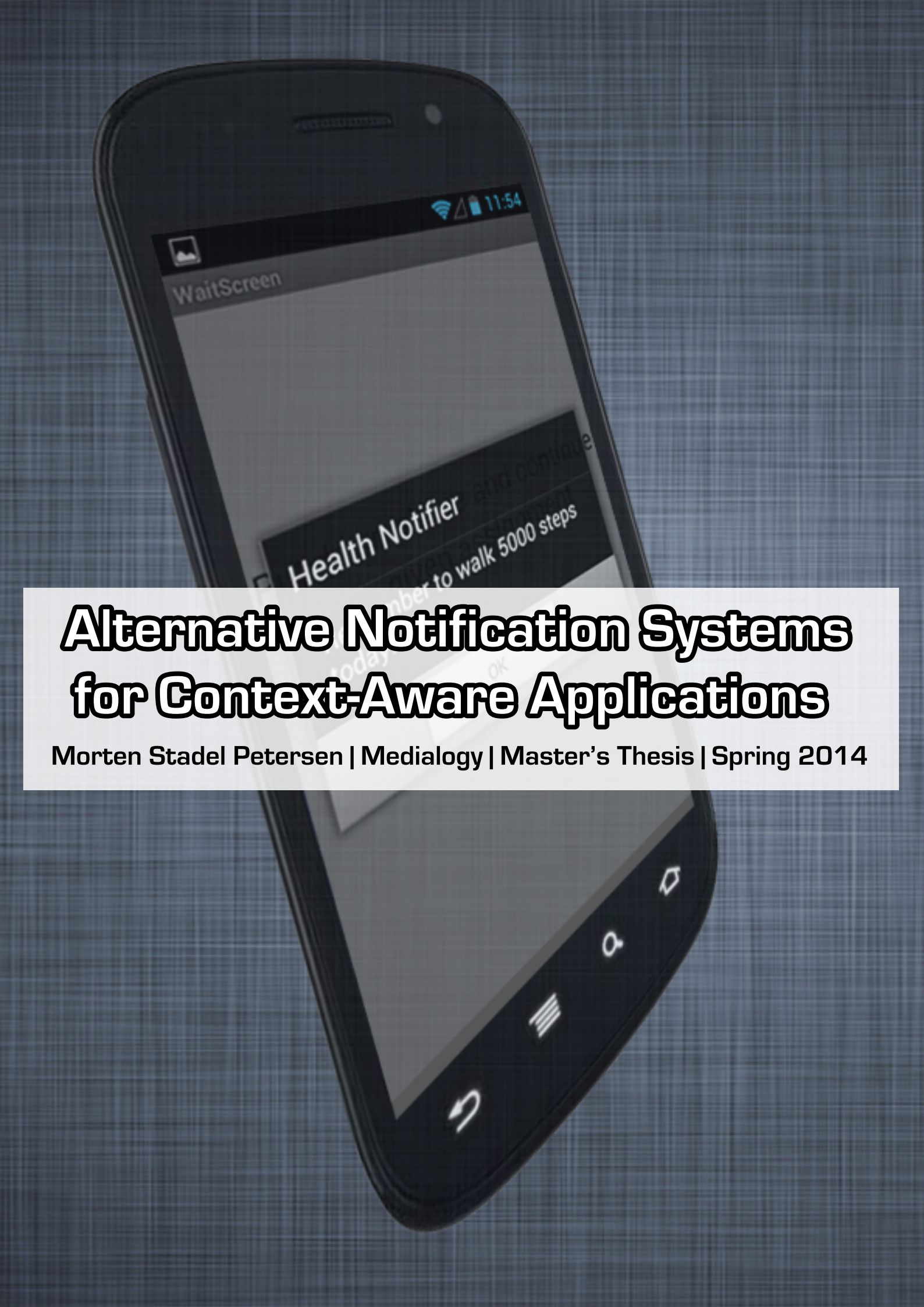

Alternative Notification Systems for Context-Aware Applications

Morten Stadel Petersen | Medialogy | Master's Thesis | Spring 2014

AALBORG UNIVERSITET

School of Information and Communication Technology
Master's Thesis

Title: Alternative Notification Systems for Context-Aware Applications

Project period: September 2013 to June 2014

Project group: mta141040

Participants:

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Circulation: 3

Pages: 58

Finished on: June 23^{rd} 2014

Abstract:

This report is a Medialogy Master's Thesis at Aalborg University. The project introduces a user study about notifications for context-aware applications. The project researches activity recognition and context-awareness. Three different kinds of notifications was made and implemented on a Samsung Google Nexus S with MIT's App Inventor 2. The user study examined if the different kinds of notifications was better to use in different contexts. To do this three scenarios was created: at the bus stop, at work and at home. In each scenario the participant was asked to rank the notification according to how practical they found them in the given scenario. A post test interview was conducted, to retrieve information on how the notifications worked in the different scenarios and if they had a negative or positive motivational factor in the scenarios. The user study showed that different notifications should be used in different scenarios and that they can have a positive and negative motivational factor.

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Preface

This report is a Medialogy Master's Thesis at Aalborg University. The project period was from September 2013 to June 2014. The report consists of eight chapters and should be read in chronological order. Attached to this report is a DVD. Available on the DVD is the report in PDF-format and in text format. Further more is the data that is collected throughout the project period and a video summary of the project. Lastly, I would like to thank my supervisor, Matthias Rehm, and the people who took part in the user study.

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Chapter 1

Introduction

Smartphones are an everyday and household object today and it assists us in many ways and we keep finding ways to make it more helpful for us. With activity recognition and context-aware applications the smartphone can assists us in even more ways. Activity recognition and context-aware applications allows the smartphone to uncovering what the user is doing and in what context. This is often done with sensors allocated in the smartphone and inferring the data available for smartphone. With activity recognition and context-aware applications the smartphone can automatically and calmly adapt for the user. If the smartphone should act proactively it is important it does it so it is not to any disturbance for the user.
There exists several ways of informing a user that something is happening on the smartphone and this is often done with notifications. These notifications can vary in the form of feedback they give, such as tactile, audible and visual. Combining the aspect of activity recognition and context-aware applications and notifications could create different results in different scenarios. This project combines the above and ends out in a user study to examine how to use notifications with a combination of activity recognition and context-aware applications.

Chapter 2

Pre-analysis

This chapter describes the different elements concerning this project and what they are used for.

2.1 Motivation

The smartphone is a big part of our everyday lives and it is useful for us in many different occasions. It helps us contact people, search the internet, helps us find the right way and etc. We are almost always carrying our smartphones with us, even over smaller distances.

With smartphones we are able to detect what the user is doing with activity recognition and context logging. With these methods we can make a smartphone act proactively in order to make an aspect of our life easier. A concern that is always part of our society is the overall health of the people. Throughout this report the focus will be on a notification system for an app with an healthy agenda.

Because we are always near our smartphone and the large amount of time we use it, it can become our best friend, but as most friends it can also be annoying or disturbing at times. If a smartphone acted proactively to assist the user to have a healthier day, it is important that the notification on the phone is welcoming and not to any disturbance.

Three scenarios are created, each one in a place where people spends time in their everyday lives. Throughout the report these three scenarios will be referenced to and at the later parts, the scenarios will be tested in a user study to find out if different notifications should be used in different context.

Scenario 1 - At the Bus Stop A place several people spends waiting for several minutes is at the bus stop. The daily commute to and from work, or just traveling without a car or bicycle will the leave the person to use the bus and therefore some persons will stack up several minutes every day waiting for the bus. In this scenario a user is arriving at the bus stops and starts to wait for the bus and this is where the smartphone will give a notification from the app.

Scenario 2 - At the Office Working at an office eight hours a day, more or less, can be strenuous. With the amount of time spend at work reminders of having a healthy daily routine could easily happen in the working hours. In this scenario the user is sitting at the office, working on a work related assignment and is interrupted by a notification from the app.

Scenario 3 - At Home A place people spend a lot of time, if not the most time, in the every day life is at themselves, at home. Given the time spend at home and the freedom to do what ever the person likes to do, this scenario is the one with least requirements. In this scenario a user a sitting on a couch watching a movie and is then interrupted by a notification from the app.

2.2 What is Activity Recognition?

Uncovering what the user is doing is called activity recognition and over the last years a number of approaches have been described to tackle this problem. Mobile phones have turned into full scale networked computers that are equipped with numerous sensors and this allows for adapting to the user in a way that was still science fiction some years ago, making the devices proactively provide the user with desired information. Activity recognition relies mainly on the accelerometer [16, 5, 19, 10] and are therefore somewhat limited to activities dealing with purely motion based activities. Other data is available, from other sensors in the phone to other information sources. Figure 2.1 shows a graph of accelerometer data and this is a very common graph in activity recognition. The graph shows all three axis and from that, features are drawn.

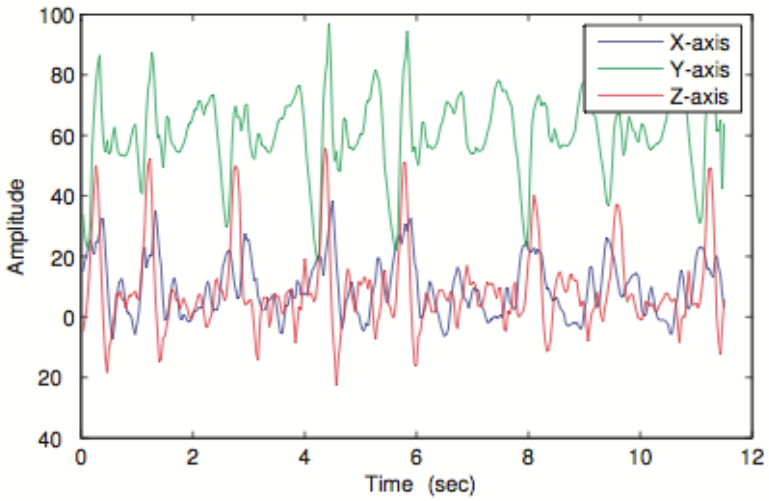


Figure 2.1: *Accelerometer data from [19].*

2.2.1 Complex Activity Recognition

Complex activity recognition differs from activity recognition in the activities recognized. In complex activity recognition the activities recognized extends from simple activities, such as walking, jogging, running, etc., to activities such as having lunch, cooking,

working at a desk, etc.. Complex activities is being defined as *an activity that consists of multiple sub-activities* [16, 17].

It is not necessary to use a complex choice of sensors to get enough data for activity recognition, just because the activity, which is to be recognized, is complex. Rai et al. [16] uses just the raw data from an accelerometer in a smartphone to get the data to recognize complex activities. In figure 2.2 a table of recognizable activities, just from accelerometer data, is shown.

	Activity	No.	Confusion Matrix					Acc
USER1	home_work	36	**0.88**	0.0	0.04	0.0	0.08	71.4
	home_break	14	0.0	0.4	0.2	0.4	0.0	%
	home_relax	25	0.066	0.0	0.667	0.133	0.133	
	home_cook	21	0.0	0.0	0.2	**0.8**	0.0	
	home_eat	17	0.2	0.1	0.2	0.0	0.5	
	office_break	17	**0.9**	0.0	0.0	0.1		84.0
	office_work	30	0.0	**0.96**	0.04	0.0		%
	office_meet	15	0.1	0.8	0.1	0.0		
	office_lunch	11	0.0	0.0	0.0	**1.0**		
USER 2	home_relax	21	**1.0**	0.0	0.0	0.0		75.0
	home_work	9	0.2	0.6	0.0	0.2		%
	home_baby	9	0.4	0.2	0.4	0.0		
	home_eat	12	0.1	0.1	0.0	**0.8**		
	office_work	80	**0.98**	0.2	0.0	0.0		97.1
	office_ toilet	33	0.067	**0.866**	0.067	0.0		%
	office_lunch	19	0.1	0.0	**0.9**	0.0		
	office_meet	20	0.4	0.6	0.5	**0.85**		
USER 3	home_relax	57	**0.98**	0.02	0.0	0.0		97.0
	home_cook	23	0.05	**0.9**	0.05	0.0		%
	home_eat	28	0.0	0.4	**0.96**	0.0		
	home_clean	11	0.0	0.2	0.0	**0.8**		
	office_work	122	**0.954**	0.09	0.181	0.0	0.181	84.5
	office_lunch	32	0.167	0.7	0.0	0.033	0.1	%
	office_coffee	35	0.2	0.04	0.56	0.16	0.04	
	office_ toilet	33	0.067	0.0	0.066	**0.867**	0.0	
	office_break	15	0.2	0.0	0.6	0.0	0.2	
USER 4	home_relax	15	**0.813**	0.062	0.125			85.0
	home_work	7	0.0	**1.0**	0.0			%
	home_cook	18	0.1	0.0	**0.9**			
	office_meet	11	0.6	0.2	0.2			95.0
	office_work	59	0.022	**0.978**	0.0			%
	office_break	41	0.0	0.1	**0.9**			
USER 5	home_cook	20	**0.95**	0.0	0.5			93.3
	home_work	6	0.333	0.667	0.0			%
	home_relax	11	0.0	0.0	**1.0**			
	office_work	65	**0.927**	0.018	0.018	0.036		76.8
	office_meet	11	0.0	0.667	0.333	0.0		%
	office_lunch	23	0.733	0.0	0.067	0.2		
	office_break	45	0.16	0.0	0.04	**0.8**		

Figure 2.2: *This table is a confusion matrix of different activities being recognised [16].*

The figure shows that just with the use of accelerometer data a very high accuracy (low: 71,4%, high: 97.1%) of recognizing complex activities can be achieved. The methods used by Rai et al. [16] includes activity features and learning algorithms.

2.3 What is Context-Awareness?

Context aware applications makes use of sensed inputs and contexts, coupled with intelligent decision making to automatically and calmly adopt to serve users [4]. Context-aware

applications focuses on recognizing the context in which the user is. When logging the context more data than just from one sensor is often used. Data such availability, place, motion, sound activity and on-body sensors can be used to determine the context [11, 17, 8]. This project focuses on data available in a smartphone and will avoid the use of on-body sensors.

2.4 Notifications

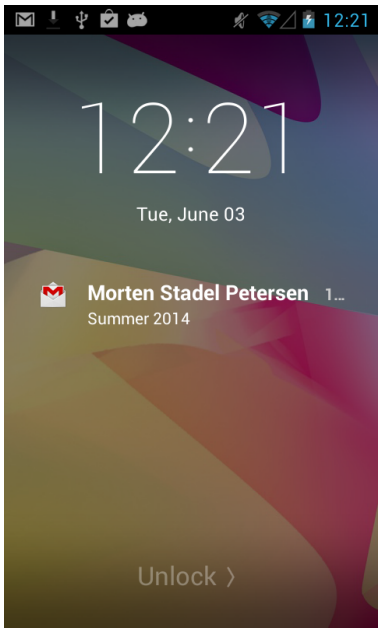
Notifications in smartphones are used to notify the user that something has happened. As an example, when receiving an email or a message the user gets an notification on the phone, to tell the user what has just happened. The notification shows on the screen and is typically followed by a sound or tactile feedback or both.

In figure 2.3 four screenshots can be seen of smartphones when receiving a notification. Screenshot 2.3a and screenshot 2.3b shows when an Android phone and an iPhone is receiving notification on the home screen. In both instances the notification drops down from the top of the screen and stays there for a short time and then disappears again. The biggest difference is the size of the notification, which is larger on the iPhone.

The bottom two screenshots shows a notification as it appears on the lock screen when the phone is on sleep mode. Screenshot 2.3d shows how the notification appears on the iPhone and screenshot 2.3c shows how it appears on an altered Android phone. As a default there are no lock screen notification on Android, but Google Play offers a lot of applications [14, 3] that, when installed, shows notifications on the lock screen.

(a) *An email notifcation on an Android home screen.*

(b) *A message notification on the iPhone's home screen.*



(c) *An email notificiation on an Android lock screen with the application SlideLock installed [18].*

(d) *A message notifcation on the iPhone's lock screen.*

Figure 2.3: *Screenshots of home and lock screens on smartphones with Android and iOS.*

The notifications are very similar for both devices and are very subtle. As mentioned, the notifications are used to interrupt the user to tell the user that something has happened. Notifications can be used in activity recognition to interrupt the user in the activity being done to act proactively. This could easily be annoying for the user if the interruption hap-

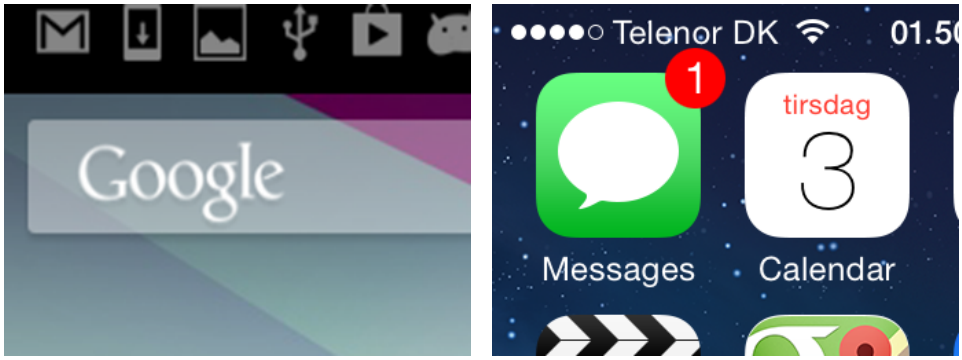
pens at the wrong time or happens frequently. It is therefore important that the notification happens at the right time or in the least disturbing way.

2.4.1 Three Kinds of Feedbacks

There are normally three kinds of notifications for a smartphone and they are as following:

- Visual feedback
- Audible feedback
- Tactile feedback

Visual feedback can show in the form as shown in 2.3 or as a number or figure visualizing a pending notification, see figure 2.4. The visual feedback can also be a blinking LED on the phone.



(a) *A white envelope showing a mail is received.* **(b)** *The number* 1 *visualises that the user has one unread message.*

Figure 2.4: *Notifications shown as a white envelope and the number one.*

Audible feedback is a notification in form of a sound. As an example, when receiving a message a sound is played, so if the user is not watching the phone it is still clear that something has happened on the phone. The last kind of feedback is *tactile* feedback and is a small motor, with an uneven weigh, that makes the phone vibrate. This kind of feedback is often used to replace audible feedback because of the inconvenience of audible phones in public spaces. All three kinds of feedback is often used together or two together.

2.5 Available Sensors

When using a smartphone for activity recognition a lot of sensors and hardware are available that can help for activity recognition. Table 2.1 is a table of available sensors, including the microphone, and it shows that modern day smartphones shares the same

range of sensors. The three smartphones in the table is chosen because of the availability for the author.

	Smartphone		
Sensors/hardware	Samsung Google Nexus S	iPhone 5	Huawei Honor
Accelerometer	*Yes*	*Yes*	*Yes*
Gyroscope	*Yes*	*Yes*	*Yes*
Proximity	*Yes*	*Yes*	*Yes*
GPS	*Yes*	*Yes*	*Yes*
Ambient light	*Yes*	*Yes*	*Yes*
Compass	*Yes*	*Yes*	*Yes*
Microphone	*Yes*	*Yes*	*Yes*

Table 2.1: *There are no differences of avaible sensors in a Samsung Google Nexus S, iPhone 5 and Huawei Honor [7, 9, 15].*

All these sensors in the phones serves different purposes for the phone. The accelerometers main purpose for a smartphone is to present landscape or portrait view, based on the way the device is held. The gyroscope is used to calculate orientation and rotation, and allows for more precise recognition of than the lone accelerometer. The proximity sensors in smartphones are used to turn the screen on or off when the user is making a call and holds the phone to the ear. The GPS is used to determine the location of the phone. The ambient light sensor is used to control the intensity of the screens brightness and make it easier to see depending on how bright the ambient light is. The compass uses a magnetometer to determine the direction of the magnetic poles. Finally, the microphone can be used in a sensory understanding to record the ambient sound in the environment.

2.6 Platform and Target Group

In this section it is determined what platform there will be used for the final product. The final product will be carried out on a smartphone. Several different kinds of smartphones are available, but the final product will eventually be carried out on a Samsung Google Nexus S running Android. The Nexus S is chosen because of its many helpful SDK's and programming environments. The target group for this project will be people who are accustomed to receive notifications on their smartphone and are interested in getting notifications from a health orienting app.

2.7 Problem Statement

The problem that will be researched in this project is: *Should a context-aware application use different notifications for different scenarios and could alternative notifications be used to motivate people?*

Chapter 3

State of the Art

In this chapter it is examined how and for what activity recognition and context-aware applications are used.

3.1 Activity Recognition

Activity Recognition is, as mentioned in section 2.2, about uncovering what the user is doing. The section will look into how it is done and what is used to do it.

Research about activity recognition is often limited to motion based patterns, because activity recognition often relies mainly on the accelerometer. This often limits the research to recognize such activities as standing still, walking, running, etc. because of the data delivered by the accelerometer, a three dimensional coordinate, but high accuracy can be achieved by extracting features from the accelerometer data [19, 10, 6, 5].

When using the accelerometer for activity recognition the data is limited to a vector in a 3D space. An example of the coordinates for accelerometer data can be seen in figure 3.1.

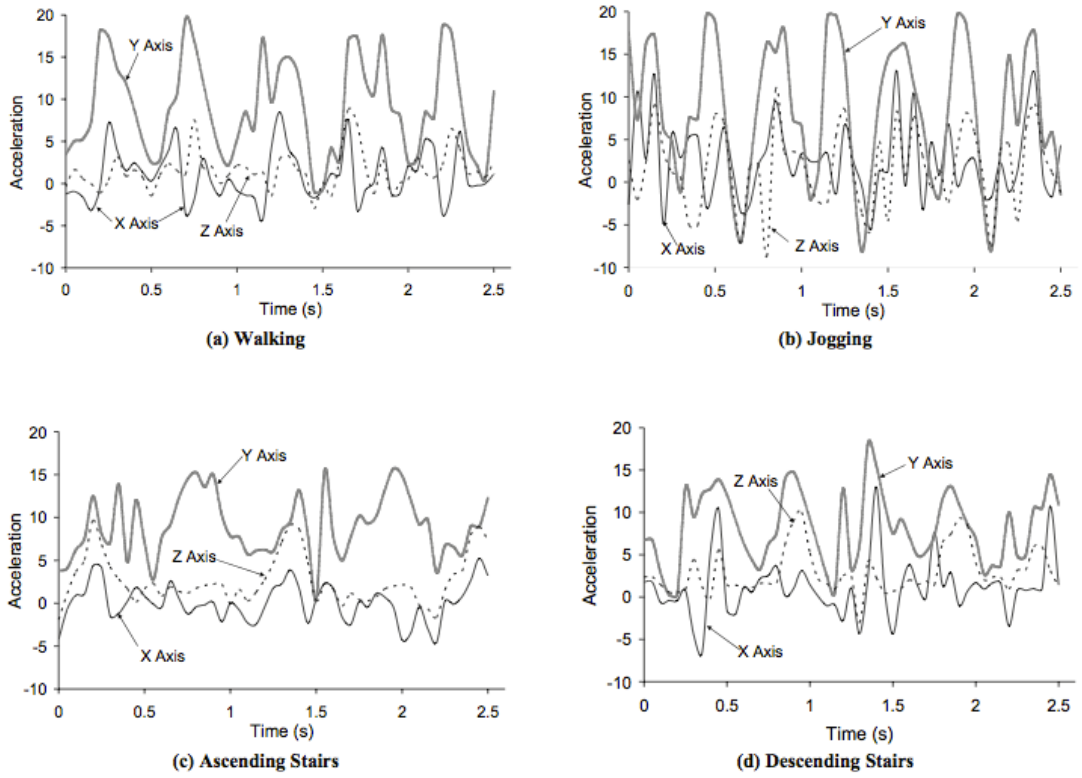


Figure 3.1: *This is an example of accelerometer data for four different, motion based activities [10].*

The data in the example figure shows the three axises from the accelerometer. In every subfigure the data shows peaks and these peaks happens for every step taken (walking, jogging, walking up and down stairs). These peaks, and the frequency of said peaks, are used to categorize the activities.

Kwapisz et al. [10], Yang [19], Fitz-Walter et al. [5], Gomes et al. [6] and Rai et al. [16] all uses the accelerometer as the only data collector, but only Rai et al. investigates complex activities. Kwapisz et al. [10], Yang [19], Gomes et al. [6] and Fitz-Walter et al. [5] uses the data to recognize simple movement activities (from standing and sitting, to running and driving). These three papers gets variated results, but for most activities they get an accuracy of about 80 to 90%. They show that a high accuracy can be achieved by only using the accelerometer data, but they are limited to basic movements.

Other sensors can also be used in activity recognition. Bieber et al. [2] suggest that including sound will not only improve the recognition of motion based patterns, but also extend activity recognition to more possible activities. Bieber et al. shows that there are a correlation between the sound data and the accelerometer data, see figure 3.2.

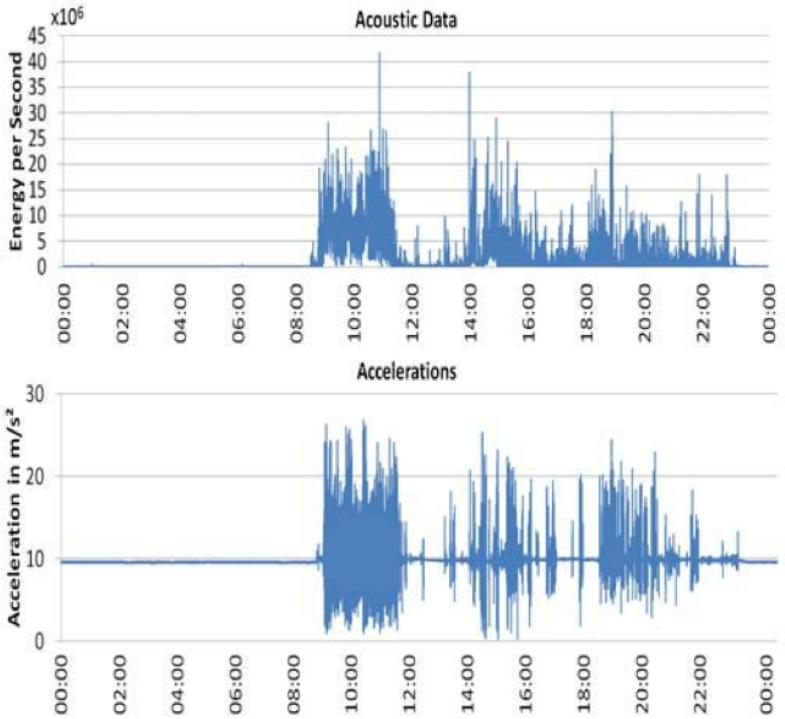


Figure 3.2: *In this example it is shown that the recorded sound corresponds to the accelerometer data [2].*

The movement of the mobile device causes a significant sound pattern as well the ambient sound provides a significant sound pattern to retrieve more information about the environment.

Lockhart et al. [13] claims that not much practical work is being done in the field of activity recognition and Lockhart et al. therefore proposes end user applications, third party applications, and crowd and social network applications. The proposed end user applications are: fitness tracking, health monitoring, fall detection, context-aware behavior, home/work automation and self-managing systems.

3.2 Context Awareness

Context-awareness is not so much about recognizing the activity but more about recognizing the user's context. It can be used to recognize such contexts as cooking an omelette for breakfast [17], modelling the personal context to learn about personal energy consumption [1], and help the user to better understand context-aware applications [11, 12].

To recognize that a user is making an omelette for breakfast, Saguna [17] proposes and develop an activity algebra and is used in defining atomic and complex activities. Furthermore Saguna develops an algorithm to infer complex concurrent and interleaved activities where context reasoning is to infer situations. The definition of an *atomic activity* is an activity that can be observed by a set of sensors. A *complex activity* is defined as a tuple with a sub-set of atomic activities from the complete set of atomic activities and a sub-set of context information from the complete set of context information. Both sub-sets must appear for the

complex activity to appear. Furthermore the complex activity consist of the start and end atomic activity and the start and end context information. Lastly, the start and end time of a complex activity is denoted. To improve the accuracy Saguna assigns weights to atomic activities and context information in the complex activity according to its importance in relation to the complex activity. The sum of all the weights is 1.

Energy consumption rises important environmental and economic issues. Avramides et al. [1] proposes using technology for teaching teenagers about energy consumption. For teenagers to understand about energy consumption, they need to be supported in learning about energy consumption as linked to personal choices and behaviors. Therefore, Avramides et al. says, that learning about energy must be embedded in the everyday contexts in which energy-related behaviors and choices are made.

To identify teenagers circumstances a design framework called Ecology of Resources is used. The framework offers a process for working participants that models and takes account of their context. The EoR framework is structured in three phases. The three phases creates a model to identify and organize potential resources for learning, identifies the relations between and within the resources, and identifying the possible ways the relationships is best supported. The support might be technology, such as an application. Avramides et al. creates an app which enables the user capture photos or videos examples of energy usage to support the learning about energy consumption based on the EoR framework.

Lim et al. [11, 12] researches how context-aware applications and their autonomous behavior should be explained to provide trust to the user and what the usage and usefulness of context-aware applications. To help the user understanding the autonomous behavior of context-aware applications they present a study on design and usability issues for making an intelligible mobile context-aware application. The findings from this study emphasizes on the importance of making explanations usable and quickly consumable, relating the application's behavior to the real world activity and supporting effective problem solving and debugging strategies.

Chapter 4

Design

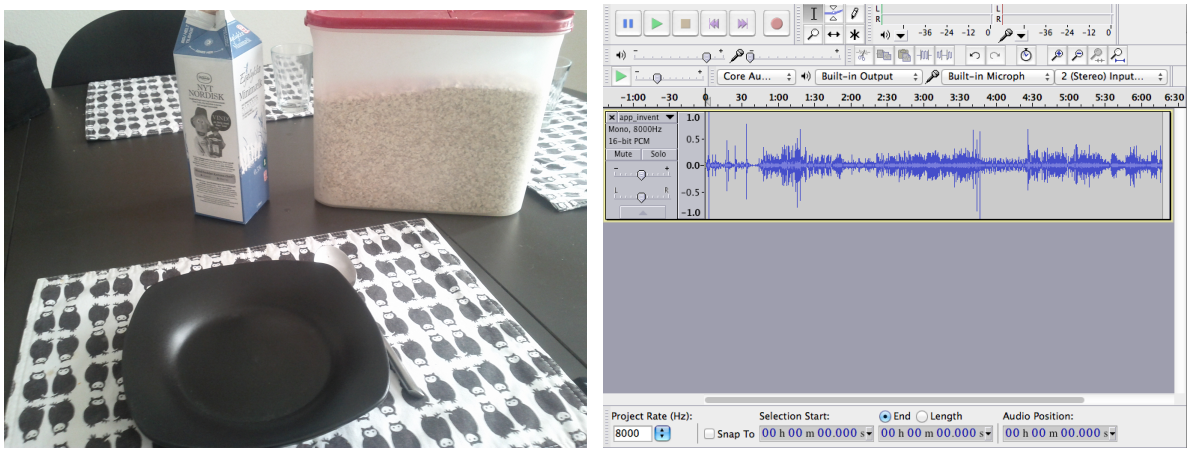
In this chapter the notifications for the notification system will be designed according to the three scenarios described in section 2.1. The chapter will break down each scenario in which activities that must be recognised and what the elements of these activities are. Later, an app with the three notifications will be designed to be used in the user study.

4.1 Breaking Down the Scenarios

This section will break down each scenario in order to create the correct notifications for the final product. The design will be created on the basis of how the scenarios are broken down and how they can be recognized. A small data collection was made to support the breaking down of scenarios.

4.1.1 Context Logging

To help and support this chapter a user logged the activities he was doing for three days. He did this by taking a picture of what he was doing and then recording the sound through the activity. The picture gives a clear idea of what the user was doing and the sound recordings can say something about the noise levels when doing the activities.



(a) *A pciture showing milk, oatmeal and a soup plate indicating breakfast.*

(b) *The profile of the sound bite corresponding to the picture to the left.*

Figure 4.1: *A picture of breakfast and the corresponding sound profile.*

Through the three days of logging 46 acitivity samples was logged - 46 pictures and 46 sound recordings (see figure 4.1 for a sample and all the samples can be found on the attached DVD). The 46 activities consisted of 16 different activities, which can be categorized into eight different categories. The average time spend on the categories and the average sound level for the categories can be seen in table 4.1. The eighth category, miscellaneous, is missing from the table because miscellaneous is consisting of single activities which cannot be categorized with other activities.

Category	Average time	Average dB
Eating	49 min 23 sec	-26.3
Work	95 min 29 sec	-31.2
Playing Games	123 min 24 sec	-26,3
Kitchen Work	21 min 14 sec	-23.7
Grocery Shopping	14 min 23 sec	-24,0
Bathroom	5 min 44 sec	-37,0
Watching TV	169 min 5 sec	-21,0

Table 4.1: *The average time spend on an activity in a category and the average sound level.*

In the table it can be seen that the user spend a lot of time working, and in this case work is sitting at a computer. The most time is spend watching TV and it might be a good time to remind the user to do an healthy activity. It is hard to determine, based on the audio level if it can be used to recognize these activities because of the minimal range (the numbers are negative, because of the dB scale, in Audacity, which goes from 0 to - 96 dB).

4.1.2 Recognizing the Activities

To be able to know how the activities in each scenario can be recognized, each scenario will be analyzed to find out what elements the activities consists off.

Scenario 1 The first scenario is at the bus stop. The user is standing, waiting for the bus. The bus stop is outside and the environment can be loud and noise comming from traffic, other people or the weather, but the noise level is not necessarily a constant factor. A constant factor is the location of the user. If the user is waiting at the bus stop the user is stationary or at least almost stationary. The GPS could be used to determine the users location and look up on the internet if the location matches the location. The notification should not appear just when the user arrives at the bus stop, since it is possible that the user is just walking by. An accelerometer can be used to determine of the user is standing still, or almost standing still. If the location matches and the user is standing still, it seems likely that the user is waiting for a bus, and the notification can appear.

Scenario 2 The second scenario is at work. The user is sitting at a desk working on a given assignment. In this scenario the accelerometer can be used again as it is proven that an accelerometer can be used to recognize that a person is sitting or standing, depending on how the user like to work at a desk. The phone could also use the time as a probability that the user is at work.

Scenario 3 The third scenario is at home. The user is sitting in a couch watching TV. A way for the phone to recognize that the user is at home the GPS could be used, if it already new the coordinates for home. Again, the accelerometer comes to mind, that it can determine if the user is sitting down. Since a movie is playing it can be assumed that there is a somewhat constant noise level and a microphone might be able to determine that a movie is being watched when combining with the location and the user sitting down.

4.2 Design of Notifications

In this section three different notifications will be designed, and these notifications will be tested to see if they are better in different contexts and if they can have a motivational factor in making the user want to do an exercise. The notifications will incorporate the three kinds of feedback: tactile, audible and visual. The one thing that the three notifications will share is the reminder in the notification. The notification will be from an app called "Health Notifier" and will read: *"Remember to walk 5000 steps today!"* and can be dismissed by pressing an "OK" button.

Notification 1 This notification will consist of tactile feedback and visual feedback. The tactile feedback is the motor in the phone which causes the phone to vibrate. This makes the user able to feel a notification if the surroundings are loud or if the phone is required to be silent. The vibration is accompanied by a happy stimuli in form of a picture of a kitten, this is to see if it can have a motivational factor. The vibration and the picture will be called when the notification appears.

Notification 2 This notification will consist of audible feedback and visual feedback. The audible feedback for this notification will be a song instead of a beep, which is the standard kind of feedback. This is because, the notification should try to have a positive motiva-

tional factor and this is done by playing a happy, up beat song. The visual feedback in this notification is the reminder which will appear on the screen, as it will in all cases.

Notification 3 This notification will only consist of visual feedback. The visual feedback in this notification is the reminder. It will not be assisted by sound or vibrations, only the reminder. This is to see, if such a notification is the better even though it requires that the user must look at the phone to be reminded.

These three notifications will be implemented in the final app and will be tested to see which is better for which context and if they can have a motivating factor.

4.3 Design of App

In this section the app for the final product will be designed and in the next chapter it will be implemented as designed in this section.

The app made for this product will be an app which purpose is to remind the user to walk 5000 steps each day. It will have three different ways of notify the user, as described in the previous section.

The app is intended to be very simplistic and will only require the user to press OK to dismiss the notification on the screen. The app will present three buttons which will start a countdown to each notification. In figure 4.2 the screen with the three buttons can be seen to the left. When pushed is it intended that the app will continue to a waiting screen where the notification will appear after a random countdown. The wait screen can be seen to the right in figure 4.2. The wait screen will simply contain a message to the user that they should put down the phone and continue with the given assignment for the current scenario.

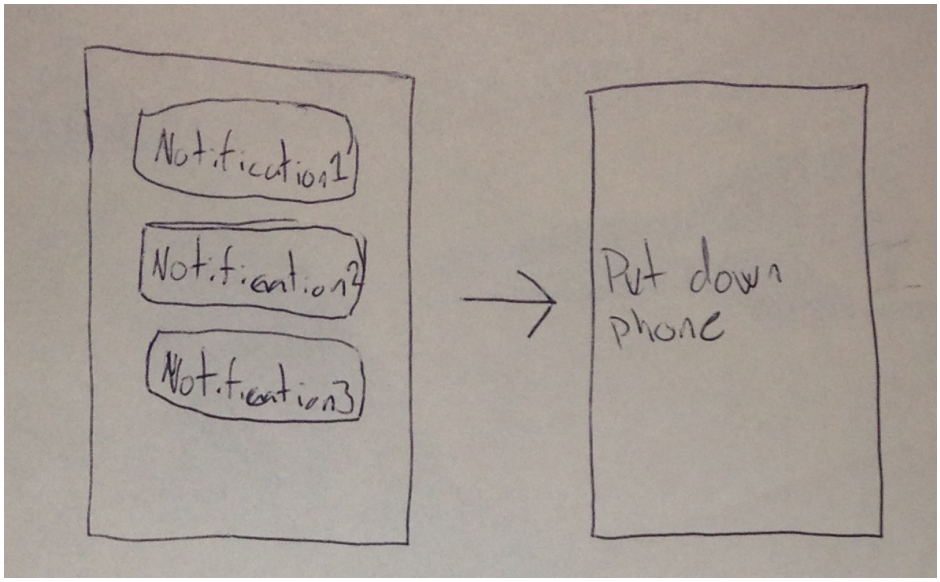


Figure 4.2: *The sketches for the main and the wait screen. When one of the buttons are pushed on the main screen it will open a new wait screen.*

Figure 4.3 illustrates three sketches. Each sketch represents each kind of notification. From left to right: notification assisted with vibration and picture, notification assisted by a song and lastly a notification not assisted by sound or vibration, only the notification. In each notification the actual notification will remind the user to walk 5000 steps. When the notification is dismissed by pressing the OK button, it will return to the main screen and the next button can be pressed to start the timer to the next notification.

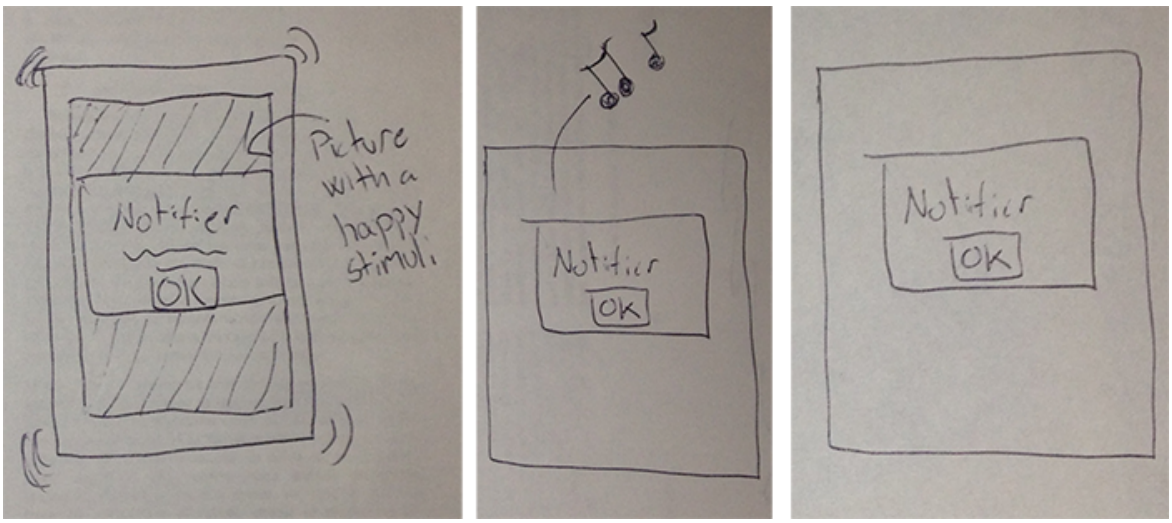


Figure 4.3: *This figure sketches each of the three notifications. From left to right: vibration and picture, song, and stand alone notification.*

Chapter 5

Implementation

In this chapter the hardware will be described and how the software for the product was created.

5.1 Hardware

As determined in section 2.6 an Android device was chosen for this project. The hardware used for this product is a Samsung Google Nexus S. The phone was released in the in late 2010 and is running Android version 4.1.2 Jelly Bean. The dimensions are 123.9 mm x 63.0 mm x 10.8 mm with an 4 inch screen and weighs 129 g.

5.2 App Inventor 2

The software for the product was created with MIT's App Inventor 2[1]. The App Inventor is a browser based, drag and drop program to create apps for Android devices. A screenshot of the App Inventor can be seen in figure 5.1.

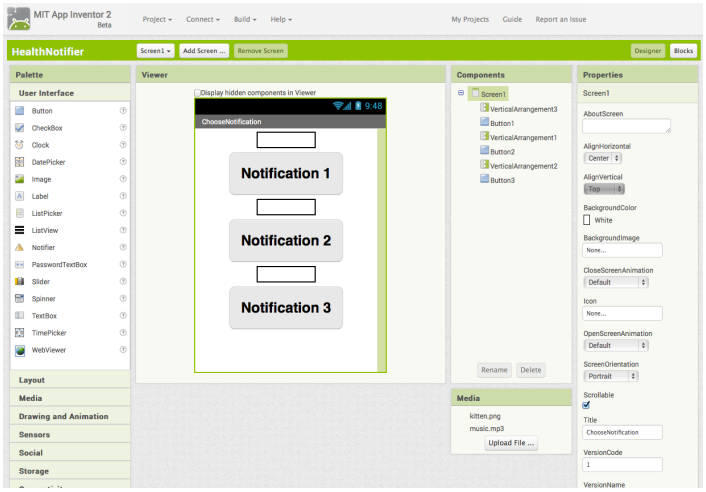


Figure 5.1: *A screenshot from App Inventor 2.*

[1](http://appinventor.mit.edu/explore/)

The App Inventor consists of a *Design* view and a *Blocks* view. The *Design* view is used to design the layout of the app, by dragging buttons, images, etc. into the *Viewer*. The *Blocks* view is used to program the app's behavior by putting blocks together. In this section it is described how the *Design* view and *Blocks* view was used to create the product.

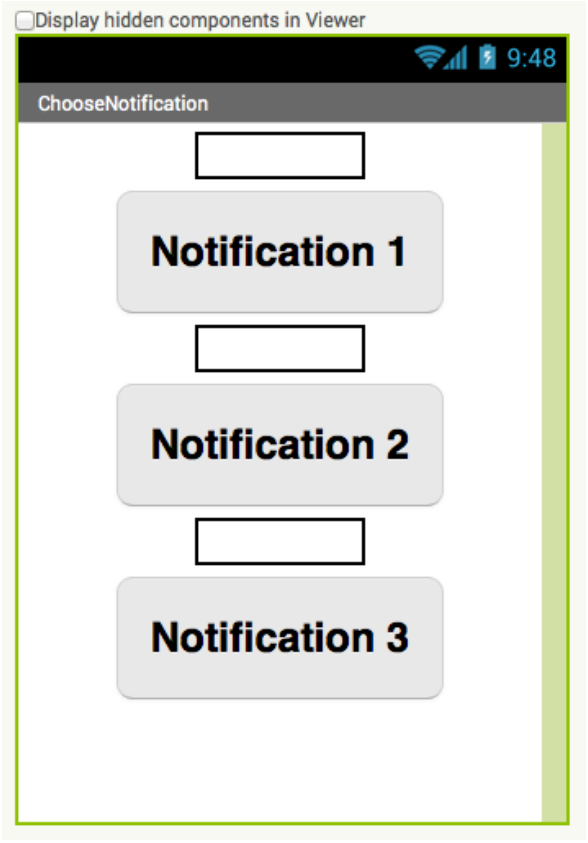


Figure 5.2: *The design view for the main screen of the app.*

First, the main screen of the app was created, see figure 5.2. It consists of three buttons and and three vertical arrangements (the three white, with black outlines, squares). The three vertical arrangement's only purpose is to create space between the three buttons. The three buttons will navigate to a waiting screen (see figure 5.4) and each will start a count down to play the notification.

Figure 5.3: *The block view for the main screen of the app.*

In figure 5.3 the blocks used to create the behavior of the buttons can be seen. Each block says that when the corresponding button is pressed it should open up a new screen, called *Screen2*, *Screen3* and *Screen4*.

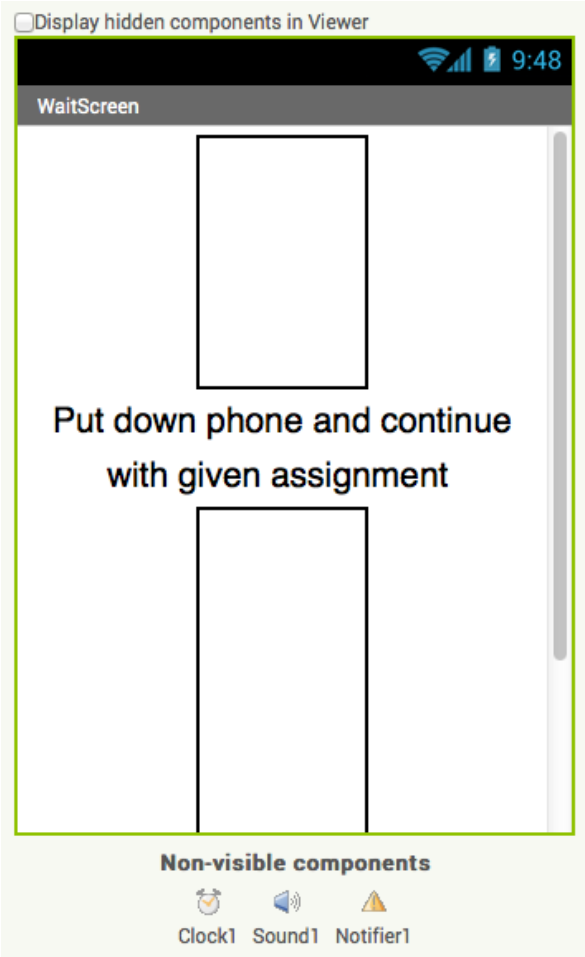


Figure 5.4: *This waiting screen will be shown when one the three buttons is pushed.*

When pushing the three buttons a new screen is opened and it will look like the one in 5.4. The waiting screen consists a text label, two vertical arrangements and return button (not shown in figure). It has three non-visible components: a *clock*, a *sound* and a *notifier*. These three components are used respectively for creating a timer, creating a sound or vibration and a notification with a message.

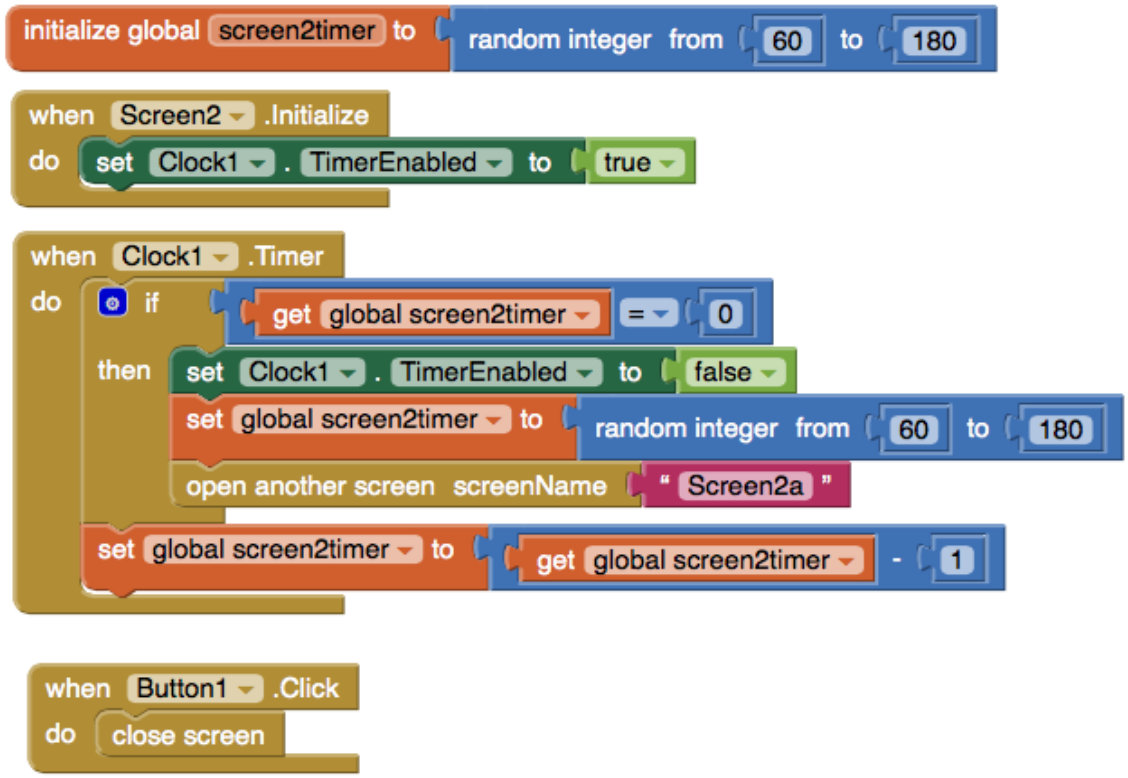


Figure 5.5: *The block view for the waiting screen when the* Notification 1 *button is pressed.*

When pushing the button *Notification 1* the waiting screen will open and a random timer is started. When the timer reaches zero the notifier will go off. The first block seen in figure 5.5 is the initialization of a global variable, *screen2timer*, which is a random integer between 60 to 180 (one to three minutes). The next block starts the timer, which fires every 1000 ms. In the third block the timer checks if *screen2timer* is equal to zero. If not, it will subtract 1 from the variable and the loop starts over. If the variable *screen2timer* is equal to zero the timer stops, it resets the variable to a random integer between 60 and 180 and lastly it opens another screen named *Screen2a*. The last block is for a return button which closes the waiting screen and returns to the main screen.

Figure 5.6: *The design view of a screen showing a kitten.*

When pushing the button for *Notification 1*, and the timer reaches zero a new screen is opened and the design of this screen can be seen in figure 5.6, and it simply shows a kitten. This screen also has non-visible components: a sound and a notifier.

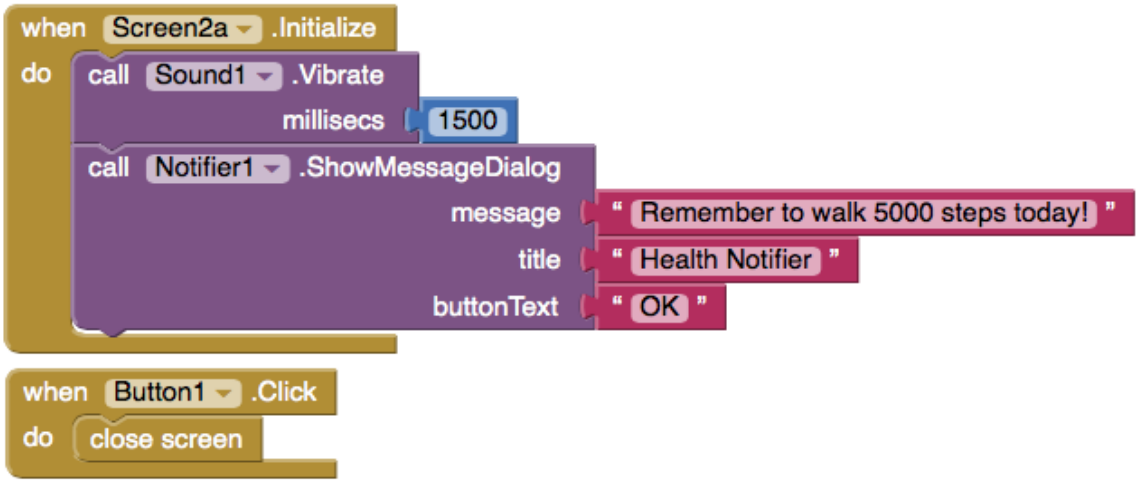


Figure 5.7: *The block view of figure 5.6.*

Figure 5.7 is what is happening behind the screen in figure 5.6. When the screen is initialized the first block calls the sound and the notifier. When calling the *Sound1* the phone starts vibrating for 1500 ms. *Notifier1* shows a message from the Health App reminding the user to walk 5000 steps today. The second block is for a return button, not shown in figure 5.6.

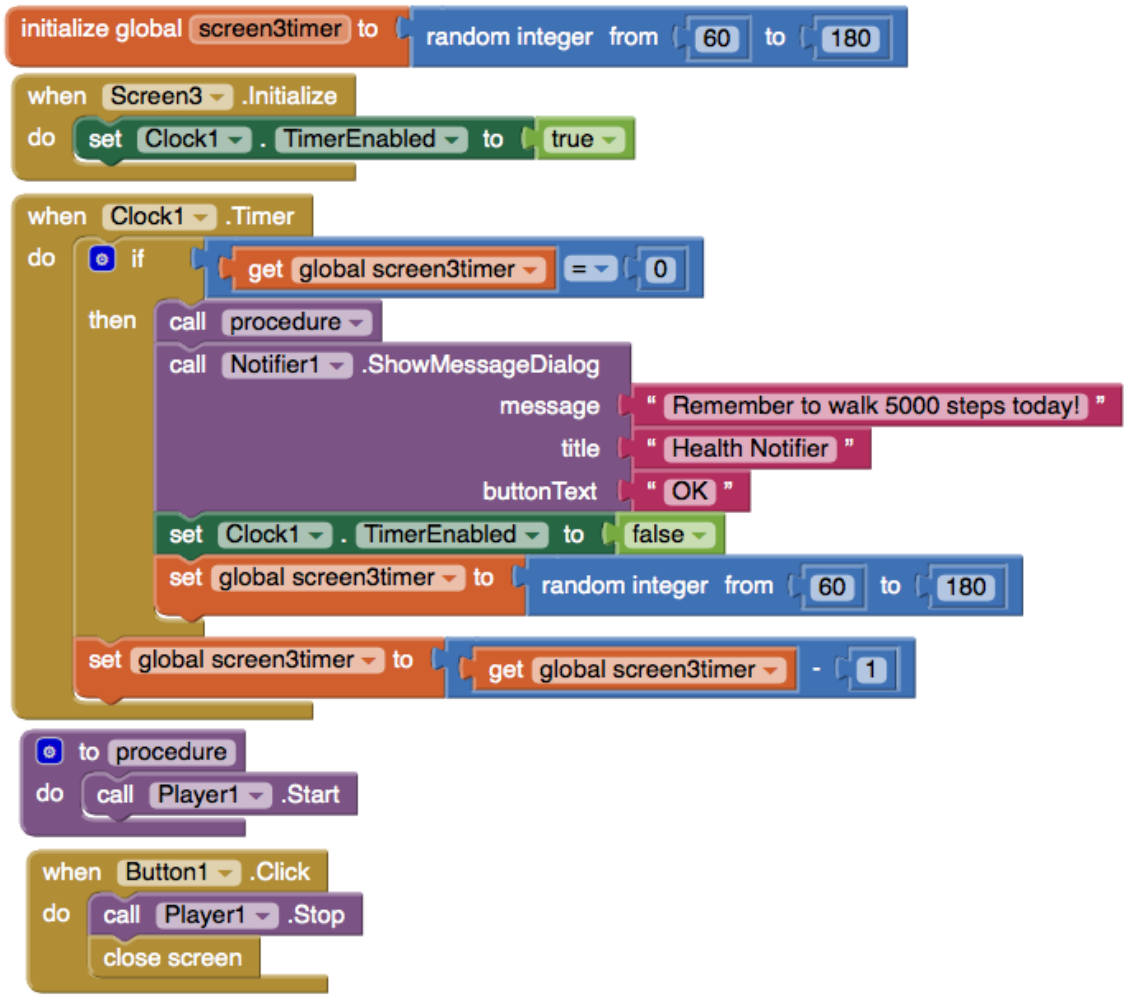


Figure 5.8: *The block view for when the button* Notification 2 *is pressed.*

When pushing *Notification 2* button the wait screen will appear just as did when pushing the *Notification 1* button. The blocks seen in figure 5.8 works as the ones in figure 5.5. The first block is the random integer which determines when the notification should go off. The second block is the one that starts the timer. In the third block, when the timer reaches zero, it starts playing a song. This is done with the *procedure* call. The *procedure* block calls a *player* to start the song. When the song starts a notifier is shown on the screen which reminds the user to walk 5000 steps today. The last block stops the song and returns to the main screen.

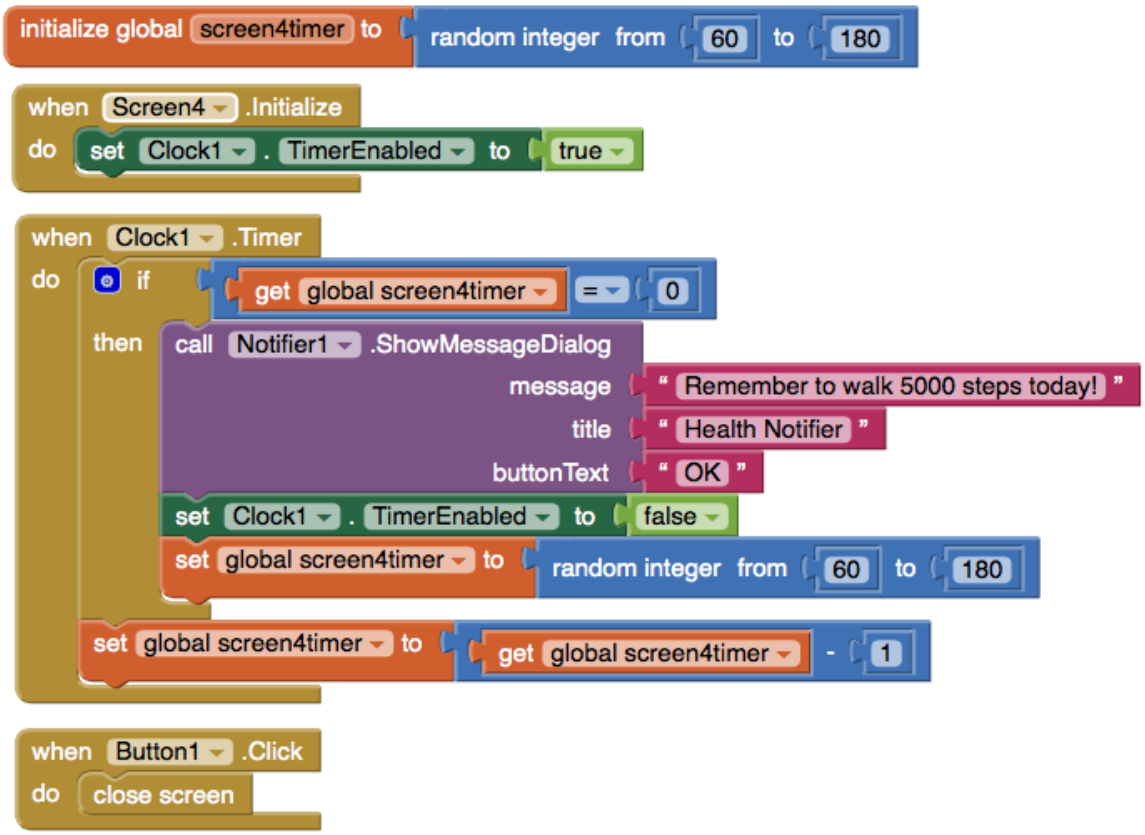


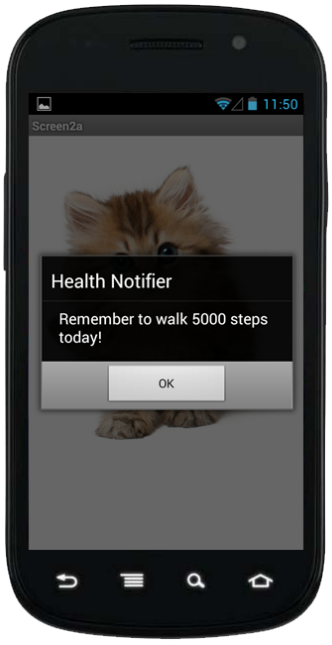
Figure 5.9: *The block view for when the button* Notification 3 *is pressed.*

The last set of blocks, seen in figure 5.9, is for when the button *Notification 3* is pressed. These blocks works just in the previous two cased, these ones only shows the notification which reminds the user to walk 5000 steps today, it does not play a song or vibrate.

(a) *The main screen of the final product.*

(b) *The wait screen of the app. The grayed out area can be reached by scrolling on the screen.*

(c) *This figure depicts the notification the user will reach every time being notified.*



(d) *This screen appears when* Notification 1 *is pressed. The notification is assisted by a picture of a kitten.*

Figure 5.10: *This figure shows the final product and the four different screens it consists of.*

In figure 5.10 the finished product can be seen. Figure 5.10a the main screen can be seen, showing only the three buttons which leads to each of the three different notifications. Figure 5.10b shows the wait screen that is initialized when pushing one of the three buttons.

The grayed out area in the button is visible when scrolling on the screen and it contains the button which returns to the main screen. Figure 5.10c shows the message of the notification with the accompany of vibration or song. Figure 5.10d shows the notification with the picture of the kitten behind it. This concludes the app and the .apk file for the app can be found on the attached DVD.

Chapter 6

User Study

In this chapter the user study is conducted. First, it is described in detail how it was designed and executed and here after results from the study will be described.

6.1 Method

This section provides the details on how the user study was performed. The section is divided up in four subsection so it is easy to distinguish between design, participants, apparatus and procedure of the user study.

6.1.1 Design

This user study will look into, if different kinds of notifications should be used in different contexts. Three different types of notifications, from section 4.2, will be examined in each condition.

For this user study there are three conditions and each condition is described in more detail in section 2.1 and 4.1. The three conditions are the three different contexts that the user study will take part in; at the bus stop, at work and at home.

The user study is designed to be a repeated-measure design, meaning that every participant will partake in all of the three different conditions. To counter balance the order of the conditions a *latin square* is used, see table 6.1. By using a latin square it is ensured that order of conditions are tested equal amounts of time.

	First	**Second**	**Third**
Participant 1	Condition 1	Condition 2	Condition 3
Participant 2	Condition 2	Condition 3	Condition 1
Participant 3	Condition 3	Condition 1	Condition 2

Table 6.1: *A latin square shows in which order the participants of the test should do the conditions.*

Finally, the test will measure what notification is the best in every condition/context, by extensive interviews.

6.1.2 Participants

Three participants will take part in the test. All three are the age 26 and two are male and one is female. All participants has a history with smartphones, ranging from two to six years, and therefore notifications. To take part in this test each participant will receive a bottle of wine. The participants will not be naive of the purpose of the study. They will be aware of, that the notifications are the important part of study.

6.1.3 Apparatus

To perform the test two smartphones and a semi-structured interview will be used. One smartphone will be receiving the notifications and is the smartphone the participants will use. The second smartphone will be used by the facilitator to record video and sound throughtout the test and interview.

6.1.4 Procedure

Before the participant is placed in the first condition a pre test interview is performed, to gather demographic information about the participant. Each participant will be placed in all of the three conditions, dictated by the latin square (table 6.1). When placed in the condition the participant is asked to do what is described in each scenario, see section 2.1. The facilitator chooses the first notification on the smartphone and hands over the smartphone to the participant. The participant is asked to place the phone where he or she normally would have it in the given context. After a random time between one and three minutes the notification will go off and the participant will notice the notification. Next, the participant will continue to do what is instructed and the facilitator will choose the next notification, and this will repeat until the three notifications are used. After the three different notifications are used, the participant is asked to rate them from the most practical to the least practical.

(a) *Scenario 1 - The Bus Stop - the participant is placed at a local bus stop.*

(b) *Scenario 2 - At Work - the work environment is simulated with a computer and a desk, home at the facilitator.*

(c) *Scenario 3 - At home - this scenarios is simulated with at TV and bed home at the facilitator.*

Figure 6.1: *The three locations used in the three scenarios.*

The participant moves on to the next condition, as dictated by the latin square, and repeats the above for the two remaining conditions. The three scenarios used in the test can be seen in figure 6.1. After the participants has been through every condition a semi-structured interview will take place, done by the facilitator. The interview will be recorded and later transcribed. The predetermined questions can be found on the attached DVD. After the interview is done the test is over for the participant.

6.2 Results

This section will describe the results obtained in the user study. Furthermore it will also look into what the results mean.

After each condition each participant was asked to rank each kind of notification from most practical to least practical in the given scenario. In the table 6.2 the results if of this can be seen.

	Scenario1			**Scenario 2**			**Scenario 3**		
Participant	***One***	***Two***	***Three***	***One***	***Two***	***Three***	***One***	***Two***	***Three***
Notification - from most practical to least practical	1	2	2	3	3	3	1	1	1
	3	1	1	1	1	1	3	2	2
	2	3	3	2	2	2	2	3	3

Table 6.2: *This table shows how each participant ranked the practicalness of each notification in each scenario.*

As a reminder: Notification 1 was the the notification with tactile feedback and a picture of a cat. Notification 2 was the one with a happy song playing. The last, Notification 3, was the notification with only the notification box. Scenario 1 was at the bus stop, scenario 2 was at work and scenario 3 was at home.

The first thing to notice is the agreement in *scenario 2*. Here, all three participants agreed on the order of practicality of the notifications in a working environment. They all answered that the complete silent, only visual notification, was the most practical in the working environment, and thereafter the vibrating notification and lastly the notification which played a song. In this scenario they ranked the notification based on how much sound it made. It should be mentioned that all three participants placed the smartphone in front of them on the desk in this scenario and therefore they could easily see the completely silent notification.

In scenario 1 and 3 the three participants couldn't agree completely, but participant 2 and 3 agreed in both scenarios. In scenario 1, at the bus stop, participant 2 and 3 agreed that the song was the most practical of the three. They based this on the fact they were outside, and it could be a noisy environment with traffic and other people. Participant 1 counter argued that the song was the most impractical because it was disturbing for other people, and that he did not like that, and therefore placed the song as the least practical. In scenario 3 all three participants agreed that the notification with vibration was the most practical. They all agreed that this was because it didn't disturb the movie, but they were

still available to notice the notification. Participant 2 and 3 agreed that the least practical was the completely silent notification.

After the participant had been through all the three conditions, a post test, semi-structured interview was conducted. The interview was recorded. The transcriptions of these recordings can be seen in appendix A and is available on the attached DVD. The recordings are in danish but transcribed to english.

Every participant was asked if any of the notifications had a positive or negative effect on them. Participant 1 answered: *"The song generally feels intrusive . . . because if I'm sitting and watching TV it might be okay if it was just a* riiing *. . . But I think I still would prefer vibration at the bus stop even if the sound is 'smart'. And when with other people sound is very intrusive."* Here participant 1 talks about what the table 6.2 also shows that he did not like song because it was too intrusive and it would also be very disturbing, for him and others. Participant 2 answered: *"Depending on the situation, yes . . . The one with the sound, uhm, when it is in the work place . . . There are some norms (in the work place) on how a work place is, it depends on the work place, but if it is a very formal work place and so on, then it might be a bit intense to have such a ringtone . . . At the TV, there it is a bit intense with the song, it is very disturbing."* Participant 2 is mentioning, just as participant 1, that the song is more disturbing than practical. Even though participant 2 said it was the more practical, when standing and waiting for a bus. Participant 3 simply said: *"I became really happy when I saw the cat. It was very fluffy. When I first saw it over at the couch and it didn't come up the next time then it was a bit sad."* Participant 3 is the first to mention that the cat had positive effect on her.

The participants was asked about the message of notification. The notification said: *Remember to walk 5000 steps today!* The participants was asked which of these scenarios or contexts they felt most motivated to do this. All three agreed that they felt least motivated in scenario 3, watching a movie on TV. *"Especially when watching the movie it was very 'UGH', because it is properly late and not in the middle of the day"*, answered participant 1 and participant 2 *"When I'm sitting in the sofa, it is properly evening, and that is not when I want to walk 5000 steps."* Participant 3 didin't say directly that it was scenario 3, but mentioned the two others as the scenario where she felt more motivated: *"Either, it is at the bus stop . . . I could imagine if I sat in an office and wanted to something (other than what I was doing), then I would be happy if such a notification came up".* All three participants agreed that it had potential when it notified at the bus stop or at work. Participant 1 said: *"Or, it was funny, at the bus, because I'm waiting for the bus, so it might be possible that you think: 'Alright, I'll walk instead' . . . if I'm going to Nytorv (downtown), I would be like: 'Fine, I'll just walk' . . . But if I'm working then I would believe you be like: 'Fine, I'll do that when I'm done'."* Participant 2 agreed: *"If it is at work or at the bus, I'm most likely going somewhere, then it seems possible and I can fit it into my agenda."* and so did participant 3: *"I think it would be more motivating at the bus stop, because you're already outside."*

Lastly, all participants was asked if they found the song or picture of a kitten motivating in regards to walking the 5000 steps. Participant 1 and 3 agreed that the kitten had a positive feedback and the song a negative feedback, as they answered, respectively: *"Yeah, the kitten did. I was like: 'Ha, there's a kitten'. But no, not the song, it is a bit too fake, 'hey remember to walk*

5000 steps', where as the kitten was more subtle." and *"The song definitely wouldn't. Most of all it was disturbing . . . Yeah. Some. (asked if the kitten had a positive feedback) Even if you're sitting in the couch, it could be an irritating message to get, but it was a cute kitten afterward"*. Participant 3 mentioned that the kitten did not a positive effect on him, but neither did it have a negative effect.

Chapter 7

Conclusion

This project set out to answer the question if a context-aware application should use different notifications for different scenarios and could alternative notifications be used to motivate people. To answer this a user study was performed. For the user study three different scenarios was created: at a bus stop, at work and at home. To be able to recognize the activities in each scenario, knowledge of activity recognition and context-awareness was gathered. The research showed that activities such as standing, sitting in different contexts can be done with activity recognition and context-awareness, and done with high accuracy. Next, notifications was design to be used in the user study. It was determined to use three notifications with tactile feedback, audible feedback and visual feedback. For the user study an application, which notified the user that he or she should walk 5000 steps every day, was made and was used in the three scenarios by the three participants that partook in the user study. The user study showed that, at work, the notifications was chosen because of how much noise they made. Generally audible feedback fared the worst, except in scenario 1, at the bus stop, where two of the three participants preferred audible feedback. In a post test interview the participants all agreed that it was a good idea if a context-aware app was able to use different notifications depending on the scenario. The participants felt more motivated when they were at work or at the bus stop, every participant agreed that, when at home, was the least motivating factor. Two of the three participants agreed that visual feedback in form of a happy stimuli would positively motivate them to walk the 5000 steps. Every participant agreed that the song would not have a positive affect on them.

Chapter 8

Discussion

The scenarios The second scenario, at work, could have been simulated better, as it was simulated home at the facilitator. The environment did not simulate an office work place, and factor such as coworkers and location could have had another effect on the user. More scenarios could have been used, and perhaps, been more specified.

The notifcations The notifications could have been more extensive as there were only three. More research could have gone into the different notifications and the physical and psychological effect is has on people using smartphones. The reminder, reminding the user to walk 5000 steps a day, should not have been one of a kind since the user possibly became very used to the message and the effect of seeing it the first time wouldn't be the same. A bigger mix of different notifications, varying between tactile, visual and audible feedback should have been used to get a bigger view of which kind of notification had the better effect in each scenario. The reminder shouldn't always be a visual feedback, and it should have been researched it if it possible to remind people of doing something with other then just words.

A small sample size The sample size for the user study was small. Three participants partook in the study. Agreement was often accomplished and this could be because of the small sample size and by only using three different notifications.

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Appendix A

Transcriptions

Transcriptions

F = Facilitator
P = Participant

Participant 1

F: Were there any of the notifications you reacted more positively on or some you reacted more negatively on, or neutral reaction?

P: The song generally feels intrusive.

F: Because it is too loud?

P: It might be, because if I'm sitting and watching TV it might be okay if it was just a *riiing,* but if it is a song… I think a sound would be okay. But I think I still would prefer vibration at the bus stop even if the sound is "smart". And when with other people sound is very intrusive.

F: What was written on the notification?

P: Word for word?

F: No, that's okay.

P: I should remember to walk 5000 steps today

F: In which of these three contexts do you think you would remember to do this?

P: Clearly at work. Or, it was funny, at the bus, because I'm waiting for the bus, so it might be possible that you think: "Alright, I'll walk instead". Especially when watching the movie it was very "UGH", because it is properly late and not in the middle of the day. But if I'm working then I would believe you be like: "Fine, I'll do that when I'm done". And at the bus it might also be fine, because on one hand I'm waiting to get on the bus "Thanks for reminding me", but on the other hand if I'm going to Nytorv (downtown), I would be like: "Fine, I'll just walk".

F: So, it not enough to take the context of only going with bus, it could depend on how busy you are and the distance?

P: Yes, for an example, if I'm standing there hungover, don't know why that was my first thought, and was going to Burger King (downtown), then I might think… Ah, okay, if I'm hungover… But if I wasn't busy you properly would think: "Right, I could as easily walk". But if I'm standing there because I must get the bus.. It might not be that I'm standing waiting for a bus, more the timing of it.

F: What do you think makes a notification annoying?

P: Uhm, actually pressing "OK"… I don't know how it is on an android, I've never had one. But on my iPhone i don't want notification that requires that I press a button. I like the ones that comes down from the top of the screen or on the lock screen. Not when it.. If i'm sitting and doing stuff on my phone I don't want.. It is first recently that I've learned than you can push it back up (on iPhone), because if you want to go back in an app, you can't. I hate that a notification demands me to do something. If it from something I don't really want notifications from, if it something that I didn't think "I want notifications from this".

F: What do you like about notifications?

P: I like that you just can put it away and I don't have to remember to look it up. It it nice just to know it. I mentioned mails, that is very nice that you can VIP people and then you see it instantly. That's nice.

F: Do you think it would be a good idea to get notifications to react differently depending on the scenario, context?

P: For example, if it knew I was working and then it wouldn't say anything?

F: Yeah.

P: Hmm, yes, because I wouldn't mind that it said a *diiing* when I'm at home.

F: How do you normally use notifications?

P: Silence and vibration, but I always have my phone on silence.

F: Are there any scenarios where you think, that would be nice if it had done this or that?

P: Uhm, I can imagine some situations, but I can't remember any. I could imagine, if it was lying someplace where i couldn't hear it, the vibration - you can say vibration only makes sense when it is in the pocket, because if it lying somewhere you hear the vibrations. So in that case, yes, depending on the situation.

F: Do you think that, because it was a happy song or that there where a picture of a kitten, could affect you in a positive way, when reading you have to walk 5000 steps today.

P: Yeah, the kitten did. I was like: "Ha, there's a kitten". But no, not the song, it is a bit too fake, "hey remember to walk 5000 steps", where as the kitten was more subtle.

F: Okay, I think that was it.

P: The kitten was fun.

F: The kitten was fun? It gave positive feedback?

P: Yup.

F: Alright, thank you.

P: You're welcome.

Participant 2

F: Where there any of the notifications you reacted more positively on or some you reacted more negatively on, or neutral reaction?

P: Depending on the situation, yes. The one with only the picture (no sound, no vibration), that has a common denominator that it is kinda stressful. Because if I know that something will come in a moment, then I will always think of that instead of thinking on everything else. For an example, if it was in my pocket, as it were at the bus stop, then I feel that I'm also thinking about, then taking it

up the pocket, putting it down the pocket again. The same at the television, you are also looking at it, the same at the work situation. It depends on where it is. A small stress factor.

F: But what if you weren't aware of that a notification would might appear?

P: Then I wouldn't see it. And, I would still think, "I need to check my phone", even though I'm not expecting something. The one with the sound, uhm, when it is in the work place, then it is very.. There are some norms (in the work place) on how a work place is, it depends on the work place, but if it is a very formal work place and so on, then it might be a bit intense to have such a ringtone just because you should remember to walk 5000 steps. So, I would never prefer (song), and that's why I said the one with without sound was best, if it is lying on the desk. At the TV, there it is a bit intense with the song, it is very disturbing. Vibration is a bit of a joker, because of how it is a cross between the two (song and silenced). That depends on the surface the phone is lying on, if you don't want it to make a lot of noise, then I can put it on a soft surface, then I still have a little bit of conscience of what going on, but it is not as noisy.

F: Yeah, the vibration works two way. You can feel it and hear it.

P: And, that you can feel it, is what is happening at the bus stop. If doing something active it is not enough with the vibrations, you need sound. And that's why is it properly best with sound when I'm out doing something, because then you can hear it.

F: How do you normally use notifications? Silence? Vibrations? With sound?

P: Standard, almost always on silence. When I'm transporting my self, the transport is brief, work or the train station, but if I'm sitting still then the vibration.. And if I'm sitting in the train I don't like the sound. And I often sit in the silence area. So I can't really remember.. When it is just a normal everyday at home and my phone is just lying around I have sound on. But I have vibrations on all apps.

F: What about the message on the notification, where it reminds you to walk 5000 steps today. How do you react to that message in the different contexts?

P: My first reaction when sitting at the computer was: "Oh my, I'm going 5000 steps today? Not now when I'm working", so I think, because I'm sitting here writing… In the couch (watching TV) I'm thinking.. There weren't really anything nor at the bus stop. So, I reacted more at the computer, the work place.

F: Do you see it as annoying or as a stress factor?

P: It's properly a bit of a stress factor, a moment of irritation.

F: What do you like about notifications, what don't you like about notifications?

P: I like important stuff. I don't like if there is too many of them. Then it is just a mess. Or if..

F: So you don't want the same app to spam you?

P: No, that was my next point, an app can notify about important stuff, but it could also notify about bad stuff. You know, an example could be a news app, a lot of junk comes from there."I don't want to read about that". Just with emails, you can get a lot of spam from there, but you can choose yourself what to get from there. It depends on several stuff. And in a respond to this scenario, then it might be more relevant and less irritating if I had adjusted my mind to walk these 5000 steps a day. If I had the ambition to do it, then I think it would be cool, but if I had lost my motivation a bit and I didn't care, then it would be very irritating.

F: What about it when it tries to play a happy, up beat song, does that have anything to say?

P: No, I don't think so.

F: What about a picture of a kitten?

P: It has nothing to say, I'm only looking at the text not the background.

F: So it didn't have any positive or negative effects?

P: No, neither positively or negatively. I couldn't say how it would be if you had used a gloomy song, but the happy is hard to answer, because I think I'm lacking a reference point.

F: If a notification is aware of the context you are in, that it reacts to that, would that be a good idea?

P: Yeah, that'd be very nice. Really nice. It would annoy you less, if it knows you are working, and it didn't say anything. In my world, marketing, every time you get a stimuli, you can't ignore it, accumulate it and it would be an irritation factor, and it wouldn't depend on the importance of it, only the frequency of it.

F: What about walking those 5000 steps? In which scenario do you think you would be most motivated?

P: The least in the couch (watching TV), the most at the bus, and in the middle at work. When I'm sitting in the sofa, it is properly evening, and that is not when I want to walk 5000 steps. But if it is at work or at the bus, I'm most likely going somewhere, then it seems possible and I can fit it into my agenda.

F: The three different kind of notifications, could they have anything to do with your motivation to do this, walking 5000 steps?

P: Yes and no.

F: How's that?

P: If i'm at home I think the sound would work the best for me, it might be because it is a bit up beat, it livens you up. It's a bigger stimuli if than if it was a quite song, so it might have a small motivation factor.

F: Thank you.

Participant 3

F: Where there any of the notifications you reacted more positively on or some you reacted more negatively on, or neutral reaction?

P: The sound?

F: For an example, yes.

P: I became really happy when I saw the cat. It was very fluffy. When I first saw it over at couch and it didn't come up the next time then it was a bit sad.

F: What do you like about notifications? What do you want it to do?

P: If it was an app like Hipstermatic (an retro camera app where you can apply filters to your photo) or an “hobby” app then I don’t need it to do anything. But if it was an app you used a lot, checking mail or checking messages, then it is better that it did something.

F: The notification on the phone..?

P: The one that said I should walk 5000 steps.

F: Yeah, in which scenario do you think you had the most motivation to walk these 5000 steps today?

P: Either, it is at the bus stop or.. I could imagine if I sat in an office and wanted to something (other than what I was doing), then I would be happy if such a notification came up. But if it was a job you were really happy about I think it would be more motivating at the bus stop, because you’re already outside.

F: Alright. The kitten and the song, do you think that they would have a motivating factor on you?

P: The song definitely wouldn’t. Most of all it was disturbing.

F: Even though it was a happy song?

P: Yeah, I still think it was disturbing. If you’re sitting at home watching a movie it is very irritating, and if you’re in a public space if there comes a sound and it is especially annoying if you’re sitting at work. I think it doesn’t matter on the location when using a song, it is still annoying. The kitten was definitely better.

F: Would you say you get a little motivated by the kitten?

P: Yeah. Some. Even if you’re sitting in the couch, it could be an irritating message to get, but it was a cute kitten afterward.

F: Do you think it’s a good idea if you phone could give you different kind of notification depending on the scenario, contexts you’re in?

P: Yeah, that could be really smart. If you’re sitting at a lecture, or something, then it would be nice if it knew it should be silent and then turn back on when it is done.

F: Are there anything that can annoy you with notifications?

P: If it is unimportant, it’s often an update or something you should pay for.

F: I think that was it. Thank you for your time.

P: You’re welcome.