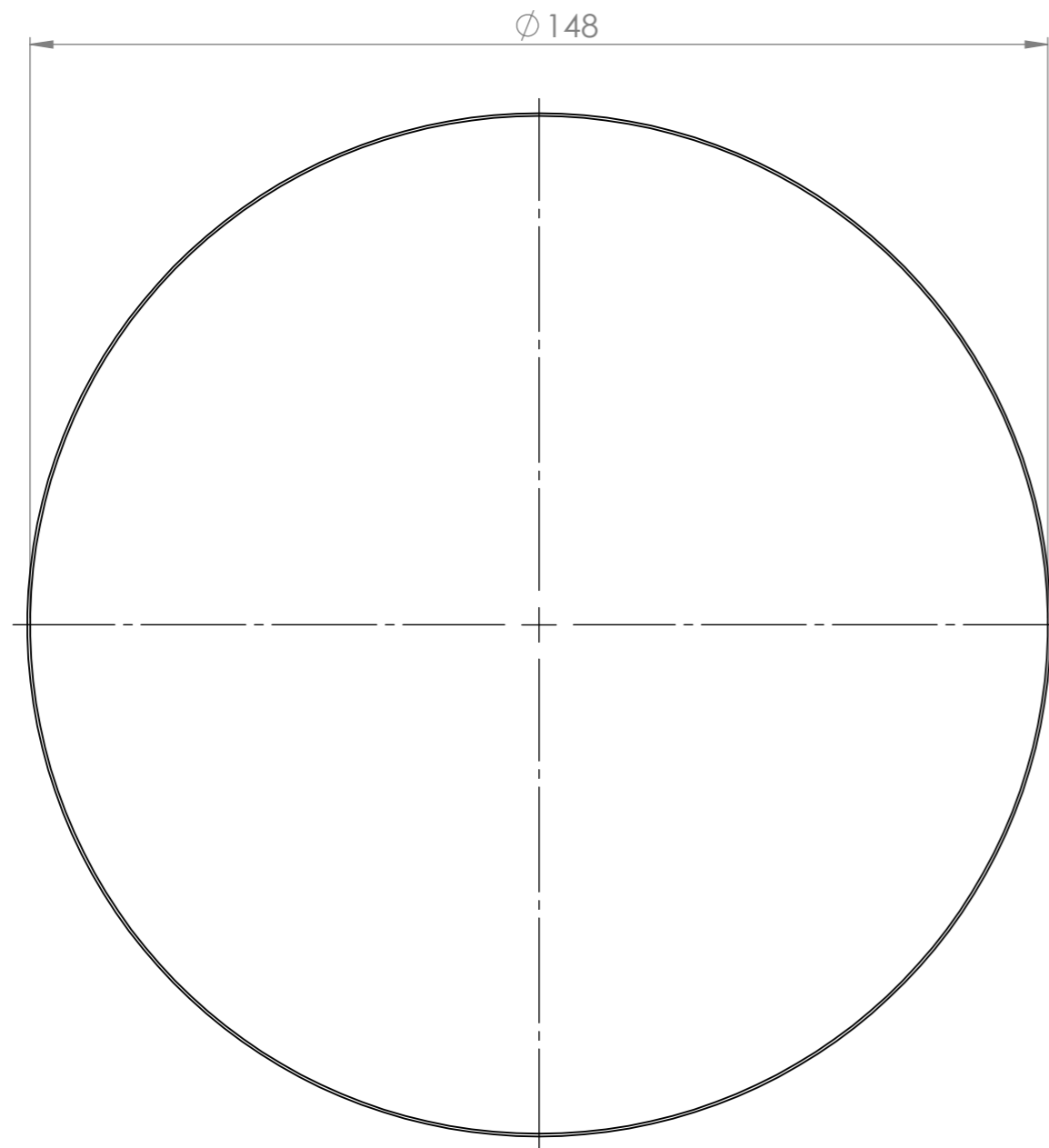
**TEAM 3**

Anca Gogu  
Giulia Dalle Nogare  
Ulla Tanderup Gade



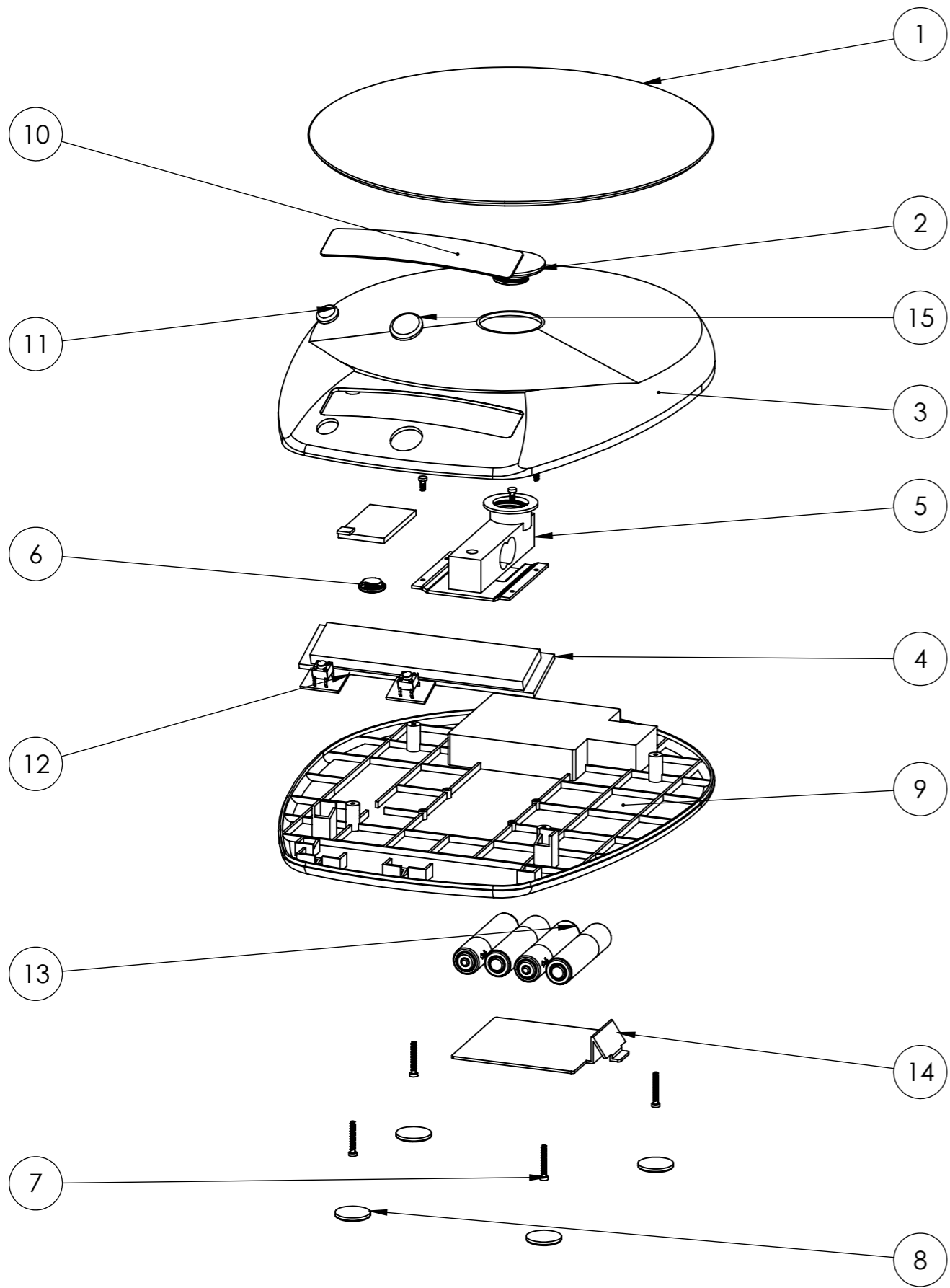
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Rev.	Revision description.	All dimensions are in mm unless otherwise stated	All dimensions without tolerance according to DS / ISO 2768-1		<b>KeeCo</b> Rendsburggade 14, 9000 Aalborg
G		Created date:	Last change date:		
F		<b>25-05-2016</b>	<b>25-05-2016</b>		<b>Scale</b>
E		Materials:	No.	Sheet size	
D			<b>1/9</b>	<b>A3</b>	
C		Finish:	Weight:		
B					



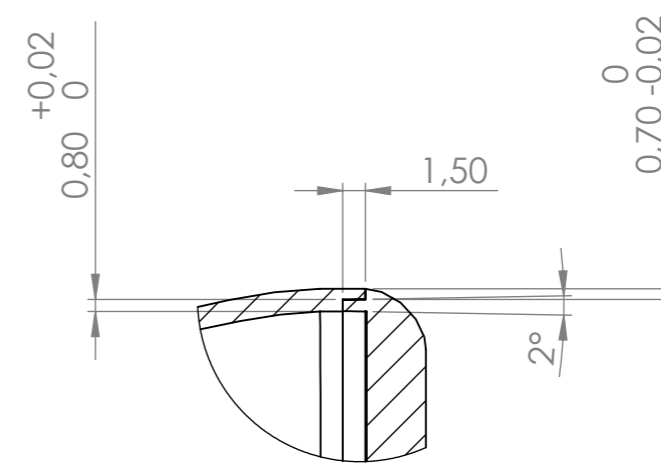
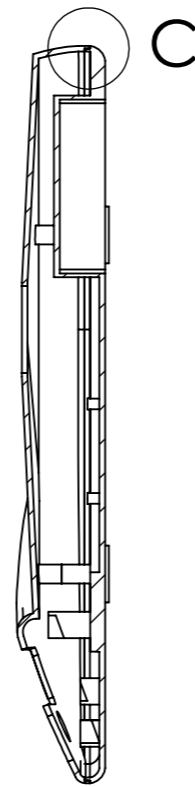
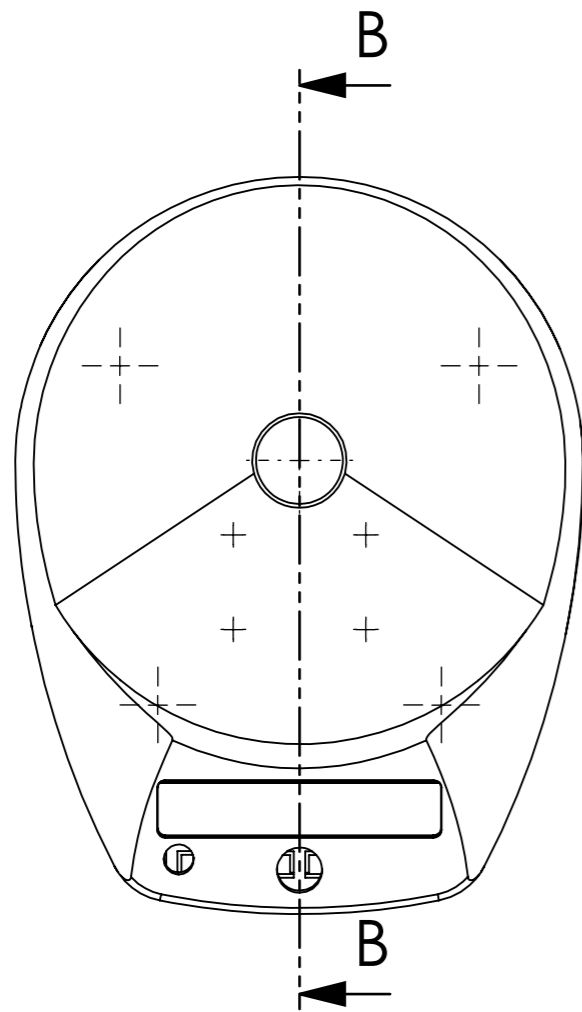
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G		Created date:	Last change date:		
F		<b>25-05-2016</b>	<b>25-05-2016</b>		
E		Materials:	No.	Sheet size	Item Name:
D		<b>Stainless steel</b>	<b>6/9</b>	<b>A3</b>	
C		Finish:	Weight:	Scale: <b>1:1</b> Drawn by: <b>Ulla</b>	
B		<b>2R</b>	<b>34,32 g</b>		



ITEM NO.	Part Name	Description
1	Measuring plate	Stainless steel
2	Supporter	ABS
3	Upper scale body	ABS
4	Screen	6,5 x 92 x 23,3 mm, 70 mA, 2,4 V ~ 5,5 V
5	Load cell	55,25 x 12,70 x 12,70 mm, 5 V
6	Speaker	10 x 10 x 2,9 mm, 2,5 mA, 8 V
7	4 x M1,6 Screws	Stainless steel
9	4 x Feet	Silicone
9	Lower scale body	ABS
10	Screen protector	PS
11	Tare button	ABS
12	2 x Button	6 x 6 x 8,50 mm, 50 mA
13	4 x Batteries	AAA sized battery
14	Battery lit	ABS
15	On/Off button	ABS

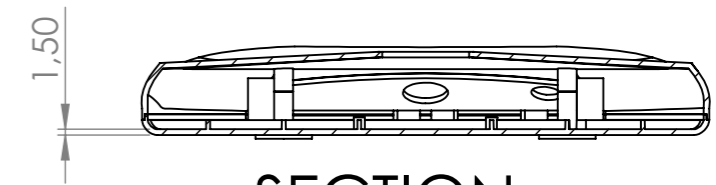
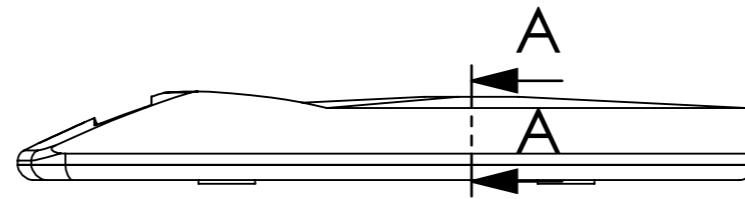
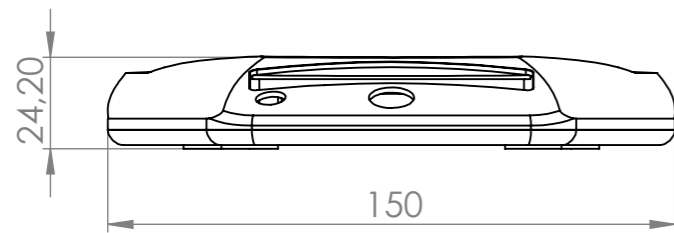
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F		Materials:	No. <b>2/9</b>	Sheet size <b>A3</b>	Scale: <b>1:2</b> Drawn by: <b>Ulla</b>
E		Finish:	Weight:		
D					
C					
B					



DETAIL C

SCALE 2 : 1

SECTION B-B

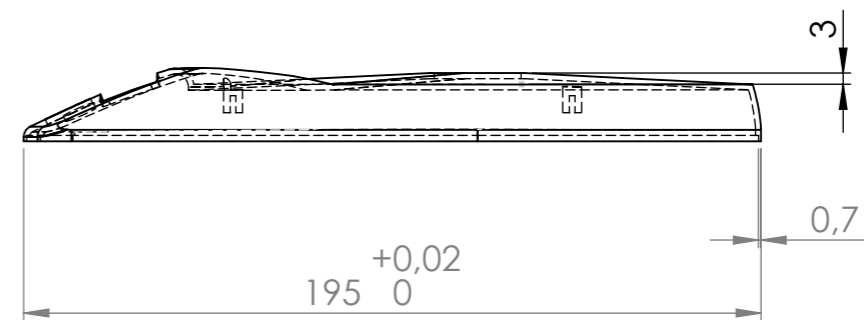
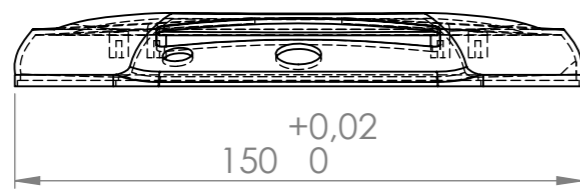
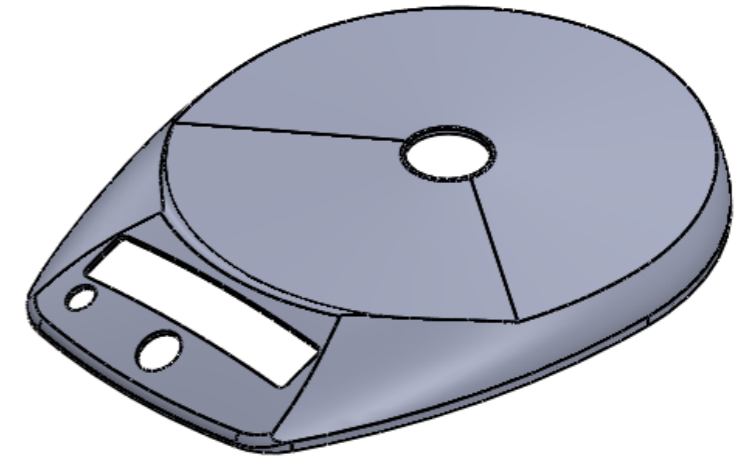
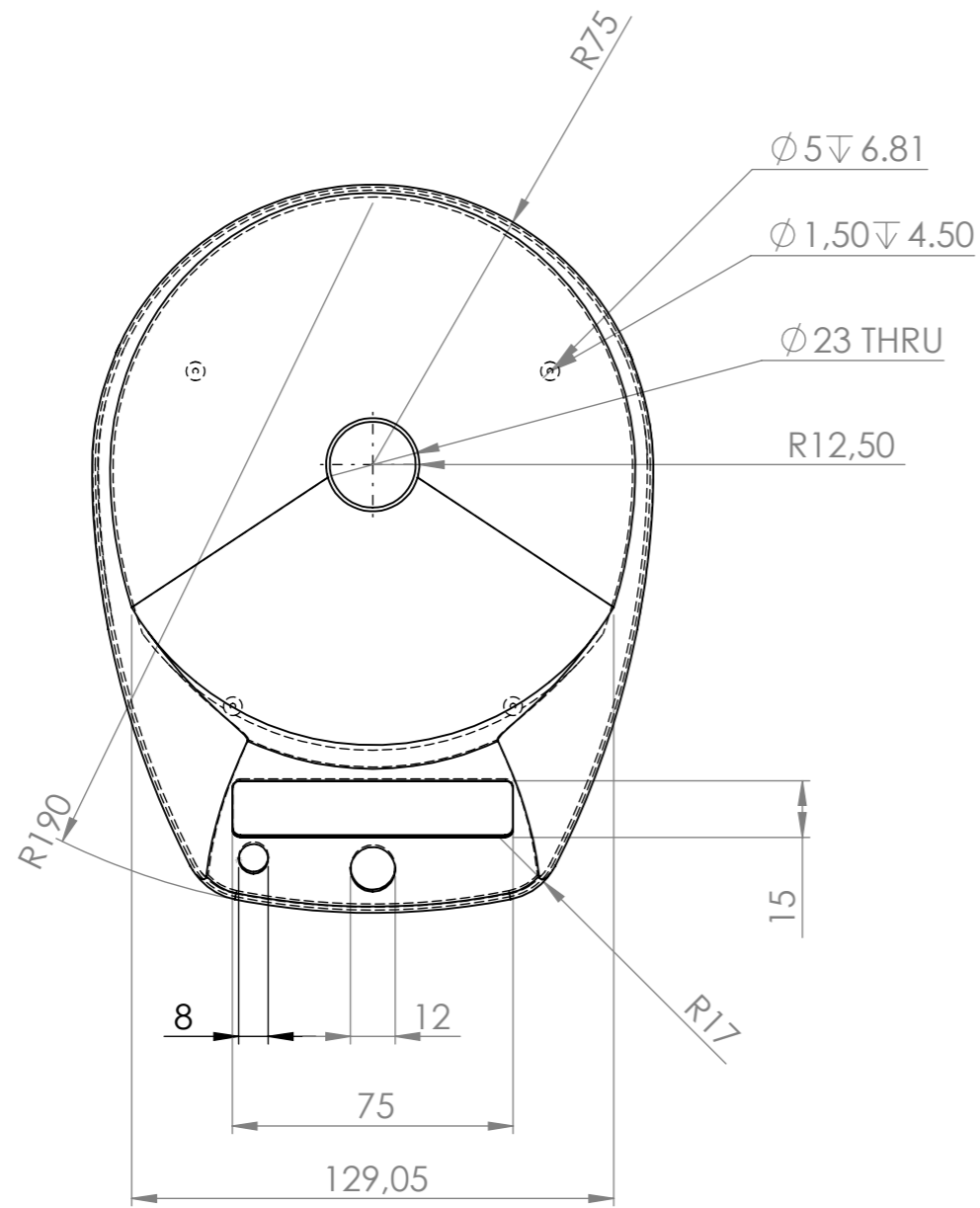


SECTION A-A

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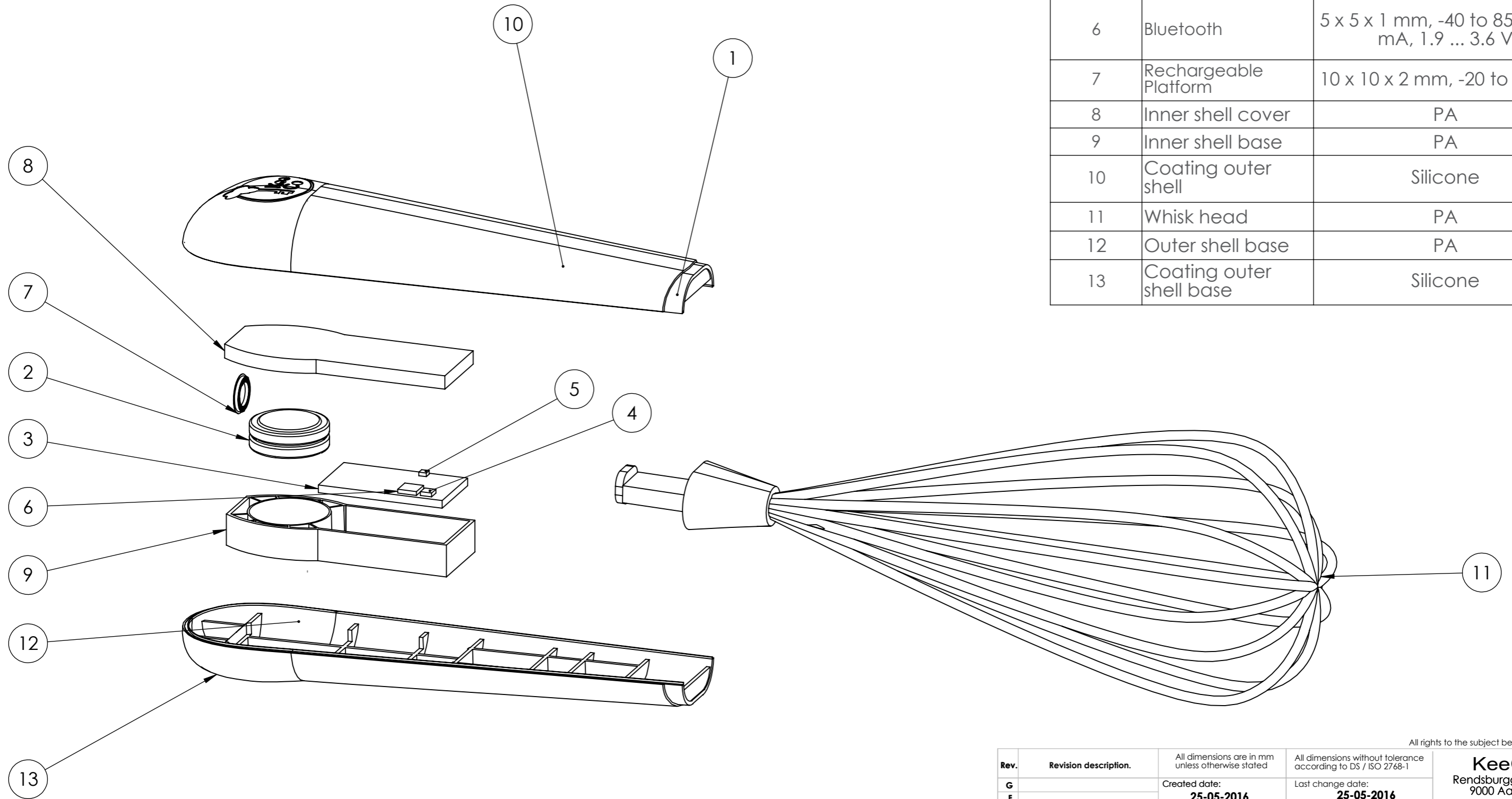
Rev.	Revision description.	All dimensions are in mm unless otherwise stated	All dimensions without tolerance according to DS / ISO 2768-1		<b>KeeCo</b> Rendsburggade 14, 9000 Aalborg
G		Created date:	Last change date:		
F		<b>25-05-2016</b>	<b>25-05-2016</b>		<b>Scale body assembly</b>
E		Materials:	No.	Sheet size	
D		<b>ABS</b>	<b>5/9</b>	<b>A3</b>	
C		Finish:	Weight:		
B		<b>PM-T1</b>	<b>90 g</b>		





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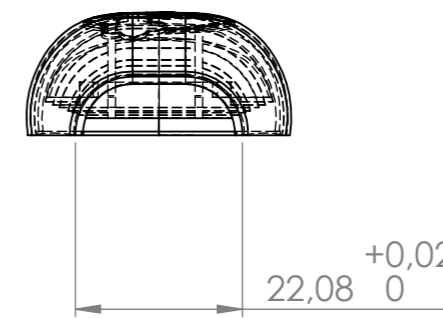
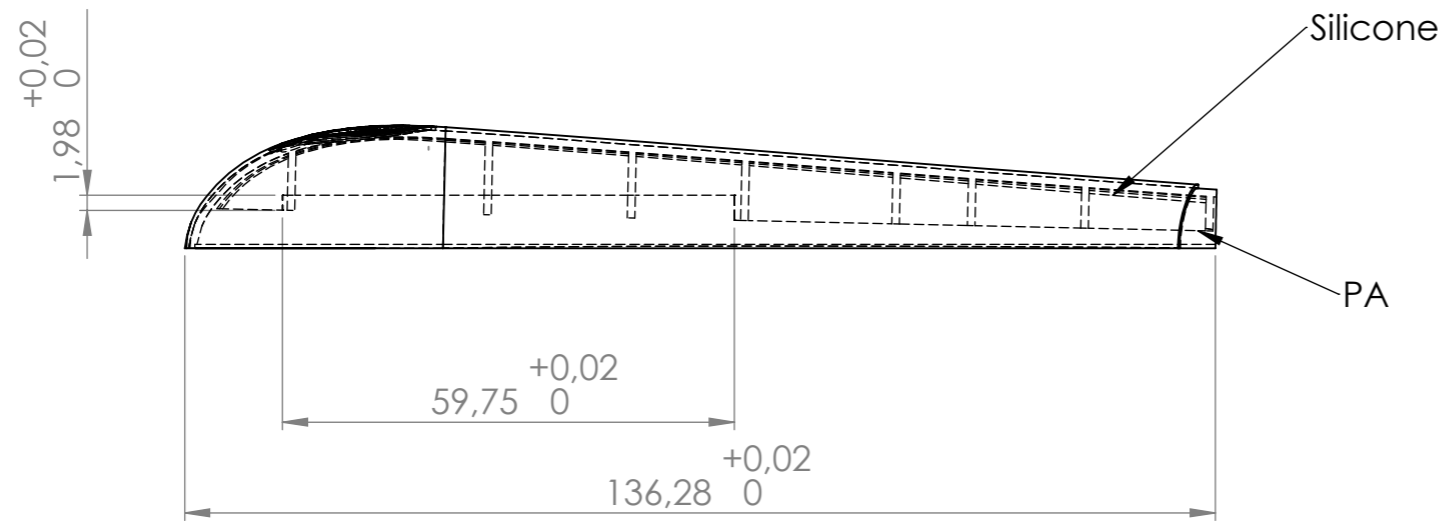
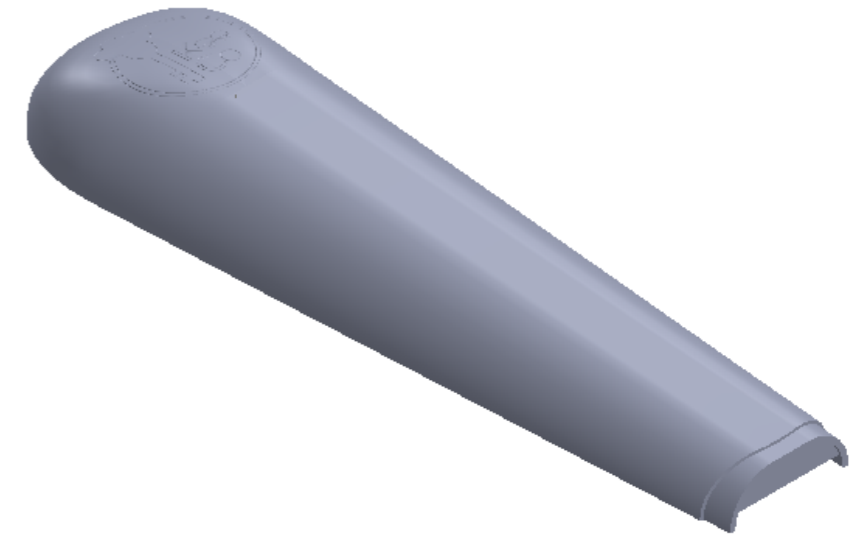
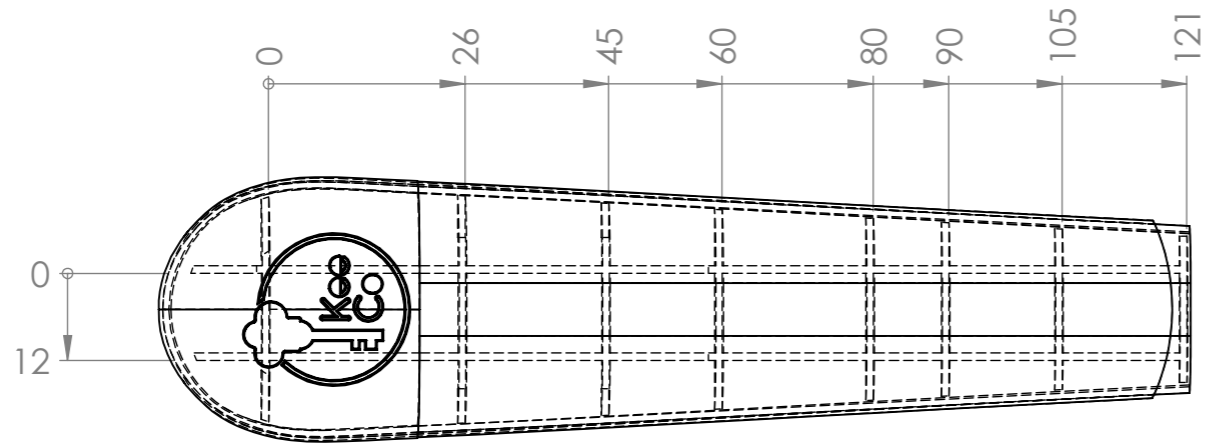
Rev.	Revision description.	All dimensions are in mm unless otherwise stated	All dimensions without tolerance according to DS / ISO 2768-1		KeeCo Rendsburggade 14, 9000 Aalborg
G		Created date: <b>25-05-2016</b>	Last change date: <b>25-05-2016</b>		
F		Materials: <b>ABS</b>	No. <b>3/9</b>	Sheet size <b>A3</b>	Scale: <b>1:2</b> Drawn by: <b>Ulla</b>
E		Finish: <b>PM-T1</b>	Weight: <b>45 g</b>		
D					
C					
B					



ITEM NO.	Part Name	Description
1	Outer shell	PA
2	2 x Battery	20 x 1 mm, -20 to 60 °C, 280 mAh, 3 V
3	Microprocessor	33 x 18 x 6 mm, 150 mA, 5 ... 12 V
4	Gyroscope	3 x 3 x 1 mm, -40 to 85 °C, 5mA, 2.2 ... 3.6 V
5	Accelerometer	2 x 2 x 0,95 mm, -40 to 85 °C, 130 µA, 1.62 ... 3.6 V
6	Bluetooth	5 x 5 x 1 mm, -40 to 85 °C, 13 mA, 1.9 ... 3.6 V
7	Rechargeable Platform	10 x 10 x 2 mm, -20 to 105 °C
8	Inner shell cover	PA
9	Inner shell base	PA
10	Coating outer shell	Silicone
11	Whisk head	PA
12	Outer shell base	PA
13	Coating outer shell base	Silicone

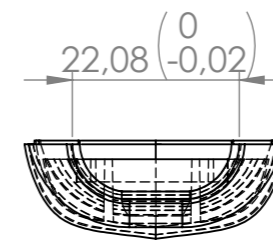
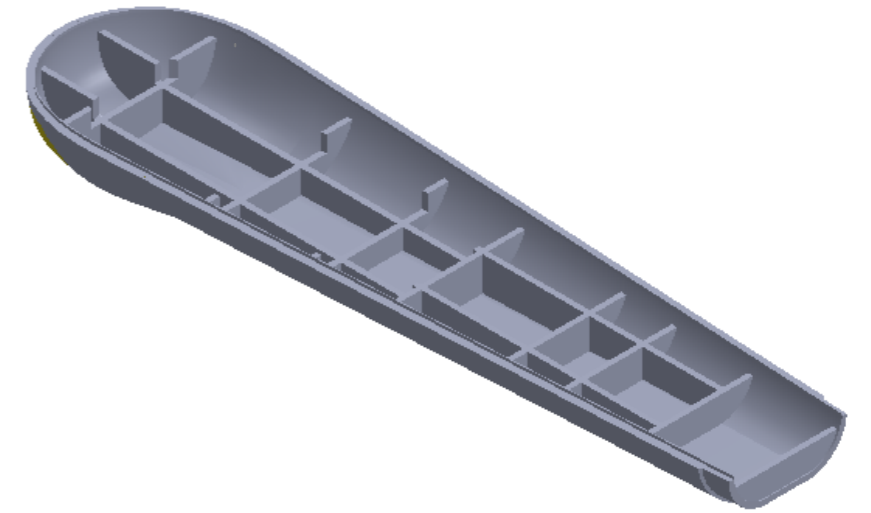
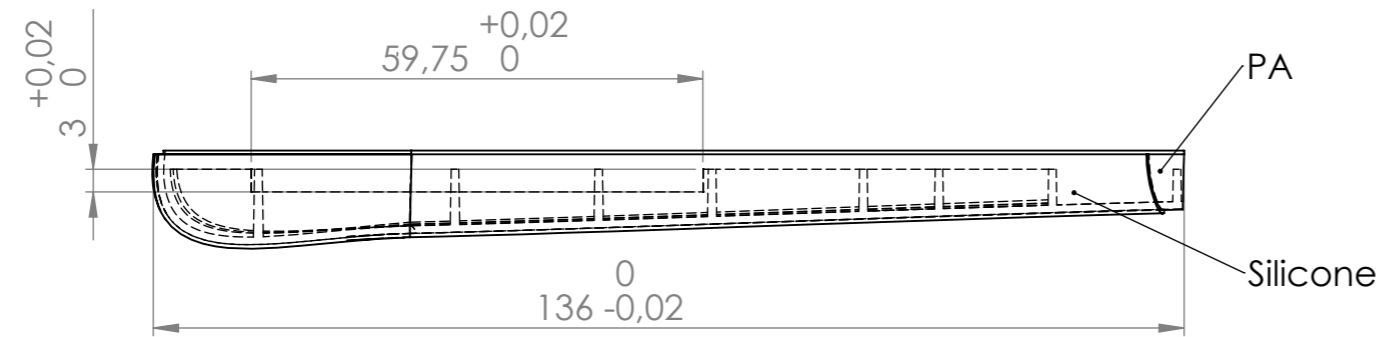
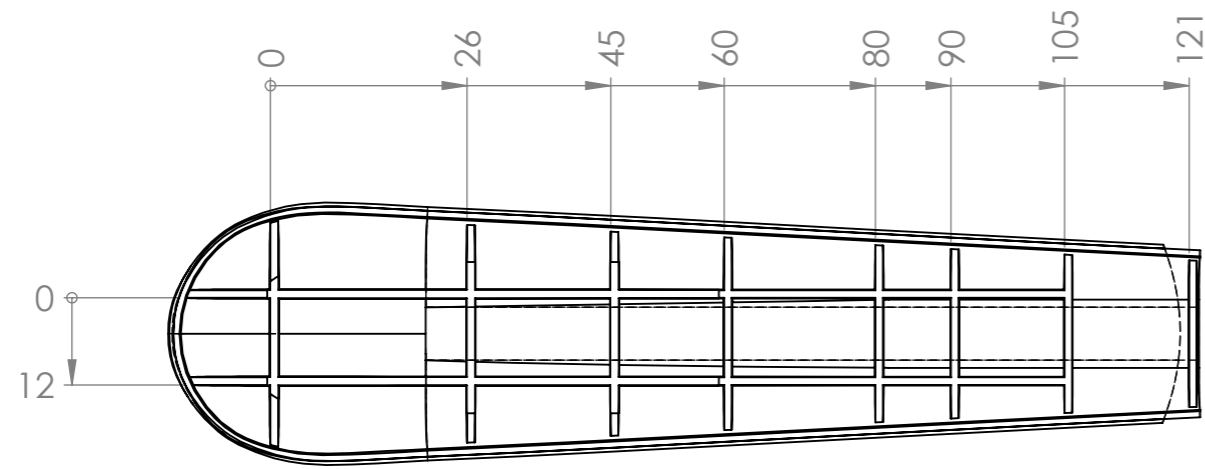
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Rev.	Revision description.	All dimensions are in mm unless otherwise stated	All dimensions without tolerance according to DS / ISO 2768-1		<b>KeeCo</b> Rendsburggade 14, 9000 Aalborg
G		Created date: <b>25-05-2016</b>	Last change date: <b>25-05-2016</b>		
F		Materials:	No.Tolerancer: <b>7/9</b>	Sheet size <b>A3</b>	Item Name: <b>Exploded view Whisk</b>
E		Finish:	Weight:		Scale: <b>1:2</b>
D					Drawn by: <b>Ulla</b>
C					
B					



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Rev.	Revision description.	All dimensions are in mm unless otherwise stated	All dimensions without tolerance according to DS / ISO 2768-1		<b>KeeCo</b> Rendsburggade 14, 9000 Aalborg
G		Created date:	Last change date:		
F		<b>25-05-2016</b>	<b>25-05-2016</b>		
E		Materials:	No.	Sheet size	Item Name:
D		<b>PA and Silicone</b>	<b>8/9</b>	<b>A3</b>	<b>Outer shell cover</b>
C		Finish:	Weight:		Scale: <b>1:1</b> Drawn by: <b>Ulla</b>
B			<b>11 g</b>		



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G		Created date:	Last change date:		
F		<b>25-05-2016</b>	<b>25-05-2016</b>		
E		Materials:	No.	Sheet size	Item Name:
D		<b>PA and Silicone</b>	<b>9/9</b>	<b>A3</b>	<b>Outer shell base</b>
C		Finish:	Weight:		Scale: <b>1:1</b> Drawn by: <b>Ulla</b>
B			<b>11 g</b>		