Aalborg University
Department of Computer Science
Selma Lagerlöfs Vej 300
9220 Aalborg
Telephone:(45)96358080
http://www.cs.aau.dk

Title:
The potential for pervasive computing to change peoples cooking and eating habits

Theme:
HCI Master thesis

Project Timeframe:
SW10, 1. February, 2011 - 16. June, 2011

Project Group:
d613a

Group Members:
Martin Lejsgaard Myrup

Supervisor:
Jan Stage

Abstract:

This master thesis consist of two articles and a summery of those. The main theme is peoples cooking and eating habits and the thesis tries to answer the research question: *Can pervasive computing be used to change peoples cooking and eating habits?*.

Using a literature survey, a questionnaire and a workshop this master thesis identified five areas that should be considered if new kitchen systems were to be developed for students. To motivate students to cook more at home, systems should make the cooking process more sociable; it should enable the student to easily keep track of expirations dates on groceries; make the cooking process more efficient; inspire the student and provide healthy alternatives to both recipe suggestions and ingredients.

By utilising a system that enabled patients to see and communicate with a relative while admitted, interviews and grounded theory, this thesis suggest that it is possible to motivate patients at hospitals to eat more. Several other benefits of utilising the system was identified like feeling less alone; feeling closer to each other; positive change in mood; easing the everyday.

These results indicate that for specific target groups it is possible to change cooking and eating habits by using pervasive computing. The results show that sociability, connectedness and the ability to make everyday activities easier should play an important role when designing systems for this purpose.

Copies: 3

Total Pages: 40

Paper Finished: 16th of June 2011

Signatures

Martin Lejsgaard Myrup

Contents

1 Introduction

Studies have shown that the American lifestyle of college students have changed over the past decades [1]. This new lifestyle is more fast-paced with less free time, meaning that people resort to convenience food products rather than home cooked food [1, 2, 3]. Studies carried out among 19-29 year old American individuals have shown that 57% ate their meals at home in 1996, while this number was 73% in 1978 [1]. These same individuals reported to have consumed 31% of their meals at restaurents and fast-food restaurents, while the number was 15% in 1978 [1]. Commercially prepared meals are also winning pace, research from 2000 showed that 41% of the American population admitted, that they consumed three or more commercially prepared meals a week - compared to 36% in 1992 [2] .

Similar studies have been carried out in European countries, like Denmark, and showed the same tendencies. According to [4] only 50% of danish adolesences in the ages of 15-24 eat breakfast everyday, only 33% eat lunch everyday and about 75% eat dinner everyday. Like in America, Danish adolesences are also eating more preprocessed food. According to [4], the daily intake of preprocessed food have increased from 79 grams a day in 2000 to 104 grams a day in 2004.

Pervasive computing is a term for information and communication technology integrated into our environment. The advancement in hardware development as well as advances in location sensors, wireless communication and global networking has allowed for pervasive computing to emerge. Today pervasive computing is in everything from toys and desktops to factories and city areas and supports human activities in many areas [5]. The question is whether the potential of pervasive computing, could also be used to change peoples cooking and eating habits and thus the overall research question for this master thesis is: *Can pervasive computing be used to change peoples cooking and eating habits?*. Below this research question is divided into two separate research questions, each studying different aspect of this overall research question.

Studies like [6, 7] have shown that due to the proliferation of convenience food, children are less inclined to learn the skills of cooking. A study carried out in Great Britain showed, that adults that lack the skills to cook are less inclined to learn how to cook and cook at home, choosing the alternative of eating out or eating pre-processed meals instead [8]. Not only is it an expensive habit, but a concern for public health, as eating away from home and eating preprocessed food constitute a potential health risk [2, 9].

The first research question is *What are students cooking habits and can pervasive computing be used to motivate students to cook more at home?*

Consequences of these unhealthy tendencies may be that more people will end up being hospitalised, which will constitute a new problem. Studies have shown that malnutrition among patients is common [**?**, **?**, **?**, 10]. The consequences pertaining to malnutrition of patients is complications in treatment, infections, prolonged stay, morbidity and mortality [10]. The differences between well nourished and undernourished patients were studied in [11]. They found that in average, undernourished patients stayed hospitalised six days longer than well nourished patients and 19.4% compared to 10.1% experienced complications or infections during their treatment. Mortality was also significantly higher for undernoursihed(12.4%) patients compared to well nourished patients(4.7%).

In addition to having an impact on the patient, the treatment of undernourished patients also influence the health sector in terms of expenses. In [11] they identified that an undernourished patient represented a mean daily expense of US$ 228.00/patient compared to US$ 138.00/patient for well nourished patients - representing a difference of 60.5% in expenses. To study whether or not pervasive computing can change this, the second research question is *Can pervasive computing be used to motivate patients in a hospital to eat more?*

This summary consist of the following chapters: Chapter 2 contains resumes of the two articles. Chapter 3 present the research methods used in this master thesis and chapter 4 concludes this summary with a conclusion, limitations and future work for this master thesis.

2
Article Overview

This chapter provides a resume of the two articles comprising this master thesis.

2.1 Article 1

This article focuses on the problem that students do not cook at home. Studies have shown that students, and young people in general, are becoming increasingly inclined to eat pre-processed food, take away or restaurant food. The consequences of this tendency are that students eat more unhealthy food and does not acquire the skill to cook them selves.

Using a literature survey this article examined the research done so far within the area of pervasive computing in the kitchen. This was done to try and determine what had been done, to make the experience of cooking more attractive for students. By making a literature study it was possible to determine the main areas of research that have been focused so far. Six areas were identified; systems that are interactive; systems that provide visual aid; systems that enhance user experience; systems that educates; systems that supports and systems integrated into the kitchen environment. This information was used to make sure we would not repeat previous research and to enable us to compare our results with current research.

A questionnaire was sent to students at three departments at Aalborg University, in an effort to determine students current cooking habits. 96 students answered the questionnaire and from the data it became apparent that the main causes for students not to cook at home were; lack of time and a lack of inspiration for what to cook. The questionnaire showed that 37% of the participants almost always cooked at home, 49% cooked often at home, 13% cooked occasionally and 2% never cooked at home. Inspiration for what to cook was primarily found on the Internet.

A Workshop was held, with nine participating students. During the workshop, students were given a series of exercises that helped them come up with ideas for new systems, that could motivate them to cook more at home. Eight ideas were generated by the participants.

The main ideas were; an adjustable meal planning system, that was able to keep track of expiration dates of groceries in the refrigerator; a point system that motivated students to cook and eat together by issuing points based on the meal and a system that would make it possible to connect peoples refrigerators, to help friends cook and eat together, based on what groceries they had in their refrigerators.

This article identified five main areas of interest if new kitchen system were to be developed to motivate students cook at home. To motivate students, systems should either make the cooking process more sociable; enable the student to easily keep track of expirations dates on groceries; make the cooking process more efficient; inspire the student; provide healthy alternatives to both recipe suggestions and ingredients. These could also be combined.

In conclusion, this article showed that a different approach than the one currently taken by researchers, is needed to be able to create new kitchen systems that would motivate students to cook more at home.

2.2 Article 2

This article focuses on whether or not it is possible to use pervasive computing to motivate patients at a hospital to eat more. Research have shown that undernourishment among patients in hospitals is a significant problem and that the consequences pertaining to undernourishment are complications in treatment, infections, prolonged stay, morbidity and mortality.

To try and motivate patients in hospitals to eat more, an empirical study were carried out. In this study, a system consisting of a laptop with Skype installed and Internet access was utilised. The system made it possible for patients and relatives to see and communicate with each other, when not physically present at the same place. Five patients patients participated in the study. Each participant had to chose a relative to participate in the study. The system was set-up in the ward of the patient and the home of the relative. Instructions were given on how to use the system to eat supper together.

The duration of the study for each couple participating lasted at least four days. During this time, interviews were used to gather data. Data was gather before the study was initiated, after the first time the couple had used the system, when the couple had used the system for at least three days and finally when the study were completed. In total 37 interviews were made. To be able to analyse these interviews using grounded theory, transcripts were made. Transcripts were in average seven pages and in total 249 pages of transcript were made.

Findings from the study suggested, that the system could motivate patients to eat more when admitted. In addition to this, the study showed that the system motivates patients to try and eat. Patients felt happier, not so far apart from their relative and less alone when they used the system.

Benefits for the relatives using the system were also identified. These included being able to see and communicate with the patient, without visiting them at the hospital; released them of stress; eased their everyday and improved their mood.

Finally, the system gave participants a feeling of eating supper together, the only thing reported missing were the physical presence.

3
Research Methods

A number of research methods have been used in this master thesis, these will be described in the following sections.

3.1 Literature Survey

A literature survey was used to be able to identify the research done within the field of pervasive computing in the kitchen and to be able to determine the focus areas of this research.

General: A literature survey is used to gather existing literature and research on a specific area of interest.

Method:: The literature survey was made by searching a variety of digital databases for publications pertaining to pervasive computing in the kitchen. Inclusion criteria were made to limit the search. Affinity diagramming was used to be able to create a literature table identifying the main interest areas of research in these publications. Resumes of the publications found were made and each group member had to create keywords describing the content of these resumes. Keywords were then grouped into groupings with related keywords by each group member. These groupings were given a title or theme. When group members had done this, the group, in conjunction, created the literature table from these groupings.

General problems: According to [12] the major drawbacks related to making a literature survey are that it may be time consuming to search for literature. It may be difficult to find literature if the search criteria are too strict or specific. Finally, not only digital databases should be search.

Specific counter measures: For the literature survey in article one, a completion date was set to make sure it would not be too time consuming. Two weeks were used to search for literature. We made the mistake of being to specific in our search for literature and using only digital databases, limiting the amount of literature found to be relevant for the literature survey. However, follow-up searches, both on the references in the literature and of the authors were made, to make sure no important or newer literature was missed.

3.2 Case Study

A case study in the form of a workshop was conducted with nine students. The aim of this workshop was to have students come up with new ideas for systems that could motivate students to cook more at home.

General: According to [13], a case study is a detailed examination of one or more situations. It can be used to do an in-depth examination of a single individual or group, to build understanding, generate theories and hypotheses, present evidence for the existence of certain behavior, or to provide insight that would otherwise be difficult to gather.

Method:: The workshop was carried out in one day and lasted for four hours. The nine students participating were split into three groups, in a way that allowed a group to be dominated by male participants and a group to be dominated by female participants, to see if any clear difference would emerge between these groups. The groups were then given three exercises that should help them think of new ideas for systems that would motivate students to cook more at home.

General problems: According to [14] the drawbacks of using case studies are that there is no systematic way of handling the data generated during the study, that it is very time consuming and it can be difficult to find suitable participants.

Specific counter measures: To be able to gather the data we were interested in, a premade form was handed to each of the group at the end of the workshop. The groups were explained how and what to write in this form. We had problems finding participants for the workshop and was forced to used primarily students that we knew. To generalised the findings from the workshop, we used participants from different study programs and age groups and both female and male participants.

3.3 Questionnaire

A questionnaire was used to gather information of students current cooking habits, design of their kitchen and reasons for not cooking at home.

General: According to [13], questionnaires are good at collecting data from a large number of people at a relative low cost.

Method: In this study we were targeting students, which is a rather large group of people, so a questionnaire seemed reasonable. Using [13] as guide, we created a questionnaire consisting of five sections each dealing with an area we were interested in gathering information about. The questionnaire was sent to three study program; Computer Science(CS), Architecture & Design(A & D) and Humanistic Informatics(Hum. Inf.) at Aalborg university.

General problems: According to [13] questionnaires are good at getting limited 'shallow' data for a large number of people, but is not very good at getting 'deep' data. Other drawbacks are that it is usually not possible to do follow-up questions if interesting phenomena starts to appear and that questionnaires are prone to bias, if questions are related to patterns of usage.

Specific counter measures: Since the data that acquired by this questionnaire by nature was shallow, nothing was done to overcome this problem. To try and overcome the problem of not being able to do follow-up questions, space was left at questions, which we sort might generate some interesting responses. This meant participants were able to elaborate. Careful consideration was taken when making the questions for the questionnaire to reduce biased questions and questions relating to patterns of usage.

3.4 Interviews

Interviews were conducted to gather data during the study of each patient participating in the empirical study.

General: According to [13], the benefits of using interviews are the ability to 'go deep' and gather data that would otherwise have been difficult to gather and the flexibility interviews provide.

Method: During the study of each couple participating, data was gathered using interviews. Participants were interviewed before they started using the system, after they had used it once, when they had used it for at least three days and finally when the study was completed. Interview was chosen rather than questionnaire due to the ability to get detailed feedback from participants. Semi-structured interviews were used. General question were made to make sure important topics were covered during the interview, additional questions were then asked based on the replies of the participant. Question were, whenever possible, asked in an open-ended fashion to encourage participants to be more detailed and elaborated in their answers.

General problems: According to [13] the downsides of using interviews are that they can be difficult to conduct and requires skill and experience to do properly. Data analysis of data gathered during an interview is also like to be very time consuming and challenging.

Specific counter measures: To try and compensate for the lack of experience with interviews, guidance was acquired from the supervisor and another professor at the university. This was done by making transcripts of the first interviews, review these and receive guidance as to what was missing and what could be change for next time. This routine was used during the first couple of interviews to refine them. A program was used to make the analysis of the data from the interviews more manageable.

3.5 Grounded theory

To be able to structure and analyse the qualitative data gathered from the interviews, grounded theory was used.

General: [13] states that grounded theory have the advantages of enabling systematic analysis of qualitative data and generate theory that can be backed up by ample evidence.

Method: Interviews were transcribed and imported to program called Atlas.ti 6.2. Using open coding and coaxial coding main categories were identified.

General problems: According to [13] the downsides of using grounded theory are, that during the coding stage, novice users might be overwhelmed by the data. Another problem is that it may be hard to evaluate theories. The evaluation of theories depends on measures that are less direct, such as the chain of evidence between the finding and the data or the number of instances in the data. Finally, theories might be influenced by the researches pre-conceived opinions.

Specific counter measures: To help manage the overwhelming amount of data Atlas.ti 6.2 was used.

The main benefits of using these methods are that they in general explores topics in more depth and detail than quantitative research would have. they are good at exploring phenomena, describe variation and individual experiences as well as group norms. The drawbacks of using these methods is that it is not possible to quantify how many answer one way or another and that the findings can not be generalised to a broader audience.[15]

3.6 Limitations

The main limitations during the questionnaire study were, that the questionnaire was distributed by mailing list at Computer Science(CS) but at Architecture & Design(A & D) and Humanistic Informatics(Hum. Inf.) it was put on their Intranet. This resulted in a limited amount of responders from A & D and Hum. Inf.. and disproportionate data regarding gender. Responders were predominantly males. Further more, as results from the questionnaire were analysed it became apparent that certain questions were either to poorly structured to gather all the information needed or questions were missing that would have given important data. These included the amount of table space students had available and the eating habits of students.

The interviews used to gather data from participants were another limitation. [13] recommends that fully structured interviews are used, when the interviewer is not experienced in conducting interviews. In this study semi-structured interviews were used even though the interviewer had no experience. The main

reason for using semi-structured interviews was that it was difficult to predict what would be said during the interviews. Four different interviews, with different context, was conducted with each participant. The semi-structured interviews contained the subjects of importance for the study, but also allowed the interviewer the opportunity to ask new questions during the interview if something interesting was stated.

4 Conclusion

This master thesis tried to answer the question: *Can pervasive computing be used to change peoples cooking and eating habits?*. Two specific target groups were examined to try an answer this. The first research question *What are student cooking habits and can pervasive computing be used to motivate them to cook more at home?* was answered in article 1, where students cooking habits and reasons for not cooking at home were examined. Data collected from this was then used to motivate a group of students to identify systems that would motivate them to cook more at home.

What can be concluded from this study is that in order to motivate students to cook more at home, a different focus is needed when designing new systems for the kitchen. New systems that aims a motivating students to cook more, should focus on making the cooking experience more sociable, more efficient, inspiring, make management of groceries easier and focus more on healthy food.

The second research question *Can pervasive computing be used to motivate patients in a hospital to eat more?* was answered in article 2, where patients at a hospital were equipped with a system enabling them to see and communicate with a relative while eating supper, even though they were not physically present in the same place.

From this study it can be concluded that enabling patients to see and communicate with relatives does indicate that it can increase patients food intake. In addition to this, enabling patients and relatives to see and communicate with each others brings forth an array of other benefits like; positively affecting the mood of both patient and relative, decrease the feeling of loneliness, make patient and relative feel closer to each other, motivate the patient to try and eat and ease the everyday of the relative.

So based on these results, the answer to the question stated by this master thesis: *Can pervasive computing be used to change peoples cooking and eating habits?* is that this study indicates that for specific target groups it is possible to change cooking and eating habits by using pervasive computing. The results show that systems that incorporates the element of sociability is likely to have an effect on people cooking and eating habits.

Furthermore, systems should try to improve or ease users everyday. This could either be by allowing them to manage certain aspect of their everyday easier or to make certain activities possible without having to be physically present. Systems that allow people to stay connected over distance also seems to be able to motivate users to use these types of systems.

When evaluation the results of this master thesis, some limitations of the work should be considered. The number of patients participating in the study were rather limited. However, having a limited amount of participants made it possible to do a more in-depth study of these patients. Over a two month period only five patients were able to participate. To be able to have more patients participating it might be necessary to cooperate with more departments than three, as in this study. The fact that only five patients participated also makes it difficult to generalise the results from this study.

The patients themselves also played a major role. In this study the opportunity to screen and find suitable patients to participants was not present. This meant that of the five patients, three of them had intestine problems and were fed nutrition intravenous, resulting in limited appetite. Medication and treatment also played a major role; the patient would be able to eat one day and then, due to treatment or medication, not be able to eat the next day. Further more, the patients participating in this study were all above 50 years of age.

Finally, to be able to more precisely determine the effect the system has on food intake, measurement of food intake would have to be done. In this study it was not done, as the hospital personal deemed it redundant. For measurements of food intake to be meaningful and useful at least 150 patients would have to participate and a control group would be needed.

Lots of opportunities for doing future work based on this master thesis are present. In article one, five areas were identified that could potentially help motivate students to cook more at home. These areas could be used as inspiration for new systems and examine whether or not they actually do encourage students to cook more at home. Otherwise the main ideas identified by the groups participating in the workshop could be subject to further research, to see whether or not they would have any effect on students. Target groups could be changed to see what similarities and differences are present between different target groups.

Another prospect for future work is the system used in the second article. A large scale study could be made, to generalise the effects of the current system and prove or disprove the findings in this study. Modifications to the system could be made to examine what impact or influence they would have on eating habits. The study of one patient and relative could be prolonged to examine the effects of the system over a longer duration of time. Studies could also be made, to look at what it would take to make a system like this a general tool available at hospitals.

5
Bibliography

[1] Samara Joy Nielsen, Anna Maria Siega, and Barry M. Popkin. Trends in energy intake in u.s. between 1977 and 1996: Similar shifts seen across age groups. *Obesity Research*, 10:2333-2338, 2002.

[2] Ashima K. Kant and Barry I. Graubard. Eating out in america 19872000 trends and nutritional correlates. *Preventive Medicine*, 38(2):243-249, 2004.

[3] Ashima K. Kant and Barry I. Graubard. Spotlight on national food spending. *FoodReview*, 23(3):15-17, 2000.

[4] Sisse Fagt, Tue Christensen, Margit Velsing Groth, Anja Biltoft-Jensen, Jeppe Matthiessen, and Ellen Trolle. *Børn og unges måltidsvaner 2000-2004 available online at: www.food.dtu.dk.* Fødevareinstituttet DTU, 2007.

[5] Centre for Pervasive Computing. Concepts and technology for the future. `http://www.pervasive.dk/` checked: 14-06-2011.

[6] Burkman M.A., Balakshin M., and Klugman R. Now we re cooking! program: helping schools communities and families make meals matter. *Journal of nutrition education*, 27:216-217, 1995.

[7] Joshua Levy and Garry Auld. Cooking classes outperform cooking demonstrations for college sophomores. *Journal of Nutrition Education and Behavior*, 36(4):197-203, 2004.

[8] Martin Caraher, Paul Dixon, Tim Lang, and Roy CarrHill. The state of cooking in england: the relationship of cooking skills to food choice. *British Food Journal*, 101(8):590 - 609, 1999.

[9] McCrory M. A., Fuss P. J., Saltzman E., and Roberts S. B. Dietary determinants of energy intake and weight regulation in healthy adults. *American Society for Nutrition*, 130(2):276 - 279, 2000.

[10] Rebecca J. Stratton and Marinos Elia. Who benefits from nutritional support: what is the evidence? *European Journal of Gastroenterology & Hepatology*, 19(5):353-358, 2007.

[11] M .Isabel T. D. Correia and Dan L.Waitzberg. The impact of malnutrition on morbidity mortality length of hospital stay and costs evaluated through a multivariate model analysis. *Clinical Nutrition*, 22(3):235-239, 2003.

[12] William C. Robinson. The literature review. http://web.utk.edu/~wrobinso/540_lec_litreview.html checked: 15-06-2011.

[13] Jonathan Lazar, Jinjuan Heidi Feng, and Harry Hochheiser. *Research Methods In Human-Computer Interaction*. Wiley, 2009.

[14] Robert K. Yin. *Case Study Research: Design and Methods*. Sage Publications, 1994.

[15] Family Health International. Qualitative research methods: A data collectors field guide. http://www.fhi.org/nr/rdonlyres/etl7vogszehu5s4stpzb3tyqlpp7rojv4waq37elpbyei3tgmc4ty6dunbccfzxtaj2rvbaubzmz4f/overview1.pdf checked: 15-06-2011.

Pervasive computing as a motivation to make students want to cook more at home.

Martin Lejsgaard Myrup
Computer Science
Aalborg University
mmyrup09@student.aau.dk

ABSTRACT

Pervasive computing is information processing, that has been thoroughly integrated into everyday objects and activities. This has the potential to be integrated into kitchen activities, to help and motivate students to cook at home. In this paper, we report from a 3-way study consisting of a literature study, a questionnaire and a workshop. The literature study showed that the technical aspects have been well studied while other areas were less studied, e.g. inspiring the user to cook. The questionnaire was used to investigate students kitchen and eating habits. It showed that students do not find the actual cooking troublesome, rather it is lack of time, inspiration and motivation. A workshop was held, with students attending, in an attempt to come up with ideas that potentially could motivate students to cook more at home. Findings from this study suggest, that pervasive computing can be used to motivate students to cook at home, but that focus need to change. Instead of focusing on the technicalities, focus should be on providing sociability, inspiration and time efficiency.

Author Keywords

Kitchen, Literature study, Questionnaire, Workshop, Pervasive computing

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation: Miscellaneous—*Optional sub-category*

General Terms

See list of the limited ACM 16 terms in the instructions, see http://www.sheridanprinting.com/sigchi/generalterms.htm.

INTRODUCTION

Pervasive computing is a term for information and communication technology integrated into our environment. Mark Weiser described his vision for pervasive computing in [22]. He imagined pervasive computing seamlessly integrated into the environment providing valuable services for humans in their everyday life. Since he wrote that article, lots of things has changed, hardware development has advanced significantly, as well as advances in location sensors, wireless communication and global networking. This has allowed for pervasive computing to emerge. Today pervasive computing is in everything from toys and desktops to factories and city areas.

During the last decade, pervasive computing in the kitchen has emerged as a research area. [13] describes one of the first attempts to integrate pervasive computing into the household kitchen, by designing an interactive counter. However, most of the research done so far has primarily focused on solving a specific problem in the kitchen or helping with a specific task within the kitchen.

A multitude of problems have been tried and solved by using pervasive computing, from systems that allow a person to watch nutritions in the food being prepared [8], to systems that guides and helps people to cook certain dishes [16]. What most of these system focus on is providing the person in the kitchen with visual help. This could be by augmenting the table surface of the kitchen to act as a virtual recipe book [13]. By placing touch screens in the kitchen that shows information on how to create a dish [10], which the person can interact with using either touch or voice commands [5], or by using projectors to project cooking information onto different surfaces [3] that are available in the kitchen. These systems tends to focus on helping, educating and improving the experience of being in the kitchen, without concerns of whether or not people even cook or want to cook.

In this paper, we propose another angle of research for this area, where pervasive computing is used to motivate people to use the kitchen, rather than focusing on helping with a specific problem. The results presented from this 3-way study is used to show the potential for pervasive computing in students kitchens, to motivate students to cook more at home.

In the following section we present previous research within the field of pervasive computing in the kitchen, in the form of a literature study. Next, we present the results from a questionnaire exploring students cooking and eating habits. Next, we present the results of a workshop carried out in an attempt to identify and solve the problems students have for not cooking at home. Finally, the combined results of this 3-way study will be presented, showing the major findings.

CHI 2011, May 7–12, 2011, Vancouver, BC, Canada.

LITERATURE STUDY

We conducted a literature study on research done within the area of pervasive computing in the kitchen. The main objective with the study was for us to become familiar with the research done so far, the methods utilised to carry out this research and to get inspiration and design ideas.

Process

The process of creating the literature study consisted of six steps:

1. Design a search protocol.
2. Search for literature.
3. Screen and examine literature.
4. Categorise keywords.
5. Categorise groupings.
6. Create the literature table.

The search protocol used for the study reflects the point of being able to determine the research already done within the field. A minimum of inclusion and exclusion criteria was specified to capture all relevant research. The protocol had three criteria:

- Publications had to be concerned with the kitchen.
- Publications had to implement information technology in the kitchen.
- Publications should have been published between 2003 and 2010, including 2003.

Searching for literature was done using *ACM Digital Library* and *SpringerLink*. *Google Scholar* was used to do follow-up research as to whether or not further publications had been published by the original authors or if newer research on the topic existed.

Screening and examining the literature was done following these three steps:

- The title and abstract of publications were read.
- If publications were found to have relevance to the field of study, these were acquired, studied and evaluated systematically according to relevance.
- Resumes of publications were made.

We found 36 publications. After the screening process this number was reduced to a total of 16 publications with enough relevance to be included in the literature study. The decision of whether or not the publications had enough relevance was based on a number of requirements each publication had to uphold. These requirements were agreed on by both group members before the screening process was commenced and included the following:

- Implementation of information technology in the kitchen.
- Evaluation of the implementation.

To be able to determine the focus areas of these publications, it was decided to make a literature table using affinity diagramming. First keywords were categorised for each of the resumes for the 16 publications. For each resume both members had to categorise the keywords they found necessary to cover the content of the publications. Keywords were then posted to a Wiki containing the resumes of the publications. Keywords were not posted before both group members had categorised them, in order to avoid bias towards certain keywords. No restrictions or guidelines were present during this phase; the categorisation was made individually.

Categorise groupings was done after the categorisation of keywords had been completed. The task of categorise groupings was also done using affinity diagramming. It was up to each group member to group keywords into groupings. Members had to group all keywords declared during the keywords categorisation and come up with a title for each of the groupings they made. Again, groupings were not posted to the Wiki before each member had made the groupings, to avoid bias towards certain groupings. No restrictions or guidelines were given; members had complete liberty in deciding what should constitute a grouping.

Finally, the literature table seen in table 2 was created using these groupings. In conjunction between both members, it was decided which of the groupings had enough context to be used in the table. New groupings or alternations of existing groupings were made, to make the rest of the keywords fit into the table. Figure 1 gives an indication of the process of creating the literature table.

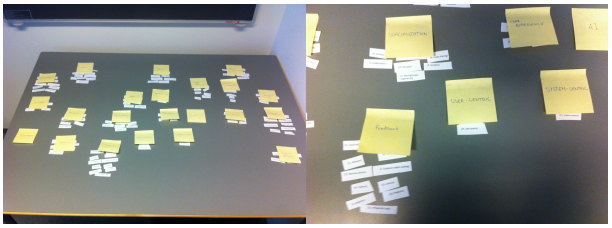

Figure 1. Keywords are seen on the white paper slips and the Post-IT indicates which grouping it is.

Robustness

As affinity diagramming was used to create the literature table, the robustness of the keywords and groupings constituting the literature table are of importance. To calculate the robustness, an 'Any-two agreement' algorithm was utilised [12]. Table 1 shows the robustness of the keywords for a selected number of publications. As can be seen in the table, robustness of keywords varied from 11% to 71%. There could be several reasons for this variation:

- No guidelines were given to the process of categorising keywords
- The free terms allowed members to use multiple keywords to cover certain aspects, that might as well could have been covered by one keyword.
- Difference in perception of the publications and what was needed to cover cover it could differ between group members. One group member might only use a few keywords, while another use several keywords to cover it.

ID	Member1	Member2	Common keywords	% of identical keywords
1	*4*	*6*	*2*	*2/8 = 25%*
2	*4*	*9*	*3*	*3/10 = 30%*
3	*6*	*6*	*5*	*5/7 = 71%*
4	*8*	*17*	*3*	*3/22 = 14%*
5	*6*	*7*	*5*	*5/8 = 63%*
6	*4*	*6*	*1*	*1/9 = 11%*
In total	*95*	*172*	*64*	
In average	*6*	*11*	*4*	*34,75%*

Table 1. Table showing the number of keywords identified by the two members of the group for each publication, common keywords and the robustness calculation of these.

Members had in average four keywords in common for each publication. This indicated, that even though no guideline or protocol was stated for categorisation of keywords, coherence in what members found necessary to cover the publications were present.

The average coherence for each publication was 34,75% with the highest being 71% and the lowest being 11%. The variation could perhaps have been reduced by taking some of the previously mentioned bullets into cosideration. The same process and algorithm was used to calculate the robustness of the groupings. In total, 42 groups were identified, 20 by one member and 22 by the other member. Of these 42 groupings 11 where deemed to be identical, giving a robustness of 26,2%.

Results

The keywords and groupings were used to create the literature table shown in table 2. The backbone of the literature table was the 11 groupings identified by both group members. In conjunction between group members, these 11 groupings were reduced and used to create the overall column headers in the literature table. The remaining keywords, not included in the 11 common groupings, were then re-distributed between these new headers wherever fit. New headers were also made from the remaining keywords giving a total of six headers in the table. For the y-axis the keywords 'User' and 'System' was used. These were chosen as most of the publications were easy to divide into whether they required interaction from the user (system-centric) or provided help to the user without the need of interaction (user-centric). To be able to determine at what point in the cooking process the system was concerned with, 'User' and 'System' were further split into 'Before', 'During' and 'After'.

Looking at the literature table in table 2 allows for some general results to be deduced. The following two list outlines the observation made from the literature table:

Areas focused:

- Systems that focus on visual aid; this goes for system-centric as well as user-centric systems.
- Interaction systems, that focuses on helping the user during the cooking process; this goes for system-centric as well as user-centric systems.

		Interaction	Visual aid	User experience	Education	Kitchen environment	Support
User	*Before*	[10], [3], [19]	[10], [3], [19]	[10], [19]	[10], [3]	[10], [3], [19]	
	Under	[8], [14], [10], [3], [19], [2], [15]	[8], [21], [10], [3], [19], [2], [15]	[8], , [19], [2]	[3]	[8], [14], [3], [19]	[8], [21], [2], [15]
	After	[7]		[7]			
System	*Before*	[3]	[17], [3]	[1], [17], [6]	[3]	[6], [3]	[1], [17]
	Under	[16], [20], [4], [3], [11]	[16], [20], [3], [11]	[16], [20], [6], [4], [11]	[16], [20], [4], [3], [11]	[6], [3], [11]	[16], [4]
	After	[20], [11]	[20], [17], [11]	[1], [20], [17], [6], [11]	[20], [11]	[6], [11]	[1], [17]

Table 2. The literature table showing the areas each publication covers.

- Systems designed to improve the users experience of being in the kitchen. Main focus has been on system-centric systems.
- Educating people on how their meal should be cooked. Main focus has been on system-centric systems.
- User-centric systems supporting the user during cooking.

Areas lacking focus:

- User-centric systems that focuses on providing a better user experience.
- Educational systems. The only focus put on this subject so far has been on system-centric systems that educate the user while cooking.

Apart from these points, the general observation is that the main focus has been given to systems that helps the user during the cooking process. I.e. not much attention has been given to systems which help the user before or after cooking. This becomes apparent for user-centric systems, only two publications have been found covering systems that help the user beforehand and only one publication covering post cooking aid has been found. For system-centric systems the trend is the same, however not as significant.

QUESTIONNAIRE

The goal of the questionnaire was to be able to gain an understanding of how students use their kitchen and which habits are predominant. We used a self-administered questionnaire, sent to three different study programs, to acquirre this data.

Process

The questionnaire itself was made using a tool called Survey Xact [18], a web-based tool for creating and analysing questionnaires. The overall structure of the questionnaire is listed below:

- General information.
- Physical surroundings.
- Cooking.
- Healthy food.
- Cooking aid.
- Workshop.

Participants started with an introduction, explaining how to interact with the questionnaire, what could be expected and the purpose of the questionnaire. General information about the participant where then acquired. The first block, physical surroundings was designed to gather information about the physical design of the student's kitchens, such as kitchen size, number of hot plates etc. The cooking section of the questionnaire investigated the frequency with which the participant cooked breakfast, lunch and dinner and obstacles for not doing so. The participant was then asked question pertaining to healthy food. This included, amongst others, questions about how often they cooked healthy food, what they thought healthy food was etc. Finally, participants were asked what cooking aid they currently used in their kitchen and how they were finding inspiration for meals.

In order to avoid biased, poorly written and disambiguated questions, it was decided to formulate closed-ended questions wherever possible. This would provide consistent data that would be easy to analyse. Open-ended questions would only be used to follow-up a closed-ended question to gain some additional information. To be able to get a broad representation of the target group of students, it was decided to distribute the questionnaire electronically to three study programs; Computer Science, Humanistic Informatics and Architecture & Design at Aalborg University. Unfortunately the questionnaire was only distributed to mailing list at Computer Science and the intranet at Humanistic Informatics and Architecture & Design which, as can be seen in the table 3, led to respondents being predominantly males from Computer Science.

Results

We received 96 respondses to our questionnaire, of these 96, 18 answered some of the question but never completed it and 10 never got past the introduction page to answer any question. In total 68 completed the questionnaire. Table 3 shows the general information about the participants of the questionnaire.

	Female	**Male**	**All**
Respondents	*11 (16%)*	*57 (84%)*	*68 (100%)*
Age (avg.)	*25*	*23*	*24*
Single	*3 (4%)*	*32 (47%)*	*35 (51%)*
In a relationship	*8 (12%)*	*25 (37%)*	*33 (49%)*
Computer Science	*2 (3%)*	*54 (79%)*	*56 (82%)*
Hum. Inf.	*6 (9%)*	*1 (1%)*	*7 (10%)*
A&D	*3 (4%)*	*2 (2%)*	*5 (7%)*

Table 3. General information.

Table 4 presents the physical surroundings of participants kitchens. The size of student's kitchens, gives us an idea of the possibility to design a new system to be placed in the kitchen. Free wall space idicates if projection can be used in these new systems.

	0 - 5m^2	**6 - 10 m^2**	**More than 10 m^2**
Kitchen size	*35 (52%)*	*26 (38%)*	*7 (10%)*

	0 - 1m^2	**1 - 3 m^2**	**3 m^2 or more**
Wall space	*34 (50%)*	*21 (31%)*	*13 (19%)*

Table 4. Physical surroundings - kitchen space.

Table 5 shows the cooking habits of participants and diagram 2 shows the main obstacles participants identified for not cooking at home. As can be seen, the majority of participants (86%) answered that they 'often' or 'almost always' cooked at home. Ideally, we would like to see the vast majority of students almost always eat home cooked food, if the alternative is either unhealthy fast food or expensive restaurant visits. Only 25 (37%) participants answered 'almost always'. However, this number could potentially be misleading, as participants could have others to cook for them and then still be eating home cooked food even though they answered 'often', 'occasionally' or 'never'. We did a cross reference check on the 33 participants who personally cooked food 'often'. Of these, 16 had other people cook for them

'often' or 'almost always' which, based on the previous results and our assumption, indicates that 41 (60%) of the participants generally 'almost always' eat home cooked food. This is also consistent with the results for breakfast and dinner with 41(60%) and 45(65%) respectively.

	Never	Occasionally	Often	Almost always
How often do you personally cook or prepare food from home?	*1 (2%)*	*9 (13%)*	*33 (49%)*	*25 (37%)*
How often do others cook or prepare your food from home?	*19 (28%)*	*25 (37%)*	*16 (24%)*	*8 (12%)*
How often is your breakfast home-cooked?	*13 (19%)*	*8 (12%)*	*6 (9%)*	*41 (60%)*
How often is your lunch home-cooked?	*10 (15%)*	*22 (32%)*	*15 (22%)*	*21 (31%)*
How often is your dinner home-cooked?	*1 (2%)*	*6 (9%)*	*16 (24%)*	*45 (66%)*

Table 5. Overview of cooking frequencies.

As expected, due to the target group being students, lunch is the meal most participants do not prepare or cook themselves.

As mentioned, participants were also asked to rate several possible obstacles for not cooking at home. Each obstacle was rated as to how big a problem they felt it posed for not cooking at home. We had listed eight obstacles; diagram 2 shows the two major obstacles for not cooking at home and the most negligible obstacle.

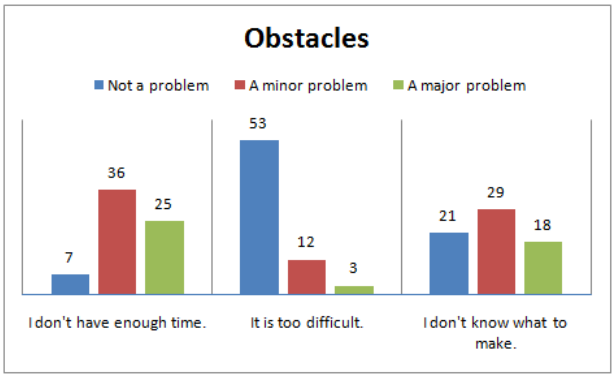

Figure 2. Diagram of selected cooking obstacles.

As can be seen in the diagram, it is clear that difficulty is considered a minor obstacle when it comes to cooking. In stark contrast, only 7 (10%) answered that they had no problems finding time to cook, while 36 (53%) said that it was a minor problem and 25 (37%) rated it as a major problem. Participants were able to explain their answer in a following open-ended question. Some of the participants explained that even though they had the time for cooking, it was not always the way they wanted to spend their time.

18 participants answered this open-ended question and several other reasons for not cooking at home were identified by these replies. Among others:

- Limitations on physical surroundings such as too few hot plates, lack of an oven or bad kitchen design.
- Cooking for oneself is boring and uninteresting, especially with regards to cooking more elaborate or complicated dishes.
- The thought of the menial task associated with cooking and eating, such as doing the dishes and cleaning afterwards.
- Lack of motivation after a long day.

As we were identifying cooking habits, we also wanted to know how much focus students had on eating healthy in terms of cooking healthy food, what they thought constituted healthy food, why they ate healthy food and if they would like to eat more healthy food. Table 6 shows the frequency of cooking healthy food between the 68 participants.

	Never	Occasionally	Often	Almost always
To what extent do you cook healthy food currently?	*5 (7%)*	*25 (37%)*	*30 (44%)*	*8 (12%)*

Table 6. Frequency of healthy cooking currently.

From a public health perspective, the majority of food cooked should be healthy, but as our questionnaire shows, 30 (44%) of the participants answered that they never or only occasionally cooked healthy food. This leaves room for improvements and possibility for systems to promote students to cook more healthy food. In fact, 41 (60%) answered that they would like to cook more healthy food. These 41 participants were asked to state the reasons for wanting to cook more healthy food from a multiple choice list and if the list did not contain their reason, an open-ended question was presented for them to explicitly state the reason.

Eating healthy makes me feel better	*29 (74%))*
To avoid illness	*23 (59%)*
I just like to know that I'm eating healthy	*19 (49%)*
I would like to lose weight	*16 (41%)*

Table 7. Motivation behind eating healthy.

Table 7 shows the main motivations for eating healthy. In addition to these reasons, some of the participants stated other reasons such as:

- Increase physical well-being and get more energy.
- Organic or healthy food tastes better.
- Concerns for the environment.

Finally, the questionnaire was used to gather information about the current cooking aid utilised in the kitchen and from where they were getting their inspiration for cooking. Table 8 shows the main sources for inspiration, along with statistics as to where students acquire help when needed. The Internet was the main source of inspiration when it comes to students.

	Never	Occasionally	Often	Almost always
Inspiration from the internet	*5 (7%)*	*26 (38%)*	*21 (31%))*	*16 (24%)*
Inspiration from cookbooks	*10 (15%)*	*29 (43%)*	*27 (40%)*	*2 (3%)*
Inspiration from friends and family	*7 (10%)*	*33 (49%)*	*27 (40%)*	*1 (2%)*
Inspiration from TV-shows	*49 (72%)*	*12 (18%)*	*6 (9%)*	*1 (2%)*
Inspiration from restaurant visits	*49 (72%)*	*18 (27%)*	*1 (2%)*	*0 (0%)*
Help with problems from the internet	*7 (10%)*	*17 (25%)*	*24 (35%)*	*20 (29%)*
Help with problems from cookbooks	*16 (24%)*	*27 (40%)*	*20 (29%)*	*5 (7%)*
Help with problems from friends or family	*7 (10%)*	*20 (29%)*	*32 (47%)*	*9 (13%)*

Table 8. Overview of sources of inspiration and help.

What is more surprising is that almost nobody found inspiration from the television. We found this a bit odd since television is flooded by cooking shows, commercials about food etc.

In terms of cooking aid, we asked participants to specify which electronically devices, if any, they currently were using while cooking. Laptops(20) and smartphones(9) were the most used electronically devices in the kitchen.

DESIGN WORKSHOP

The motivation for making a workshop was that we wanted a group of students to discuss ideas that would make them want to use their kitchen more. Data from the preliminary studies was used during this workshop to inform and inspire participants. The purpose of the workshop was to get some tangible ideas from students, as to how pervasive computing can be used to motivate students to cook.

Participants

For the workshop we invited a total of nine students, six male students and three female students. Seven of these, six male and one female, studied at Computer Science at Aalborg University, while the remaining two females invited, studied at Architecture & Design at Aalborg University. The age of the participants varied from 24 to 29 with an average of 25. Eight of the nine participants had also responded to the questionnaire. Participants were split into three groups, one consisting of all male students, one consisting of two male and a female student and one consisting of two female and a male student. This was done to observe if ideas would differ between groups with predominantly males in contrast to groups with female participants.

Process

The workshop was split into three exercises with deviating activities in between. The following shows the structure of the workshop along with a short description of each exercise:

- Welcome and brief presentation.
- Exercise 1 - Brainstorming.
- Short presentation of the research in the field.
- Exercise 2 - Mature ideas.
- Present ideas.
- Exercise 3 - Conceptualise ideas.

During the initial welcome and brief presentation we explained to the participants who we were, what we were studying and what the purpose of the workshop was. We then continued to explain the agenda for the workshop and in greater detail explained the purpose of the first exercise.

During exercise 1, groups were advised to start discussing problems or reasons they had experienced personally for not cooking at home and then brainstorm ideas to overcome these. At the end of the first exercise, we introduced participants to a summary of the data collected from the questionnaire. This was done to inspire groups. They decided for themselves if they wanted to use this data or not.

Before exercise 2 was started, we made a short presentation of the research within the field of pervasive computing in the kitchen. For this presentation, the literature table in table 2 was used. We presented the main areas of research along with the major trends identified during the literature study. At the end of the presentation handouts were given to the groups. These handouts described some of the actual systems developed for the kitchen. Both the presentation and the handouts were meant as inspiration for the groups.

Exercise 2 of the workshop was structured to first let the groups use the information from the presentation and handouts, to see if any new ideas would be generated and secondly for the groups to start maturing their ideas. Groups were asked to select between 1-3 ideas and start maturing these. Maturing meaning that the groups should start thinking of how their ideas worked, how the ideas should be incorporated into the kitchen and possibly what the interface of their idea should look like. Finally, groups were asked to prepare a quick presentation of their ideas for the other groups. We advised that paper prototypes of their ideas would be great help to visualising their idea.

Before the presentation, we asked the groups to present the idea they found the most promising. After the presentation the other groups were allowed to comment and question the idea to help the group further improve their idea. Exercise 3 was used for the groups to conceptualise their idea. Groups were asked to write down their idea on a piece of paper specifically made for this purpose. This paper would allow us to analyse and evaluate the ideas afterwards.

Results

During the workshop the three groups identified numerous reasons for not cooking at home, some of these are listed below:

- Physical surroundings e.g. lack of table space, lack of hot plates.
- Lack of time, e.g. lack of time to do the cooking, plan the meal, shop for groceries.
- The need for shopping.

- Expiration date on groceries, e.g. the need to use certain groceries before they expire.
- Lack of healthy food.
- Boring to cook alone
- Lack of inspiration.

In total, 12 reasons for not cooking at home were identified. Of these 12 reasons, four were identified by multiple groups, namely the need to do grocery shopping, lack of inspiration, lack of time and boring to cook alone. A total of eight ideas for improving the likelihood of students cooking at home were identified during the workshop. The following list briefly describes some of the ideas:

- Device to measure bacteria in food or nutrition in food.
- Device to prevent water boiling over or burnt food.
- Device that helps taste food. This device is configurable in several ways, if the user likes salty food the device could be configured to test if enough salt has been added to the dish.
- Freezer connected to an oven. Via a mobile telephone it should be possible to inform the freezer that a food item should be transferred to the oven. A mechanism will then bring that food item from the freezer into the oven.
- System to recommend recipes and guide the user through the chosen recipe.

Following is a description of the main idea each group presented.

Group 1
The first group focused on the problem of people finding it too hard and time consuming to cook and the problem of using all groceries in the refrigerator. They came up with an idea to a new type of meal planning system. The system consisted of a touchscreen with four sliders, allowing the user to choose how many days a plan should span, how much time each recipe must take to prepare, the difficulty of the recipe and the healthiness of the recipe. A 'Random'-button allowing the user to generate a completely random meal plan. An 'Empty the refrigerator'-button allowing the user to generate a meal plan, that makes sure to use all the groceries found in the refrigerator. If recipe suggestions were not satisfying, it was possible to mark one and generate a new recipe. Again, the slider-properties were used for generating the new recipe. This meant, that the user could keep generating new recipe suggestions until a satisfactory meal plan was generated. Furthermore, the system was able to send the meal plan to a mobile phone and generate a shopping list for the meal plan. A sketch of how they imagined their system would look like can be seen in figure 3.

Group 2
The second group focused on the problem that people find it boring to cook only for themselves. They came up with an idea to create a point system. A system which motivate people to dine together by introducing points. People invite each other to dinner and the host then receives points from the guests based on the quality of the food. Leagues are used to keep track of points and who the best cook and host is. The system consisted of a portable screen where

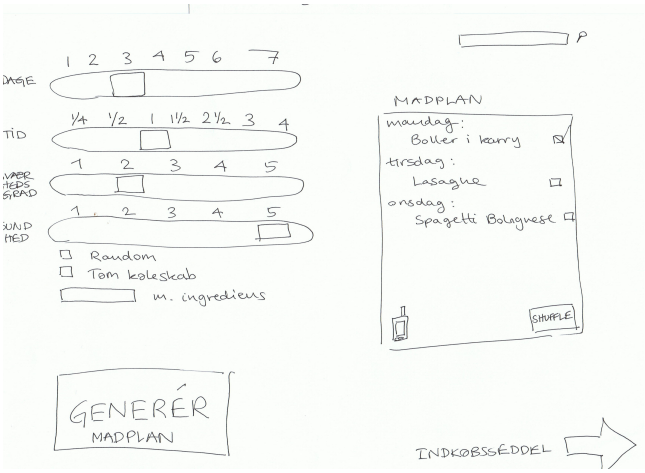

Figure 3. Sketch of the interface of the system.

the user could either chose to create a new league and invite people to participate in a league, get an overview of leagues currently attended, get recipe suggestions or get recipe suggestion based on what is currently in the refrigerator.

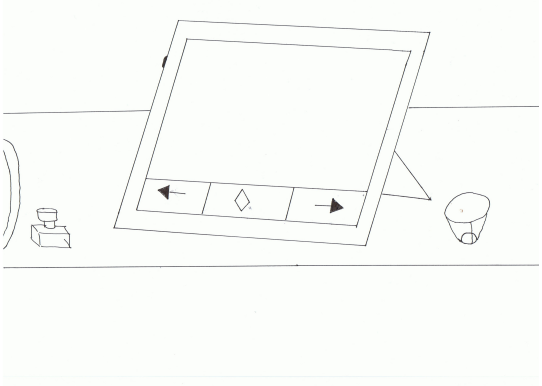

Figure 4. Sketch of the physical shape of the system.

Along with these options, the user also had a calendar available. This calendar was used to see when the user was invited to participate in a dinner with others from leagues, the user is attending. The calendar was also used by the user to set up dinners. When a dinner was setup, points were in play. Participants of the dinner were deducted a certain amount of points for participating. Participants could then acquire points by bringing ingredients needed for the meal. At the end of the dinner, participants were asked to rate the host's meal. Points given were based on their perception of the meal, taste, presentation etc. Figure 4 shows how the group imagined their system.

Group 3
The third and final group focused on the issue of groceries not being used before the expiration date and the fact that it can be difficult to motivate oneself to cook a meal every day. They came up with an idea they named 'FrigdeFriends'. They wanted to make a system that connected people's re-

frigerators in a network. Then a screen was used to interact with the system. Much of the inspiration for 'FrigdeFriends' was taken from its namesake brother 'Facebook' [9]. In addition to creating a network of refrigerators, the system was able to manage groceries in the refrigerator. Using this information the system was then able to suggest recipes based on these groceries or suggest friends that had some groceries that could be used to cook a meal together. In their presentation they called these kind of suggestions 'dinner-dates'. Like 'Facebook', people were able to add other people in the system as friends. The system could also show information of what was in the refrigerator, nutrition and health information concerning recipes and groceries, act as a shopping list and even generate meal plans. Figure 5 shows how the group imagined their system.

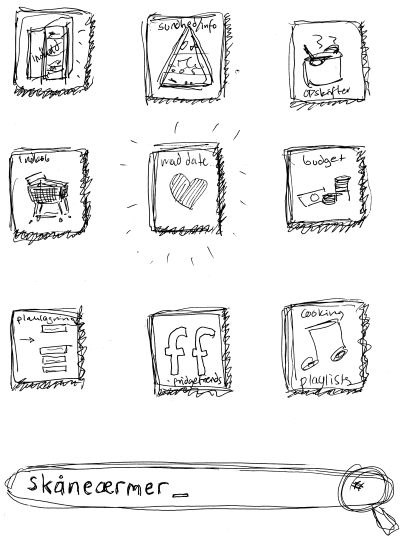

Figure 5. Sketch of the menu system.

FINDINGS

On basis of our studies, we have identified five major points of interest for designing the next kitchen system to motivate students to cook more:

- Lack of time - systems that allows the student to be able to control the time it takes to cook.
- Grocery management - systems that makes the user aware of when groceries are expiring.
- Inspiration - systems that can provide inspiration to the user.
- Healthiness - systems that promotes healthy food.
- Sociability - systems that makes the cooking process more sociable.

Lack of time

The main issue related to students not cooking at home, identified by the questionnaire, was lack of time. 61 of the 68 participants identified lack of time as a minor or major (36 and 25) problem. This was the highest number identified for all eight reasons asked as reason for not cooking. No differentiation was found between singles and participants in a relationship.

Even though the problem of lacking time was not given that much attention during the workshop, participants still identified the problem. Group 1 incorporated a way of telling the system whether the recipes suggested for a meal plan could take half an hour, an hour, two hours etc. The system would then only consider recipes with preparation time less than the specified.

Grocery management

During the questionnaire, 41 of the 68 participants identified the problem of using groceries before the expiration date as an issue for not cooking at home. No differentiation was found between singles and participants in a relationship

The same issue was identified during the workshop. Two of the three groups came up with systems that would be able to help the user use the groceries in the refrigerator. Group 1 made a meal planning system, where the user was able to inform the system of what groceries were in the refrigerator and the system could then generate recipe suggestions based on this information. The system also had an 'Empty the refrigerator' button that would generate recipe suggestion to empty the refrigerator. Group 3 made a system that allowed people to connect their refrigerators. Based on the information given by the users of what was in their refrigerators, the system could then come up with ideas that use these groceries. This could help the user in two ways. First, the system can compare groceries available in other refrigerators and come up with meal suggestions according to this information. Secondly, the system can inform users of what groceries they need in addition to the ones available, in order to cook a certain meal. Both of these suggestions helps the user use the groceries in the refrigerator and avoid throwing away groceries.

Inspiration

47 out of the 68 participating in the questionnaire answered, that finding inspiration for cooking was difficult. Of these 47, 23 were single and 24 were in a relationship, indicating that whether or not a person is in a relationship does not affect inspiration for meals. Of these 47, inspiration was primarily found using the Internet, cookbooks or from friends and family.

During the workshop two of the three groups incorporated some ways of inspiring the user to cook into their system. Group 1 made a meal planning system that inspired people by suggesting recipes for a user-specific number of days. People were then able to alter these suggestions until satisfactory suggestions had been found. Group 3 made a system that was able to inspire the user in two ways; either by suggesting random recipes when the user needed inspiration or by informing the user when a friend had groceries in the refrigerator that combined with the user's groceries could make up a meal. This would both inspire the user and promote sociability.

By doing this study we have been able to identify two different ways of inspiring students to cook. First, the 'simple' way by providing the student with the opportunity of having recipes suggested based on either complete randomness or by user adjustable settings, and the second being the more social approach, where students inspire each other.

Healthiness

The questionnaire gave a clear indication of people's awareness of healthy food. Of the 68 participants only 5 answered that they never bought healthy food. 27 answered they occasionally bought healthy food and 28 answered they often did, while the last 8 said they always bought healthy food. In the same manner only 5 answered they never cooked healthy food, while 25 said they did occasionally and 30 did often. The last 8 answered they almost always cooked healthy food. This showed a trend in people being aware of healthy food and cooking healthy food.

During the workshop two of the three groups made clear that their systems should be able to suggest healthy recipes. Group 1 made a meal planning system where the user using a slider could determine how healthy recipe suggestions should be, rating from 1 - not healthy to 5 - very healthy. Group 3 made a system that should be able to suggest healthy recipes.

Sociability

The questionnaire presented questions as to why people did not cook at home. Eight reasons for this was given to the participants, however they also had the possibility to specify reasons other than the eight presented to them. Even though, lack of time and lack of inspirations were the main reasons for not cooking, people also identified the fact that they did not want to cook only for themselves. It seems as people do not want to go through all the trouble of preparing the meal and do the dishes afterwards, if it is only for themselves. Furthermore, people in the questionnaire said that they often found themselves cooking 'everyday' meals and seldom cooked advanced recipes when alone.

The workshop made it apparent that people wanted systems that made the whole process of creating and eating meals more sociable. Group 2 came up with a system where people were motivated to cook for each other by using a point system. The host of the meal was given points by the attending people in terms of the meal and how the day went. Group 3 made a system that allowed refrigerators to communicate. People were able to become friends with other people using the system and their refrigerators were then able to communicate and suggest recipes based on what people had available in their refrigerator. These two systems were aimed at making cooking more sociable and avoid people skipping the home cooked meal because they find it boring to cook for themselves.

DISCUSSION

In our literature study we found prior research done within the field of pervasive computing in the kitchen. In this section, we compare these to our findings, along with some follow up discussion of certain aspects of the different studies.

As far as can be concluded from the literature study, lots of research done so far within the field of pervasive computing in the kitchen, has been on systems helping the user with a specific task or problem during the cooking process.

Most of these systems indirectly saves the user time, but this has not been a main focus of any of the systems we identified. Our findings suggest that the amount of time the student has to spend in the kitchen can make or break whether or not the student decides to cook at home.

Both during the questionnaire and the workshop, the problem of groceries expiring before being used, was identified as a reason for students not to cook at home, research so far seems to overlook this problem. We were not able to find a single publication dealing with the problem of groceries expiring. The reason for this could be that young people are deficient in managing groceries compared to the general public but that would have to be examined further.

Participants in the questionnaire and workshop seemed to have focused on the need for inspiration, while the research so far does not seem to be as focused on inspiration. As can be seen in the literature table in table 2, inspiration has not been identified as a main research area. When analysing the publications used for this study, three of 16 publications directs attention to the need of inspiring users. However, one of these publications does actually resemble Group 1's idea. This publication looks at a meal planning system that is able to generate recipe suggestions for a user specific amount of days, based on several user adjustable settings. The remaining two publications focused on users inspiring each other. The first one did this by making a system that was able to record the cooking process of the user. The user was then able to share this experience with other users of the system and inspire them to cook the same dish. The other system used video conferencing to make user inspire each other to cook.

The literature study did not identify many publications dealing with healthy food, only two of the 16 publications dealt with the matter of cooking healthy. The one being a system that allowed the user to keep track of the nutritions in the meal being cooked and the other being a meal planning system, that allowed for the user to specify if recipes suggestions should be healthy.

No publications were found dealing with the problem of having to cook for oneself. Most of the publications deals with helping a person through the cooking process, but none of these focuses on the fact that people might find it boring to have to go through the entire meal preparation alone and do the dishes afterwards when dining alone.

In general, the reasons for the great deviation in focus between the literature study and the questionnaire/workshop could be due to the fact, that the research acquired for the literature study is general in the terms of target group. This is general research done in an effort to create new systems that can be integrated into kitchens in any families, whereas we have looked at a very specific and limited target group. None of the main areas identified during the literature study were identified during the questionnaire or workshop. It does not seem as the students wants their kitchen appliances augmented with technology, visual interfaces covered all over their kitchen; instead they seem to be more inclined to either just get through the process of cooking as fast as possible, getting ideas for more healthy food or be able to make the cooking process more sociable. Furthermore, most of

the research done so far, seems to focus on helping one person with a single task or overcoming a single problem while cooking. None of the systems are aimed at e.g. helping people have fun, being creative or being sociable.

Finally, we were not able to identify any significant differences between ideas generated, during the workshop, by groups predominated by males and vice versa.

CONCLUSION

Pervasive computing is becoming increasingly widespread, new merchandise is being fitted with information technology, allowing it to provide valuable information to the end user. This paper has presented results from a 3-way study consisting of a literature study, a questionnaire and a workshop studying the research done so far within the field of pervasive computing in the kitchen, students kitchen and eating habits and solutions to overcome obstacles for not cooking at home. The results shows that to accommodate the desires of students, focus has to be changed.

Currently, focus seems to be on integrating systems into the kitchen that allows the user to seamlessly interact with them, provide visual aid while cooking and enhance the user's experience of being in the kitchen. At the same time, more and more appliances in the kitchen are being integrated with technology to provide some sort of information to the user in an attempt to ease the users workload in the kitchen. However, our study has revealed that a completely different approach might be needed to accommodate the needs of students.

During our study we identified five main areas that should be addressed if systems were to motivate students to cook more at home. None of these were identified in previous research as the main focus, which shows that there are areas still to be researched when it comes to pervasive computing in the kitchen. The main differences between the research done so far and the areas we found, seems to be that research up until now has focused primarily on technically aspects, failing to identify a target group and identifying problems that target group wants to overcome. In our study we have focused on a very limited and specific target group, but however also been able to reveal that making a system to motivate students to cook more at home should take into consideration that it should either make the cooking process more sociable, help the user managing groceries, time optimisation, cook healthy or provide inspiration.

The aim of this study is to provide an insight into the research done so far, provide a mean of inspiration in terms of ideas to new systems aimed at the kitchen and specific systems aimed at students. Some limitations should be considered when using findings from this study. The questionnaire was distributed to three departments, but only to mailing list at Computer Science. This meant that participants were primarily male and students from this department. During the literature study strict search criteria was used, which may have limited the number of publications found. Future work should strive at examining systems that incorporate some of the main areas identified in this study, to see if they do motivate students to cook more at home.

ACKNOWLEDGMENTS

Martin Skouboe Pedersen for helping with the research in terms of the literature study, questionnaire and workshop.

References

1. Aberg, J. An evaluation of a meal planning system: ease of use and perceived usefulness. *Proceedings of the 23rd British HCI Group Annual Conference on People and Computers: Celebrating People and Technology* (2009), 278–287.
2. Aoyama, H., Ozeki, M., and Nakamura, Y. Smart cooking support system based on interaction reproducing model. *Proceedings of the ACM multimedia 2009 workshop on Multimedia for cooking and eating activities* (2009), 39–46.
3. Bonanni, L., and Lee, C. The kitchen as a graphical user interface. *Digital Creativity 16(2):110 - 114* (2005).
4. Bonanni, L., Lee, C., and Selker, T. Counterintelligence: Augmented reality kitchen. *SIGGRAPH '05 ACM SIGGRAPH 2005 Posters*, Article No. 60.
5. Bradbury, J. S., Shell, J. S., and Knowles, C. B. Hands on cooking: Towards an attentive kitchen. *Proceedings of CHI '03 extended abstracts on Human factors in computing systems* (2003), 996–997.
6. Burneleit, E., Hemmert, F., and Wettach, R. Living interfaces the impatient toaster. *Proceedings of the 3rd International Conference on Tangible and Embedded Interaction* (2009), 21–22.
7. Chang, K., Liu, S., Chu, H., Hsu, J. Y., Chen, C., Lin, T., Chen, C., and Huang, P. The diet-aware dining table observing dietary behaviors over a tabletop surface. *Lecture Notes in Computer Science 3968:366-382* (2006).
8. Chi, P., Chen, J., Chu, H., and Chen, B. Enabling nutrition-aware cooking in a smart kitchen. *Proceedings of CHI '07 extended abstracts on Human factors in computing systems* (2007), 2333–2338.
9. Facebook. Facebook. `www.facebook.com/` checked: 15-06-2011.
10. Hamada, R., Okabe, J., Ide, I., Satoh, S., Sakai, S., and Tanaka, H. Cooking navi: Assistant for daily cooking in kitchen. *Proceedings of the 13th annual ACM international conference on Multimedia* (2005), 371–374.
11. Hashimoto, A., Mori, N., Funatomi, T., Yamakata, Y., Kakusho, K., and Minoh, M. Smart kitchen: A user centric cooking support system. *In Proc. 2008 Information Processing and Management of Uncertainty in Knowledge-Based Systems* (2008), 848854.
12. Hertzum, M., and Jacobsen, N. E. The evaluator effect: A chilling fact about usability evaluation methods. *International Journal of Human-Computer Interaction 13(4):421 - 443* (2003).
13. Ju, W., Hurwitz, R., Judd, T., and Lee, B. Counteractive: An interactive cookbook for the kitchen counter. *Proceedings of CHI 01 extended abstracts on Human factors in computing systems* (2001), 269–270.
14. Kranz, M., Schmidt, A., Maldonado, A., Rusu, R. B., Beetz, M., Hornler, B., and Rigoll, G. Context-aware kitchen utilities. *Proceedings of the 1st international conference on Tangible and embedded interaction* (2007), 213–214.
15. Lee, C.-H. J., Bonanni, L., Espinosa, J. H., Lieberman, H., and Selker, T. *Augmenting Kitchen Appliances with a Shared Context using Knowledge about Daily Events*. 2006.
16. Mennicken, S., Karrer, T., Russell, P., and Borchers, J. First-person cooking: A dual-perspective interactive kitchen counter. *Proceedings of the 28th of the international conference extended abstracts on Human factors in computing systems* (2010), 3403–3408.
17. Palay, J., and Newman, M. Suchef: an in-kitchen display to assist with "everyday" cooking. *Proceedings of the 27th international conference extended abstracts on Human factors in computing systems* (2009), 3973–3978.
18. Ramboell. Survey-xact. `https://www.survey-xact.dk/` checked: 06-01-2011.
19. Siio, I., Hamada, R., and Mima, N. Kitchen of the future and applications. *Lecture Notes in Computer Science 4551:946-9550* (2007).
20. Terrenghi, L., Hilliges, O., and Butz, A. Kitchen stories: sharing recipes with the living cookbook. *Personal and Ubiquitous Computing 11(5):409–414* (2007).
21. Tran, Q. T., Calcaterra, G., and Mynatt, E. D. *Cook's collage: Deja vu display for a home kitchen*. 2005.
22. Weiser, M. The computer for the 21st century. In *Human-computer interaction*, R. M. Baecker, J. Grudin, W. A. S. Buxton, and S. Greenberg, Eds. Morgan Kaufmann Publishers Inc, 1991, 933–940.

Pervasive computing as a motivation to make patients in a hospital eat more

Martin Lejsgaard Myrup
Computer Science
Aalborg University
mmyrup09@student.aau.dk

ABSTRACT

Undernourishment among patients in hospitals have proven to be a problem; recovery takes longer, cost more and the patient risk feeling isolated due to detachment from relatives. This paper documents an empirical study on the use of pervasive computing in a hospital, in an effort to study if pervasive computing can be used to enhance social connectedness between patients and relatives and increase food intake by patients. This has been done using existing video sharing applications, which enabled patients to see and speak with relatives when eating supper. Patients who participated in this study have been isolated, due to the course of their treatment, due to cultural differences or simply by being hospitalised for a long duration of time. Five patients participated in this study at different periods, depending on their treatments status. Participation among patients varied from five days to 2 weeks. The effect, both in terms of feeling more social connected and eating better, have been documented using qualitative research and grounded theory. Findings from this study shows that using the system made participants feel more social connected, less alone and more positive. This study indicates that the system do encourage patients to eat more. All patients, even those prohibited from eating by treatment or medication, felt motivated to try and eat.

Author Keywords

Empirical study, Pervasive computing, Patient, Relative, Food intake, Socialisation, Loneliness

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation: Miscellaneous—*Optional sub-category*

General Terms

See list of the limited ACM 16 terms in the instructions, see http://www.sheridanprinting.com/sigchi/generalterms.htm.

INTRODUCTION

It is well know that being hospitalised can have severe consequences, not only for the patients but also for the health sector. Studies like [14, 23, 26, 30] show that the most common consequences of being hospitalised is undernourishment. A study carried out at four hospitals in England, showed that 20% of the patients were undernourished at admission, resulting in increased length of admission, more prescriptions and an increased likelihood of infections [14]. Another study [23] showed that about 75% of the patients undernourished at admission would continue to lose further weight. A study carried out in Denmark in 2004 [26] showed that about 40% of the admitted patients where nutritionally at risk. Of these 40%, 11% had a Body Mass Index(BMI) below 18.5 indicating underweight and 16.7% had a BMI between 18.5 and 20.5. In addition to this, the study showed that only in 7.6% of these patients records, information about the patient being in nutritional risk were stated. Of these, only 14.2% contained a nutrition plan of which only 55.2% included a plan for monitoring the patient. Other studies [7] have shown the same lack pertaining to nutritional monitoring.

The consequences pertaining to malnutrition of patients is complications in treatment, infections, prolonged stay, morbidity and mortality [30]. The differences between well nourished and undernourished patients were studied in [7]. They found, that in average, undernourished patients stayed hospitalised six days longer than well nourished patients and 19.4% compared to 10.1% experienced complications or infections during their treatment. Mortality was also significantly higher for undernoursihed(12.4%) compared to well nourished patients(4.7%).

In addition to having an impact on the patient, the treatment of undernourished patients also influence the health sector in terms of expenses. In [7] they identified that an undernourished patient represented a mean daily expense of US$ 228.00/patient compared to the US$ 138.00/patient in the well nourished - representing a difference of 60.5% in expenses. In [14] they identified the annual expenses on disease-related malnutrition to be in the excess of £7 billion in the UK.

The prevalence of malnutrition between patients differ due to several reasons, such as whether or not the patient is diagnosed with cancer, is older than 60, has experienced any complications, such as infections, during the treatment of their illness, and the length of their stay [6].

Several tools and techniques are available to help patients experiencing undernourishment, like oral nutritional supplements, enteral tube feeding and parenteral nutrition [30]. However, studies like [7] have shown that they are only used in a very limited extend. A study from four hospitals in England [14] showed that only 4.9% of malnourished patients recieved enteral nutrution, 3.3% recieved oral supplementation and non were prescribed parenteral nutrition.

Other studies like [24, 33] have shown, that if the patient is able to move or get moved, being placed in a social environment enhance the nutritional intake by the patient, indicating that being social active can mitigate undernourishment. Studies like [4, 8, 27] have actually shown, that there is a

CHI 2011, May 7–12, 2011, Vancouver, BC, Canada.

connection between dining with people known to one and the amount of food consumed. According to these studies, people eat more when they eat with persons they know, than they would if they were to eat alone or eat with strangers.

This paper present results from an empirical study of the potential for pervasive computing to motivate patients in a hospital to eat more.

The following section presents work that relates to this study. Next, the empirical method behind the study is described along with the system that is utilised, the procedure of the study, participants, data collection and data analysis. Next, the results from the study is presented and finally the results are compared to the work that related to this study, discussed and a conclusion is presented.

RELATED WORK

In this section previous work that relates to this study is presented. Focus will be IT-based socialising and the social functions of the meal, since these constitute the two main areas of concern in this paper.

IT-based socialising

Information technology can be used for a wide array of things, in this section we are interested in seeing how information technology is being used by people to gain a feeling of being socially presence with relatives. Studies like [22, 32] on family communication have shown, that the use of emails has become ubiquitous and is used as a form of communication interchangeably with phone calls. In addition to this, instant messaging (IM) has also been widely adopted in certain populations such as teens [16]. In a recent study [1] scientist looked at these types of interaction, along with others, such as 'SMS messages', 'Internet voice' and 'webcam communication', in order to try and determine which types of interaction provided the most realistic feeling of being socially present with relatives. This study showed that being able to communicate with relatives over 'webcam and voice with text to support' provided the most realistic feeling of being together with the person they were talking to. Other forms of interaction rated high was 'webcam and voice', 'phone call' and 'Internet voice only'. In the other end of the scale, interaction forms such as voice mail, SMS messaging and email were voted the least likely to give participants a feeling of being socially present with the other person.

According to [17] as of June 30, 2010 there were 1.966.514.816 people with access to the Internet. With this enormous amount of people connected to the Internet, research has been carried out in an effort to study the effect the Internet has on communication and sociability [19, 25]. The research supporting the Internet as a mean for communication and socialisation say, that the Internet lowers the communication barriers in space and time, thereby increases the efficiency and speed of transactions, thus saving time for other activities including face-to-face interactions [5]. It offers opportunities to maintain geographically diverse networks [15]. This suggest that the social relationships of Internet users may become richer in the sense of having larger networks than those of the general population [15]. On the other hand, research is pointing in the direction that online relationships are less substantial and less sustaining [20]. Virtual ties are weaker and superficial and easily broken [21]. According to [25] the time a person spends online is primarily an asocial activity, that rather than complement the persons time to be able to do face-to-face interactions, deprives the person of exactly that.

Researches have also studied the effects or difference of mediating conversations with technology. Abigail J. Sellen [28] carried our an experiment, in which he investigated differences in conversations between subjects in the same room and subjects using video-mediated conversations. The study showed that mediating conversations with technology had no significant effect on the number of turns taken in a conversation, the average length of these turns or the distribution of turns. However, differences where found, the amount of time spent with simultaneous speech where higher in percentage in same room conversations than in video-mediated conversations. Participants identified the reason for this as same room conversations being more interactive than video-mediated conversations. Some participants even reported 'feeling distanced' by using video technology to carry out conversations. Finally, participants were more inclined to explicit state that they were done talking in video-mediated conversations, not using physical cues, as seen in the same room conversations, to switch between who would speak. In general Sellen concluded that while video-mediated conversations bear all of the symptoms of depersonalisation, psychological distance and formality, participants still found access to visual information to be both important and beneficial in conversational interaction.

The social functions of the meal

In addition to looking at how IT communication is used by people to gain a feeling of social presence, we are also interested in the social functions a meal provides. According to [29] some of the processes and activities which accompany a meal is the forming of social groupings, the forming of relationships, and socialisation. Identifying that we form social groupings when we eat, not only at home but also places like our school or workplace. Meals are also used to form new relationships and determining their closeness and the roles each person have within this relationship. Meals can also be used to reflect upon the status and power of people being part of that relationship. Finally, mealtimes bring about a form of socialisation for its participants, people listen to each other and learn from each other. This in fact, is a very important part of our childhood, since it is from socialisation that we learn our language, values, rules and attitude towards the social group we are born into.

Research have proven that social factors have a clear effect on the amount of food people consumes. One of the most studied aspect of this is a phenomenon called social facilitation. Social facilitation refers to the well established fact, that there is a positive relationship between the amount of food consumed and the presence of people while eating. This has been proven in numerous studies like [2, 4, 8, 9, 10, 12, 13, 18, 27]. It has also been proven that there is a positive relationship between listing to the radio or watching television and the amount of food consumed [3, 18].

One of the main reasons for this increased intake of food, when being together with other people, a television or a radio, has been identified as the fact that people engaged in a cognitively demanding task during a meal, diverts attention from the meal. This can impair self-monitoring of food consumed, which can lead to greater food intake compared to eating without competing tasks [18, 27]. Further more, this research have proven that eating with persons familiar to you can enhance food intake with as much as 40%-50% [10]. Other studies have proposed a more formal definition or impact of eating together, like [11], which identifies a power function of the number of people present and the increase of food consumed by a person. In this research an average of 28% more food is consumed when eating with one other person, than when eating alone. If two persons are present, this amount is increased to 41%, 53% with 3 persons and 53%, 71% and 76% with four, five or six persons present. Other research like[4] indicates that there is an increase in food consumption when being present with others, but the intake does not increase with the amount of people. In this study they found that a group of two eat just as much as a

group of four friends. [27] showed that the amount of food consumed in normal settings of people are also influenced by the presence of others. In this study people ate an average of 200kcal more when eating with others than when eating a alone.

Another explanation for the increased food intake when eating with others have been the phenomenon of time extension. Research like [8] have tried to explain the increase in food consumed, by arguing that when more people eat togehter the duration of the meal itself is longer than when eating alone, exposing persons to the food for a longer duration, allowing them to eat more. Other research have shown, that eating with others do indeed increase the duration of the meal, however, whether or not more food is consumed cannot entirely be derived from the duration of the meal. [18] showed that while meal duration is increased when eating with strangers, the amount of food consumed is not. Studies like [4, 27] concluded that eating with familiar persons compared to strangers had an effect on the amount of cookies eaten, people were more inclined to eat sweats when dining with family or friends than strangers.

METHOD

To carry out this study, a system consisting of two laptop connected to the Internet with webcams and Skype, was installed at the patient and the relative participating. This was done in an effort to study whether or not being visually able to see and communicate with family or friends during dinner time encouraged patients to eat more and feel more socialised.

Plan for the study

The overall procedure for the study was to carry out the study from the 4. of April until the beginning of May. If enough patients were eligible for the study, two participants would participate in the study each week, allowing for up to eight participants to participate. It turned out to be more difficult to find patients to participate in the study than expected and due to this, the study was prolonged until the 30th of May.

Participants

To be eligible for the study the hospitalised person had to be an able adult, with relatives able to participate in the study as well. The person had to be submitted for treatment or prevention which required isolation, feel isolated due to length of admission or feel isolated because of cultural differences. Participants had to be either Danish-speaking, English-speaking or able to receive help from an interpreter.

During the duration of the study, which commenced on the 4. of April and ended on the 30. of May 2011, 5 patients were found eligible, the following list describes each patient and the relative they chose to participate in the study:

- P1: Male, 55 years old, isolated due to treatment for cancer, reduced appetite due to medication given during the treatment, receives visits on a daily basis and has medium experience with IT, meaning that he uses Internet, email, online banking, standard applications(Word, Excel etc.) and uses these on a regular basis, has previously used MSN Messenger.
- R1: Female, 53 years old, is the wife of P1, visits P1 on a daily basis, little/medium experience with IT, meaning that she uses a computer at work for various purposes and uses standard applications at home, but does not do so on a regular basis.
- P2: Male, 61 years old, isolated due to length of hospital admission, admitted with bowel stenosis and reduced appetite due to this, receives nutritions intravenous, receives visits 2-3 days a week, little/medium experience with IT, meaning that he used to use computers a lot at work and at home, but since he was paralyzed in 2004 he almost never uses computers.
- R2: Female, 61 years old, is the wife of P2, visits P2 1-3 times a week, little experience with IT, meaning that she uses Internet, email and online banking, but does not do so on a regular basis.
- P3: Female, 73 years old, from Lebanon, isolated due to language, treated for pneumonia, reduced appetite due to cultural differences and medication given for pneumonia, receives visits on a daily basis and has no experience with IT, meaning that she has only tried to use a computer once.
- R3: Female, 60 years old, is the sister of P3, is unable to visit P3 because she lives in Lebanon, high experience with IT, meaning that she uses Internet, email, online banking, standard applications, Facebook and Skype multiple times a day.
- P4: Female, 56 years old, isolated due to length of hospital admission, admitted for short bowel syndrome and reduced appetite due this, receives nutrition intravenous, receives visits 1-3 times a week, has no experience with IT, meaning that she has never used a computer.
- R4: Male, 63 years old, is the husband of P4, visits P4 1-2 times a week, high experience with IT, meaning that he uses Internet to surf for new and exciting applications he can install and work with, email, online banking and standard applications multiple times a day.
- P5: Female, 70 years old, isolated due to length of hospital admission, admitted for short bowel syndrome and reduced appetite due to this, receives nutrition intravenous, receives visits 1-3 times a week, has no experience with IT, meaning that she has never used a computer.
- R5: Male, 77 years old, is the husband of P5, visits P5 1-2 times a week, little experience with IT, meaning that he has tried to take classes on how to operate a computer, but never completed due to dementia and back problems.

Settings

The study consisted of two different settings; the ward the patient was admitted to and the home of the relative participating. The set-up of the system in the ward was depending on whether or not the patient was confined to the bed. If the patient was not confined to the bed, the system was placed as shown in figure 1.

Figure 1. The set-up of the system if the patient was not confined to the bed.

This setting allowed the patient to be seated at a table with the laptop behind the tray containing the food. The webcam was placed behind the tray to minimise intrusion by the laptop and webcam while eating. It was the patients responsibility to position the webcam so that it was able to capture the patient while eating. The patient was able to see relatives on the laptop screen while eating.

If the patient was confined to the bed the system was placed as shown in figure 2.

Figure 2. The set-up of the system if the patient was confined to the bed.

This setting allowed the patient to stay in bed and eat with the laptop placed right beside the tray with food. The placement of the webcam was up to the patient, it could either be placed next to the laptop or behind the tray, depending on what the patient found most fitting.

The set-up of the system in the home of the relative participating was completely decided by the relative. However, relatives were advised to chose locations in the home that resembled the set-up shown in figure 1. This could for instance be the kitchen table or the living room table, with the laptop and webcam behind. Again, relatives were responsible for the placement of the webcam such that it was able to capture the relative while eating. Relatives could see the patient on the laptop screen

Materials

The system used in this study consisted of the following materials at both the patient and the relative:

- A laptop.
- A webcam.

The laptops provided to the patient and relative were preinstalled with Skype and set-up to use the Internet at the hospital or the home of the relative, depending on where the laptop was used. Participants not already having a Skype account, had one created for them along with an introduction to how Skype functions and had to be used for this study.

Procedure

A pilot study was commenced on March the 28th. The pilot study was used to test the set-up of the system and try and correct any unanticipated errors with the system.

Each study was scheduled to last for at least four days, meaning that the participants would have enough time to get comfortable with the system and allow for the necessary data to be recorded. The procedure for a single patient in the study was to interview both the patient and relative before starting to use the system. Then allow the patient and the relative to use the system to eat supper together once before interviewing them again, then let them use the system another couple of days to eat supper together before interviewing them again. This interview would indicate the end of the study. The day after that a final interview would be held with the participants.

At supper, the procedure was for the patient and relative to turn on their laptop and start Skype a couple of minutes before supper was served. All patients admitted to the departments in this study had fixed times for when supper was served. The patient and relative then had to agree upon who would initiate the call, no guidelines to how they should plan this was given. They could either call each other by telephone to plan this, agree upon who would call the next time, last time they used the system or use the system at another point in time to agree on this. After the call had been made the receiver had to accept the call and a video link would be established, allowing for the supper to commence. How participants were to act under supper was completely up to themselves, participants were advised to do as they would normally do if they were at home, but there were no restrictions as to the amount of time they could use, activities they could use the system for, topics they could talk about, etc.. During supper, patient and relative was able to see and hear each other. After supper the video link was terminated.

Data Collection

Interviews were used to capture data. Before the start of a study interviews with the patient and relative was held to capture reasons for being part of the study, motivation, expectations, prior experience with different types of information technology and eating habits prior to admission.

During the study two interviews were carried out to capture data. The first one being after participants had used the system for the first time. This was done to capture data on the experience of using the system, experience of using the system compared to a normal supper setting, etc.. The second interview was held a couple of days later to see if anything in the utilisation or experience of the system had changed, when participants had used the system for a longer period of time.

Finally, an interview was held when participants had ended the study to gather data on their thoughts of the system, experiences, technical feedback, ideas to improvements etc.

Data Analysis

Grounded theory [31] was used to analyse the interviews of each participant in the study. Grounded theory is an approach to develop theory from data in a bottom-up style. In this study it has been done by using *open coding* to systematically analyse each interview, in an effort to create codes that describes every occurrences of relevant phenomena or events in the interviews. After this *axial coding* has been utilised to create main groups or categories from codes and subgroups of codes. These categories have been used to describe the findings made during the study.

FINDINGS

From the grounded theory analysis, four main categories were identified:

- Course of meal.
- Effect of the System.
- Alternative use of the system.
- Improvements to the set-up and system.

The findings related to each of these categories will be presented in the following sections.

Course of meal

This section will describe the course of the meal for participants at home, both together and when eating alone, the course of a meal for patients before using the system and the course of the meal for participants when using the system. Finally, these will be compared.

Course of meal at home together

Participants all reported that they did make an effort of trying to eat together as often as possible, because they found that more satisfying than eating alone. The course of a meal at home was very similar in all the participants cases. The food was, in most cases, prepared by a specific member of

the household, either because other members were unable to cook or simply due to habits, and made ready for an agreed upon time. Most of the participants had their meal between 6 p.m. and 7 p.m.. During the meal the same activities were reported as taking place, as described by one of the participants:

R2: At our home I do the cooking. I try to have supper ready for 6 p.m. and then we sit down at the table and eat. While we eat we enjoy each others company and we talk and discuss general topics like what we have experienced that day etc..

The duration of the meals varied quite a lot between participants, from some using as little as 15 minutes to others using more than an hour. Variation in duration of meals was primarily due to time spent enjoying each others company during the meal and length of conversations during the meal. The only habits connected with the meal was identified to be who cooked, the time of the meal and some of the conversation subjects.

Course of meal at home alone

The course of a meal at home when participants were to eat alone, was quite different from when eating together. If the person eating alone was not able to cook, the significant other would take care of this prior to the meal, by making something the person could just put in the microwave oven or stove. If the person was capable of cooking, less effort was put into making the meal and the type of meal would be more simple and easy to cook, as explained:

P1: If I have to eat alone I usually make something quick and easy, I do not want to bother with the cooking and cleaning.

Time taken to eat the meal was shorter than when eating together, duration varied from between 8 to 15 minutes, the explanation for this was:

P2: To be honest, eating alone is not very exciting, so when I have to eat alone I do it as fast as I can, so that I can get on with other things.

Some participants also reported that they changed their eating location and eating time, so that they could either listen to something in the radio while eating, see something in the television or be in front of the computer. One of the participants explained it this way:

R5: Eating alone is kind of boring, so I take my supper with me into the living room and sit in front of the television. The television can then be my company and entertain me.

Participants did not like having to eat alone as they did not find it either motivating or enjoyable. Some even went as far as to invite somebody else when they knew they would otherwise be eating alone:

P2: Sometimes when I know I will be eating alone, I call my son to see if he wants to come and eat with me. He is a waiter so if he has time he usually comes and make some nice food to me. I appreciate that a lot, so much nicer to have company than eating alone.

Even though no habits were identified with the meal, participants seemed to actively do something to make the meal sociable by using different technologies.

Course of meal for the patient in the hospital

The course of a meal for patients was very similar in all cases, this was due to hospital policy. Patients get their supper delivered to them in their ward at a specific time between 5 p.m. and 6 p.m.. The patients can select between a hot meal with some sort of vegetables or some sort of soup. For some people the constraint of having to eat earlier than they were used to was very troublesome:

P3: If you are not hungry at 5.15 p.m. when they deliver you the food you have ordered, it can be difficult to eat anything.

However, over time patients would get used to this:

P4: In the beginning I found it kind of annoying to have to eat that early, but when you have been admitted for some time you get used to it, you change your eating habits.

Another problem experienced by many patients with supper, actually eating at the hospital in general, was that the ward they were placed in was very dull and boring. A television was present in each ward, but to be able to listen to it, they would have to use a device resembling a telephone receiver, which was not possible while eating. This, as explained by *P1* made the actual supper something that just needed to be done as fast as possible:

P1: Since you really can not do anything while you eat, I eat as fast as possible so that I can do other things than sit here alone.

Some of the patients were able to move around and enjoy the company of other patients, but still decided to eat alone in their ward because they found it odd to eat with what they called strangers. The biggest problem identified by the patients was lack of appetite and motivation to eat. Several reasons for this was given as the following statements show:

P1: My appetite and motivation to eat is very much affected by the medications I receive, but when that is not a problem, I think I could and would eat more if I had more influence on the food I was served.

P3: I do not like eating alone, sometimes I do not eat at all.

P4: The surroundings themselves does not make you want to eat and I think they[the hospital personal] should try to make more of an effort to motivate us to eat.

Due to this patients ate quickly so they could do something else they found more entertaining or enjoyable. This also meant that supper took patients from 5 to 20 minutes.

Course of meal while using the system

The course of a meal while using the system was started by initiating a call that would start the video conversation. This meant participants had to figure out who had to initiate the call and when to start the system to be able to eat together. Several different approaches to this was taken:

P1: Who called who depended on whether or not my wife would make supper for herself or just grab something quick and simple. If she would make supper for herself she would initiate the call when she had made her supper and was placed at the computer ready to go, otherwise she would just wait for me to call and then go grab something in the kitchen.

Other approaches was taken as well. Another couple had the relative start the system and log in when she was ready. The patient could then turn on the system and see that she was ready and call her. Others did this the other way around, having the patient turn on the system when ready so that the relative could call when ready. Who called who was different, some participants decided who called the other the first time they used the system, others decided during the use of the system who would call the next day and finally some made the decision during the day, either by using the system during the day or over telephone.

In general the study showed that participants tried to carry out their meals, with the system, in the same way they would do if they were at home, as explained by one of the participants:

> *P1: It is like being at home, except for the surroundings, we do the same things as we normally would during the meal. We sit and eat and talk together, just as if I was there or she was here.*

Participants would sit and eat and talk as if they were at home and most of the participants quickly forgot they were speaking into a computer and not their relative in person:

> *P2: It is just like being with her, I mean, I know I am not there with her, but it feels like it, after the first 2-5 minutes we forget we are using a computer to do this.*

Duration of the meals varied a lot, from 15 minutes to more than an hour and a half. The average time used for a meal via this system was 25 minutes. The reasons for shorter than average meals was normally due to something in their treatment, either reactions to medication or just feeling ill. The longer meals were most of the time due to others being present:

> *P3: The first time we used the system my other sister was eating with us as well, this made the supper take longer than usual because we had so much to talk about.*

Or something important had happened that they needed to talk about or because they used the opportunity to handle some business, which would otherwise have been brought to the hospital by the relative or had had to wait until the patient got home. The only habits connected with the meal was identified to be the time of the meal and some of the conversation subjects.

Comparison of course of meal

There seems to be a resemblance between eating at home alone and eating as a patient in the hospital. The time spent eating is reduced to a minimum and both situations lack socialisation. Different approaches were taken to counter this lack of socialisation. Participants eating alone at home tended to eat in front of the television or computer or by the radio to get sense of sociability. Patients on the other hand finished their meal as fast as possible so they could do other things that they enjoyed more and found more socialising. Participants also stated that they ate less when they had to eat alone, whether it be at home or in the hospital, compared to when they ate together. The only difference was that when eating at home, the participants had the opportunity to decide what to eat, when to eat and where to eat, whereas the hospital makes the food for the patient and decide the time patients have to eat.

The resemblance between eating together at home and eating together using the system was considerable. Eating with the system was reported to be very much like eating at home together. During the meal, the same activities took place, participants ate together, talked and discussed different topics and enjoyed the company of each other. The topics discussed were a bit different when using the system, focus tended to be on the patient and less on everyday topics. Some differences were identified. Participants reported that the ability of enjoying each others company was reduced when using the system. Couples that had reported that they could sit and enjoy each other company for more than an hour, were not able to enjoy the company the same way when using the system. This meant that couples did enjoy the company, but not for as long as if they had been at home. The reason for this was lack of physical presence. Even though participants felt as if they were eating together, the lack of physical presence prohibited participants from feeling convinced that they were together as well. These factors made most of the meals over the system shorter than people were used to when eating together. Another difference was the meal. Relatives at home, in most cases, would still make something easy and quick for themselves, even though they were to eat together with the patient. The biggest difference participants identified between using the system and eating together was actually the lack of activities after the meal. When using the system, participants ended the video conversation when they had finished eating, but most participants were accustomed to do certain activities after the meal, like wash the dishes together, go watch the news, take a walk etc. which was not possible with the system.

Alternative use of the system

This section will describe some of the alternative utilisation of the system participants used throughout the study.

As became evident early in the study, even though participants did not have much experience with computers or Skype, the fact that the system was so user friendly and easy to use intrigued participants. Some so much that they wanted to learn more about computers so they could use Skype when they got home. It also lead participants to use and think of alternative uses of the system. As one of the participants describes:

> *P2: We enjoy being able to see each other when we talk, so we have used the system when ever possible instead of the telephone.*

It was common for participants to use the system multiple times a day. Mainly the system was used when participants would other wise have used the telephone to communicate with each other. Some used it to do chores they would other wise had have to do when the patient would return home or the relative would need to bring it to the hospital. As a relative describes:

> *R1: The smart thing is, that we have been able to do some stuff that he normally do and I do not know how to do, like faxing papers. With this system he can see what I do and guide me.*

Participants reported that they used the system for other meals like breakfast and lunch as well. When they used it for these meals, participants used the system the same way they used the system for supper. One of the couples participating used the system during ward round, with the doctors and nurses participating in the video conversation. The benefit from this was reportedly huge:

> *R2: If I had to decide between using the system to eat together or participate in ward round, I would chose ward round. It is very nice for relatives to be able to hear what the doctors have to say about the patient and be able to ask questions which we normally can not.*

The fact that participants saw what the system could offer them, made a lot of the participants start to think about using the system to communicate with others as well. Most of the participants had children and grandchildren and in some of the cases, patients had their children buy the equipment needed to be able to communicate over this system:

> *P2: I told my boys to go buy a webcam and install Skype, so that I could talk to them and see my grandchildren. They did, and we have been talking and I am very happy they did that, it is a big help for me. Being able to see my grandchildren means a lot to me.*

Finally, most participants had other relatives or friends join one of the conversations during the study. This was either done by having them buy the equipment needed to call the patient themselves or by being present at the relatives home when they were to use the system.

Effect of the system

This section describes the effects the system had in general on participants, on the patient and on the relative.

General effects of the system

In general the system made the duration of the meal longer. This is when compared to relatives having to eat at home alone and the patients eating alone on their ward. Duration of the meal was in average 25 minutes compared to 8-20 minutes when eating alone. The main reason for this was explained by one of the relatives:

> *R3: We do use more time when eating together with the system than we would if we were to eat alone by ourselves. Using this system we have each other to talk to and we are able to see each other, this makes you want to spend some more time eating and not just finishing the meal as fast a possible because your are sitting alone.*

It was difficult to compare the duration of a meal via the system with the duration of a meal eaten together before admission. This was due to many different activities taking place when they used the system. Sometimes other relatives or friends would be present, prolonging the duration, other times the patient would be so ill that they only used the system for a brief meal. Participants did agree that the lack of physical presence did make them spend less time enjoying each others company and hence spend less time eating together.

Participants found the system more pleasing to use than the telephone:

> *P4: We try to use the system as much as possible, it is so much nicer to be able to see each other when speaking, especially when one of the persons is admitted to a hospital.*

Another advantage of the system compared to the telephone was that it was free to use, several participants complained about increasing telephone bills. One couple in particular benefited from this:

> *P3: My family is spread all over the world, I have a son in Canada, sisters in Lebanon and Sweden and other family in Australia, you could imagine the telephone bill we rack up over the month, but with this system, I can call them for free and even see them while I speak with them.*

The best part of using the system was by all participants identified, as being able to see each other. That they were able to see and speak with each other made couples feel closer.

It became evident, that the impact of the system was influenced by the distance between the relative and patient:

> *P1: My wife lives 20 minutes from the hospital, so even though we do appreciate the opportunities the system have given us, I am convinced that the system would have a bigger impact on people if they lived further apart and did not have the possibility to visit each other each day.*

In general the system motivated participants to start using computers, even participants with non or very little experience in using computers, as stated:

> *R2: It have opened my eyes for a whole new world of possibilities. It is so easy to learn, that I am certain that I will keep using it after we have finished here.*

Effect on the patient

All patients reported, that the opportunities to see and speak with their relative helped them feel less alone while admitted:

> *P5: Sometimes you do feel rather alone, even though there are other patients, nurses and doctors here, it is simply not the same as speaking with family. There is certain stuff you can not speak to them about. Being able to see and speak with my wife when I need to talk or feel alone has made my stay less lonesome.*

Patients even reported getting better due to the fact that they could see their relatives on a regular basis:

> *P3: I feel better now that I can see my sister everyday.*

A positive change in mood was often reported by patients:

> *P1: I can not imagine anybody that would not get more positive when they suddenly get the opportunity to see their wife everyday.*

Many couples did also make arrangements with other relatives or friends, to have them join the meal. This was, as explained by a patient, very giving:

> *P3: My sister told my other sister that we were using this, which resulted in that my other sister dined along with us the first time. That I am able to see other relatives as well does just make this system even better.*

A major problem many of the patients were experiencing during their admission was that time went by very slowly. Patients were accustomed to the daily routines of the hospital. When they used the system they all reported that they easily forgot about time and that it was a nice break from the daily routines.

The main objective of the system was to enable patients to eat more. However, what became apparent during the study, was that patients ability to eat varied quite a lot, from one day being able to eat to the next day having to feed of nutrition fed intravenous. The main reason for not being able to eat was reactions to medication given to the patient or reactions to the treatment the patient was undergoing. When patients were feeling well enough to eat, most of them reported that they felt they had eaten more than they used to:

> *P3: I have eaten more now than I else would, but that is because my sister have been very good at pressuring me to eat.*

The main motivation to try and eat was that the relative had used time and effort to make supper and then they felt sort of an obligation to try to eat something. Another motivation came from the relative. Many patients reported that while they were sitting and eating, the relative would try to press them to eat some of the food they had been served. In one case, the relative had the patient film the food with the webcam and then tried to motivate the patient to eat it, by saying something like *'That looks good, how does it taste?'*. The system had another motivation factor as one of the patients describes:

> *P2: Now that I know that I will be eating with my wife, it is also a good motivation to get up and out of bed. There has been days before were I have stayed in bed all day, but not while we have been using this system.*

Effect on the relative

One of the things all relatives agreed upon as a benefit of using the system, was the ability to see the patient. This was used to see whether or not the patient was in good shape and try to help them if not:

R3: It is nice to be able to see her, because I can see whether or not she is feeling alright. If not I can try to comfort her. Over telephone I do not have this possibility and she might tell me that she is okay but really is not.

The ability to see the patient was also used to try to help and motivate the patient to eat. Most of the relatives were well aware that patients do not eat as well as home, when admitted:

R1: I can see that he is not eating enough, he has dropped in weight so I try to motivate him to eat by talking to him and encouraging him to try and eat even though it is difficult for him due to his treatment.

Some of the relatives experienced a relieve in their own everyday, as explained:

R1: Before we got this system my normal day was very hectic. I would come home from work, take a quick shower and then drive straight to the hospital to be with him. Now I have some time for my self and do not have to rush when I get home from work. I can do some stuff at home before we eat together and relax a bit more.

In general relatives found that the system made their everyday a little bit easier, by allowing them more time at home and less rush to go visit the patient. As one stated:

R5: I feel less stressed the days i plan to go visit my husband, the fact that I can get home, sit down a bit, go make food, eat with him, and then go visit him, makes the day more manageable.

For most of the couples participating, the system did not change the frequency of visits, but for one of the couples it made a huge difference:

P3: The fact that we used this system made my sister from Lebanon cancel her trip to visit me. She had planned a 10 day trip to Denmark the next week, but when she heard that we would get the opportunity to use this system she decided to cancel it because she believed it would work as if she was here.

This sister explained why she had stayed home:

R3: I think I can do the same things using this system compared to if I had been there. The only thing I am not able to do, is to be there when the doctors and nurses are present, but then her daughter in law will be there instead.

The relatives being at home all day, enjoyed the fact that they could just sit down at the computer, call the patient and then see and talk to that patient. The possibility to see the patients days when the relative was not able to visit them was a relieve:

R2: I do sometimes feel guilty when I sit at home and he is up there all alone, so I am happy that now I can see him even the days I can not go visit him.

One downside when using the system was that relatives had to eat at the same time as patients would eat. The earlier eating time affected some relatives more than others:

R2: I do not like to eat so early, because then I know I will get hungry later at night and will have to eat again.

This was also a reason for some relatives to put less effort into the meal cooked, when eating with the patient and the reason why some relatives ate less during the study:

R1: Some of the days I have just made something light and easy to eat with him, and then made a proper meal later at night.

In general most of the relatives recognised that having to eat early for a longer period of time would probably bother them, but if they were to use the system for a longer duration, relatives imagined that they would just be watching when the patient ate, and wait for themselves to eat later at night.

Improvements to the set-up and system

This section will be used to describe improvements to the system stated by participants.

When participants were asked if anything could be done, to make the system better or the experience of using the system better, only a limited amount of responses were given. In general participants had a difficult time thinking of anything that could be changed or improved, because they were surprised that a system like this was even possible. However, somethings were stated:

R2: If I should say one thing I think could have been better it would be the quality of the picture.

Others experienced problems with the microphone:

P1: We experienced that sometimes a high strident sound would appear making it almost impossible to carry on the conversations. Another problem was that you had to sit in certain positions, if not then the other person would have a hard time hearing you.

While participants liked the mobility of the webcam, some of them thought that if the webcam could record the entire eating set-up and not only the two persons eating, it could perhaps enhance the feeling of eating together.

Patients confined to the bed had some difficulties using the system and propose different set-up of the system. They proposed a system where the monitor was part of the bed and when they needed to use the monitor, they would be able to pull it down in front of them. Other ideas to different set-up was made as well:

R3: You could have a ward where the set-up of the system was made such that both bed confined patients and non-confined patients could use it without having to physically turn and change position to use it. Another option would be to have a mobile set-up of the system which nurses could then bring to you when you have to use it. Similar to both these systems would be that patients could then register for a certain time a day they would like to use the system.

Patients preferred the monitor of the laptop rather than an external monitor, the reason for this was eloquently stated by one of the patients:

P2: If I should use it at home to speak to my children I would probably like to have a larger screen, but for the purpose I have used the system, the size of the screen is fine. The fact that it is not bigger makes the event feel more private, like it is just her and me, and feel more intimate.

The physical presence was by all participants identified as the main thing lacking from the system to make it feel like a real meal together, however no ideas was expressed as to how this could be enhanced.

IMPROVEMENTS AND CHANGES TO THE SYSTEM

This section describes some of the changes and improvements that could be considered for the set-up of the system and the system itself, if similar studies were to be carried out. These changes and improvements are based on the experience gathered through this study.

To make the system more versatile, user friendly and improve some of the problems pointed out by participants, the following improvements could be considered if a similar study were to take place. The build-in microphone in the computer have caused some problems with the sound and positioning of participants. To avoid this a wireless microphone could

be used, this would allow for participants to sit in whatever position they would like and if problems with sound should occur, a wireless microphone is easier to reposition and replace than an entire computer.

A better webcam could also be considered. The webcams used in this study could only record participants upper body and head. To improve the experience, webcams that were able to capture surroundings as well, could prove to make the meal more realistic. Alternatively, it could be examined whether or not different positions of the webcam would influence the experience.

Using a laptop proved to be a problem in the cases were patients were confined to the bed. To resolve this problem other devices, such as a tablet or smartphone could be used instead. Examination of what type of device works best for studies like this could then be carried out. Some participants also had difficulties operating a computer mouse, this could be solved by using a touch screen. Otherwise, making a frame for the system could be considered. A frame should make sure both bed confined and non confined patients would use the system in the same manner.

Changes to the system could also be considered. During this study it became evident that participants use the system for lots of alternative purposes. To make the system easier to use, an addition could be made, that would allow participants to make arrangements for time to use the system and who should call. Automation of this could also be considered. This would help participants which have difficulties starting the system. Instead the system would turn on and initiate the call when they had arranged. This would not only make the system easier to use when participants were to eat together, but also when alternative use of the system were to take place.

These changes would also make it easier for other relatives to participate, since they would just have to make an arrangement and then the system would initiate the call when it was due. The only thing other relatives would have to do was to get the same system as the patient.

To make the system more interactive to use, more webcams could be used. Participants should then be able to decide from which webcam they would like to see the other participant. Webcams could be placed so that one would record the participant, another the food etc.

DISCUSSION

The work related to this study suggested that people do feel the most socially present when using 'webcam and voice with text to support' [1], closely followed by 'webcam and voice'. In this study participants have been able to communicate with each other using webcam and voice. When asked if they felt socially present with the other person, all agreed that they did. However, as [28] also identified, the lack of physical presence did decrease this feeling and the experience of being together. When asked if participants would have felt the same presence if the system only had voice and no vision, they all agreed that it would significantly decrease the experience, some even made the remark that if a webcam was not used, they might as well use the telephone. So this study supports the fact that to get the best feeling of being socially present using mediated communication, webcam and voice is the best solution available at the moment.

The analysis of the conversation of couples using the system showed, that conversations were carried out the same way they would have been if they were at home. Participants did not report any problems with conversations using the system, there were no problems with interpreting when the other had finished speaking, as suggested by A. J. Sellen [28]. They did mention, as A. J Sellen's study also showed, that they felt more distanced when talking via the system, than if they were talking together at the same location. Again, lack of physical presence was the cause for this. This lack of physical presence also meant that relatives did not think that the system could substitute physically visiting the patient at the hospital.

Using the system for alternative purposes proved to be something most of the participants did. The majority used it so they were able to see each other when communicating during the day. Some used it to be able to see and talk to other relatives than the one participating in the study and others to be able to see and talk to family in other countries or even other parts of the world. This seem to support the fact that the Internet is a viable source for maintaining geographically diverse networks as [15] also suggested. Using the system was by no participants found to be an asocial activity, which some research have suggested [25].

Studies like [2, 4, 8, 9, 12, 18, 27] have suggested that eating together increases the amount of food participants consums. This observation was also made in this study. However, the patients health conditions and medical situation did have a major impact on this observation. Three out of the five patients participating were treated for difficulties with their intestines and were receiving nutritions intravenous, rendering them less physically able to eat. So while some of the patients were able to get the full effect of the system every day, others were not as lucky and one of the patients participating was not able to eat anything during the study. All patients did however say that they felt motivated to try and eat.

For the relatives, observations varied quite a bit. From relatives reporting that they would eat more than if they had to sit and eat alone to others reporting the opposite, that they ate less. It seems as the effect for the relative of mediating a meal, to a great extend depends on the perception of the system. Some perceived the system more as a tool to help the patient, and focused less on eating for themselves and others perceived it more as a tool to eat together and help the patient.

Furthermore, it has been suggested [8], that eating together with someone prolongs the meal. This experience is supported by this study. All couples did use significantly more time when eating using the system, than they had reported they did alone.

Using the system over a short duration of time, as in this study, did not bring forth any changes in usage of the system for eating with. None of the participants reported any changes in the way they were eating together over time. Neither did any of the couples report adopting any habits while using the system. The only changes reported during the study was change of use. Most of the participants using it for alternative purposes than eating together, reported that they already started doing so the day after they had started the study. Using the system for alternative purposes seemed more or less to have the same effects as using it for supper, except for the motivation to eat.

None of the participants found the restraint of having to use the system to eat supper together every day during the study to be a burden. Instead participants reported that it was exciting and something they looked forward to use. Over time patients could not imagine it would be a burden to use the system, but relatives did mention that it might be a burden to have to eat at a specific time every day for a long period of time.

In general the system had the biggest impact on participants mood. Even though the main focus of the study was to improve food intake in patients, patients seemed to care more

about the ability to be able to see and talk with their relatives, than having a relative to eat together with. However, indirectly this change in mood might also have an influence on the amount of food eaten by patients.

CONCLUSION

This paper has presented findings from an empirical study, studying the effects of allowing patients and relatives to eat together using a system that enables them to see and speak with each other, when not physically together. The findings indicates that it is possible to increase food intake in patients by enabling them to eat with relatives while admitted. However, it has also shown, that the treatment and medication patients receive while admitted, do have a big influence on the effect of the system. This suggest, that if the system was to be implemented at a hospital, some sort of screening of patients would be necessary, to find suitable patients.

If proper screening is carried out in advance, this study suggest that the benefits or impact from allowing patients to use this system is an increase in food intake or at least a motivation to try and eat, reduce patients feeling of being alone while admitted, a positive change in mood, a feeling of not being apart from their relatives and an a feeling of being socially connected. Put together, this has the potential of reducing time patients spent admitted and positively improve the experience of staying at the hospital.

The system benefits the relatives as well. Relatives are able to see and speak with the patient, opposed to using the telephone, without visiting them at the hospital. Giving them a feeling of not being so far apart from the patient, not feeling guilty if they are prevented from visiting the patient, releasing them from stress and improve the mood in a positive way.

Finally, it can be concluded that patients sees eating alone at home very similar to eating alone when they are admitted. Whereas the experience of eating together with this system is much more like eating together at home. The only main different identified by participants were the lack of physical presence.

The aim of this study was to investigate, through an empirical study, whether or not pervasive computing has the potential of increasing food intake in patients.

Some limitations should be considered when using findings from this study. The number of participants was rather limited. During the two months this empirical study lasted for, only five patients, from three departments, were able to participate. Three of the five patients had intestine problems and were fed nutritions intravenous, which reduced their appetite significantly. Participants were all above 50 years of age. Measurement of food intake was not carried out as hospital personal deemed it redundant. For measurements of food intake to be meaningful and useful, at least 150 patients would have to participate and a control group would be needed. Thus, future work should strive at making a large scale study to be able to generalise the effects of the current system and prove or disprove the findings in this study. Modifications to the system could be made to examine what impact or influence they would have on patients eating habits. Finally, future work could also examine what it would take to make a system like this a general tool available at hospitals.

ACKNOWLEDGMENTS

Medicinerhuset Aalborg and its staff for its cooperation.

References

1. Albuquerque, A. L. P., and Perkis, A. When simple technology affords social presence: a case study for remote family members.
2. Bell, R., and Pliner, P. L. Time to eat: the relationship between the number of people eating and meal duration in three lunch settings. *Appetite 41(2):215-218* (2003).
3. Bellisle, F., and Dalix, A.-M. Cognitive restraint can be offset by distraction, leading to increased meal intake in women. *American Journal of Clinical Nutrition 74(2):197-200* (2001).
4. Clendenen, V. I., Herman, C. P., and Polivy, J. Social facilitation of eating among friends and strangers. *Appetite 23(1):1-13* (1994).
5. Coget, J.-F., Yamauchi, Y., and Suman, M. The internet, social networks and loneliness. *IT & Society 1:180-201* (2002).
6. Correia, M. I. T. D., Caiaffa, W. T., da Silva, A. L., and Waitzberg, D. L. Risk factors for malnutrition in patients undergoing gastroenterological and hernia surgery: an analysis of 374 patients. *Nutricin Hospitalaria 16:59-64* (2001).
7. Correia, M. I. T. D., and L.Waitzberg, D. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clinical Nutrition 22(3):235-239* (2003).
8. de Castro, J. M. Social facilitation of duration and size but not rate of the spontaneous meal intake of humans. *Physiology & Behavior 47(6):1129-1135* (1990).
9. de Castro, J. M. Social facilitation of the spontaneous meal size of humans occurs on both weekdays and weekends. *Physiology & Behavior 49(6):1289-1291* (1991).
10. de Castro, J. M. Family and friends produce greater social facilitation of food intake than other companions. *Physiology & Behavior 56(3):445-455* (1994).
11. de Castro, J. M., and Brewer, E. The amount eaten in meals by humans is a power function of the number of people present. *Physiology & Behavior 51(1):121-125* (1992).
12. de Castro, J. M., Brewer, E. M., Elmore, D. K., and Orazco, S. Social facilitation of the spontaneous meal size of humans occurs regardless of time, place, alcohol or snacks. *Appetite 15(2):89-101* (1990).
13. de Castro, J. M., and de Castro, E. S. Spontaneous meal patterns of humans: influence of the presence of other people. *American Journal of Clinical Nutrition 50:237-247* (1989).
14. Edington, J., Boorman, J., and E. R. Durrant, e. a. Prevalence of malnutrition on admission to four hospitals in england. *Clinical Nutrition 19(3):191-195* (2000).
15. Franzen, A. Social capital and the new communication technologies.
16. Grinter, R. E., and Palen, L. Instant messaging in teen life. *Proceedings of the 2002 ACM conference on Computer supported cooperative work* (2002), 21–30.
17. Group, M. M. Internet usage statistics. `http://www.internetworldstats.com/stats.htm` checked: 10-05-2011.
18. Hetherington, M. M., Anderson, A. S., Norton, G. N., and Newson, L. Situational effects on meal intake: A comparison of eating alone and eating with others. *Physiology & Behavior 88(4-5):498-505* (2006).
19. Hlebec, V., Manfreda, K. L., and Vehovar, V. The social support networks of internet users. *New Media & Society 8(1):9-32* (2006).
20. Kraut, R., Kiesler, S., Mukhopadhyay, T., Scherlis, W., and Patrerson, M. Social impact of the internet: what does it mean? *Communications of the ACM 41(12):21-22* (1998).
21. Leung, L., and Lee, P. S. N. Multiple determinants of life quality: the roles of internet activities, use of new media, social support, and leisure activities. *Telematics and Informatics 22(3):161-180* (2005).
22. Liechti, O., and Ichikawa, T. A digital photography framework enabling affective awareness in home communication. *Personal and Ubiquitous Computing 4(1):6-24* (2000).
23. McWhirter, J. P., and Pennington, C. R. Incidence and recognition of malnutrition in hospital. *BMJ 308:9458* (1994).
24. Milne, A. C., Avenell, A., and Potter, J. Improved food intake in frail older people. *BMJ 332(7551):11651166* (2006).
25. Nie, N. H., and Hillygus, D. S. The impact of internet use on sociability: Time-diary findings. *IT & Society 1(1):1-20* (2002).
26. Rasmussen, H. H., Kondrup, J., Staun, M., Ladefoged, K., Kristensen, H., and Wengler, A. Prevalence of patients at nutritional risk in danish hospitals. *Clinical Nutrition 23(5):1009-1015* (2004).
27. Redd, M., and Castro, J. M. D. Social facilitation of eating: Effects of social instruction on food intake. *Physiology & Behavior 52(4):749-754* (1992).
28. Sellen, A. J. Remote conversations: The effects of mediating talk with technology. *Human-Computer Interaction 10(4):401-444* (1995).
29. Seymour, D. The social functions of the meal. *International Journal of Hospitality Management 2(1):3-7* (1983).
30. Stratton, R. J., and Elia, M. Who benefits from nutritional support: what is the evidence? *European Journal of Gastroenterology & Hepatology 19(5):353-358* (2007).
31. Strauss, A. C., and Corbin, J. M. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*.
32. Venkatesh, A. The tech-enabled networked home: An analysis of current trends and future promise.
33. Wright, L., Hickson, M., and Frost, G. Eating together is important: using a dining room in an acute elderly medical ward increases energy intake. *Journal of Human Nutrition and Dietetics 19(1):23-26* (2006).