COPD home interaction device

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Master Thesis
COPD home interaction device

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Summary

COPD is short for Chronic Obstructive Pulmonary Disease. According to the World Health Organization COPD is the worlds 5th most common disease and 4th leading cause of death[WHO09]. COPD is a combination of chronic bronchitis and lungemphysema. 2% of the Dutch population has COPD (330.000 individuals) and 6000 people die of COPD every year in the Netherlands, which is 4% of all deaths [Riv09].

Previous studies investigated the effectiveness of a self management program for average COPD patients in Twente. The problem of the current situation is a lack of insight in the real daily life and activities of the patients and a lack of cross-organizational communication among the involved members and health professionals. To solve the problem this research investigated the possibilities to develop a digital dairy on the COPD home interaction device. The development of the COPD home interaction device is part of the COPD dot COM project. The COPD dot COM project is a cooperation between the Medisch Spectrum Twente (MST) hospital in Enschede, the Roessingh Research and Development and Novay.

The goal of this research was: *design and evaluate a user interface for the COPD home interaction device to support the registration of subjective information of the health status. The user interface will persuade patients for long-term interaction with the COPD home interaction device and change the patients attitudes towards their disease.* The approach to this research was that of usability engineering and a user centered design process for user interface.

This thesis describes the research to design the two prototypes. The input device for the CODP home interaction device is a touch screen device. The dairy exists of ten questions about complaints and the registration of the lung capacity. One prototype has a minimal design to complete the diary. The other prototype is a diary that uses persuasive technology. Persuasive technology can be defined as any interactive computing system designed to change peoples attitudes or behaviors [Fog03] and can be useful to motivate COPD patients to complete their diary and change the patients attitudes to their disease.

The two prototypes of the dairy were subject of a usability study and user evaluation with 22 COPD patients at physiotherapist practice FitClinic in Enschede. The most important results of these evaluations were:

- No significant measurable differences between the two prototypes of the dairy were found on statements about usability.
- During the interviews with the participants some indications for differences between the prototypes were found. The persuasive prototype of

the diary was defined as more friendly while the basic prototype of the diary was defined as quick and short.

- All participants were able to work with the interface of the COPD home interaction device and completed the dairy successfully.
- Participants were less interested in the possible extra functionalities of the dairy.

Preface

This thesis is a reflection of the research that I started in February 2009 and is the end product of a Masters degree course in Human Media Interaction.

First of all, I would like to thank all the members of my graduation committee: Betsy van Dijk, Stans Drossaert, Anton Nijholt, Wout Slakhorst and Ellen Szwajcer for their support, feedback and the time they invested in guiding me through this research.

Furthermore I would like to thank the project members of the COPD dot COM project for their feedback during the workshops. Special thanks to the physiotherapist practice FitClinic in Enschede. Paul and Henk, thank you for helping recruiting COPD patients for the usability study and evaluation and for your hospitality and thanks to all participants of the usability study and evaluation.

Also, many thanks to the people at Novay, who provided a great atmosphere to work in, as well as the conversations at the coffee table. And especially to my fellow graduates for the "coffee break set games", "half 4, cup-a-soups" and "Friday, icecream-days".

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Chapter 1

Introduction

1.1 Scenario

Peter is 68 years old and lives alone. Peter is diagnosed as COPD patient for 15 years and lately his disease is getting worse. A couple of times Peter ended in a situation in which he experienced extreme dyspnea with the consequence that his self esteem was decreased. So, Peter avoids physical activities and situations that might induce a new attack of dyspnea, resulting in a poor physical condition, which made him vulnerable for new situations in which dyspnea might occur. To get out of this vicious circle Peter decided during his last visit at the lung physician to participate in a new disease management program. This program is carried out in close cooperation between the first, second and third health care lines in a (virtual) COPD centre. First Peter gets an extensive screening and based on the results an individually tailored program is composed. Additionally, Peter keeps up a diary. Everyday Peter fills in his diary including mainly subjective information on the COPD home interaction device. So also today. The first question of his medical diary is "Did you have more complaints than normal in the last 24 hours?" The only two possible answers to this questions are "Yes" and "No". Because Peter had a bad day with more complaints than average, his answer is yes. In the following questions Peter indicates the type and seriousness of his complaints. Are his complaints normal, some worse than normal or much worse than normal.

Beside his medical diary, Peter also keeps up nutrition and a physical exercise diary. In this way Peter and his health care professionals get a better view of the daily life and progress of his COPD. Peter receives feedback regularly about his behavior as well as advise how to continue. During treatment Peter has a weekly consultation with his case manager to talk through the objectives for the coming period and to discuss progress.

1.2 COPD dot COM

The situation in the scenario above will be one of the results of the COPD dot COM project. COPD dot COM is a project within the framework of the ZonMw program ICT en disease management [Zon09]. The objective of the COPD dot COM project is to design, develop and demonstrate a prototype ICT system

for COPD disease management. The COPD dot COM project is a cooperation between the Medisch Spectrum Twente (MST) hospital in Enschede, the Roessingh Research and Development and Novay.

Most of the COPD patients in Enschede are under care of general physicians. When the clinical picture and the exacerbations of the patient become more serious, pneumonologist and other health professionals get involved. The health status of patients in the hospital is recorded in a medical file. This medical file is on paper and contains all essential and historical medical information and is used to exchange information and standardize care. Results of medical examinations, such as X-rays or lung function tests are stored in a central computer system. The medical data of the paper file is not always up to date and some data is missing. The present care felt suboptimal. The key problems are a lack of insight in the real daily activities of the patients and a lack of cross-organizational communication among the involved members and health professionals.

A part of the COPD dot COM project is the design of a very easy to use device for interaction between COPD patients and the health professionals. The design of the user interface of the COPD home interaction device is the subject of the research described in this thesis. COPD patients can enter their diary information in the COPD home interaction device. This diary information can be either objective or subjective. Objective information is unprejudiced information and is measurable. In this case of COPD dot COM, the patients objective information contains heart rate and lung function parameters. Subjective information is information according to someones opinion. In the case of COPD dot COM, patients subjective information can be how the patient feels about the seriousness of complaints, nights rest or food. This device will be used for giving feedback from the health professional involved in the treatment to the patients and entering subjective and objective diary-information. In the past there were some versions of diaries on paper and television. These diaries are offline resources of data. The patient has to bring along the diary to the health professional. The design of these existing diaries can be used as inspiration for the diary on the home interaction device.

1.3 COPD

COPD is short for Chronic Obstructive Pulmonary Disease. According to the World Health Organization COPD is the worlds 5th most common disease and 4th leading cause of death [WHO09]. COPD is a combination of chronic bronchitis and lungemphysema. The most common symptoms of COPD are couching, expectorate and (progressive) dyspnea. The primary causes of COPD are long-term smoking, air pollution (like long-term exposure to dust and noxious particles) and some inheritance properties [Riv09]. The progress of COPD can be divided into four GOLD (Global initiative for chronic Obstructive Lung Disease) states; mild (GOLD I), moderate (GOLD II), severe(GOLD III) and very severe (GOLD IV). By measuring the lung capacity of the patient the severity of the disease can be measured and categorized. The lung capacity is mainly expressed in two constructs; FEV1 and FVC:

- FEV1 stands for Forced Expiratoty Volume in one second. FEV1 is the volume of air expelled in the first second of maximal forced expiration from a position of full inspiration. [Not09a]

- FVC is short for Forced Vital Capacity. FVC is the volume of air expelled by a forced maximal expiration from a position of full inspiration. [Not09b]

The four different COLD classifications in relation with the FEV1 and FVC can be found in figure 1.1.

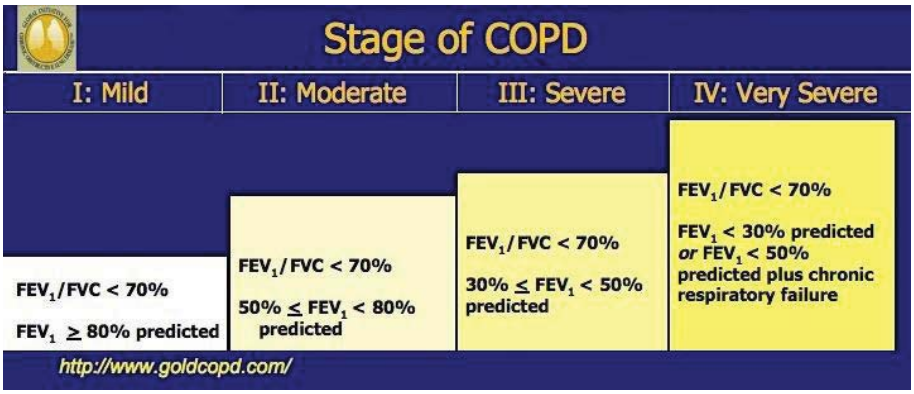


Figure 1.1: The progress of COPD can divided into four GOLD states. From [GOL08]

2% of the Dutch population has COPD (330.000 individuals) and 6000 people die of COPD every year in the Netherlands, which is 4% of all deaths [Riv09]. In general COPD patients in the Netherlands are 40 years or older. The majority of the COPD patients have a low socio-economic standing. Most of the COPD patients have a low level of education and/or a low income. Because of the low socio-economic standing and the relative high age of the COPD patients, the number of digital illiterates is high [Hei06]. In the case of Twente many COPD patients are old employees of the textile industry.

A worsening of the condition of the COPD patient within a couple of days is called an exacerbation, which happens one to three times a year on average [MST09]. Besides the primary complaints of COPD, COPD involves decreased quality of life. The quality of life in the scope of physical as well as in the scope of emotion and social wellness is worse with regard to the average Dutch population and they also experience a worse general health. [TT02]

The only treatment that is effective to slowdown the decreasing of the lung function is to stop smoking. Other therapies are focused pharmacotherapy and treatment of the symptoms. Modern treatments consist of quit smoking, medication and paying attention to physical exercise, nutrition, diet, active lifestyle (reactivation) and pulmonary rehabilitation. Examples of such modern treatments are the self management programs of the COPE (COPD Onderzoek afdeling Pulmonologie Enschede) I and II projects. The goal of the COPE projects is to design, develop and demonstrate a self management program for COPD patients. In this self management program COPD patients learn to know their disease and recognize the symptoms to decrease the number and seriousness of the symptoms by a combination of medication and paying attention to physical exercise and food. In the COPE project different health professions cooperate in the treatment of the patients. Examples are the pneumonologist, nurse prac-

titioner and physiotherapist. In section 1.4 the COPE studies will be discussed in more detail.

1.4 COPE studies

COPE stands for "COPD Onderzoek afdeling Pulmonologie Enschede". The research question of the COPE I project was how effective a self management program will be for average COPD patients. The COPE II study investigates the effects of the self management and physical exercise programs by COPD patients. The COPD dot COM project can be seen as a logical continuation of the COPE studies.

1.4.1 COPE I

The regular treatment of COPD consist of a quit smoking course, control of symptoms, decrease the number of exacerbations and the improving of the quality of life. Stop smoking is the only proven treatment that is effective to slow down the decreasing of the lung function. Self management programs can be an additional treatment. Self management programs are treatments by which patients learn to handle their disease and how to treat themselves with medication. To investigate the possibilities of a self management program for COPD patients the COPE I study was accomplished [MvdV05].

269 people participated in the COPE I study. All the participants have a moderate or severe form of COPD (GOLD II and III). During a period of 22 months the participants are monitored and questioned. The group of participants was divided into a self management group and a control group. The control group only received the regular treatment. The self management group received a group fitness program and instructions to treat themselves with prednisolon and or antibiotics in case of an exacerbation.

The use of a questionnaire demonstrated that there was no impact on the quality of life of the participants in the self management program [MvdAvdV$^+$04]. There were also no significant differences between the two groups on the disturbances and the walking distance.

The subjective experiences of the participants, the physiotherapist and the physicians were in contrast with these results. Interviews with twenty participants from the self management group demonstrated that the fitness program and a better endurance as a consequence of this program was the most important part of the program. Participants were positive about the possibility to treat exacerbations by themselves. Different participants reported an increased self-confidence, were better able to cope with their COPD and reported feelings of safety due to the frequent follow-up visits and 24 h access to the hospital [MvdAvdV$^+$04].

1.4.2 COPE II

The COPE II study was a future study of the COPE I study [Eff09]. In this study the added value of self treatment and intensive fitness program was investigated. In total 200 participants of the Medisch Spectum Twente participated in the COPE II study. These participants had three or more exacerbations

in one year or one admission to hospital. In this study, the group of participants was also divided. All the participants were instructed about the self management program. These instructions included information about COPD, exacerbations, medication, nutrition, communication, relaxing and breathing. Some participants also got individual instructions about self treatment in case of an exacerbation. Other participants took part in an intensive fitness program.

The self management program included a diary. Participants were asked to complete the diary daily during the whole study. Every day, participants had to register a question about how they are feeling today. In the case of a worsening, participants had to register their symptoms and take medication. Also the use of prednisolone and antibiotics was registered. In figure 1.2 the diary for one month can be found. The plan of action in case of a worsening can be found in figure 1.3.

The number of completed diaries by the participants of the COPE II study was high. More than 80% of the participants completed the diary during the study. Possible causes are the easiness of the COPE diary and the motivation of the participants. Completing the diary was instructed by the health professional. At the start of this research the COPE II study is at its final stage and results were not published yet.

1.5 Motivation

COPD is the worlds 5th most common disease and 4th leading cause of death. Modern treatments for COPD consist for the greater part of self management. The COPE studies investigated the effectiveness of a self management program for average COPD patients in Twente. The COPE studies showed that the use of a dairy could help getting a better insight in the daily life of a COPD patient and made it possible for patients to treat themselves with medication in case of an exacerbation. The COPE dairy was on paper and patients send the dairy every month to their health professional. The problem of the current situation was a lack of insight in the real daily life and activities of the patients and cross-organizational communication among the involved members and health professionals. To solve the problem this research will investigate the possibilities to develop a digital dairy. The development of a digital dairy makes it possible that dairy information becomes available at real time and notify remarkable results automatically. The design of the dairy for the COPD home interaction device will a user centered design and will be discussed in the coming chapters of this thesis.

1.6 Goal

The goal of this research is to design and evaluate a user interface for the COPD home interaction device to support the registration of subjective information of the health status. The user interface will persuade patients for long-term interaction with the COPD home interaction device and change the patients attitudes towards their disease.

The method to design the user interface of the COPD home interaction device will be a user centered design, in line with the COPD dot COM project

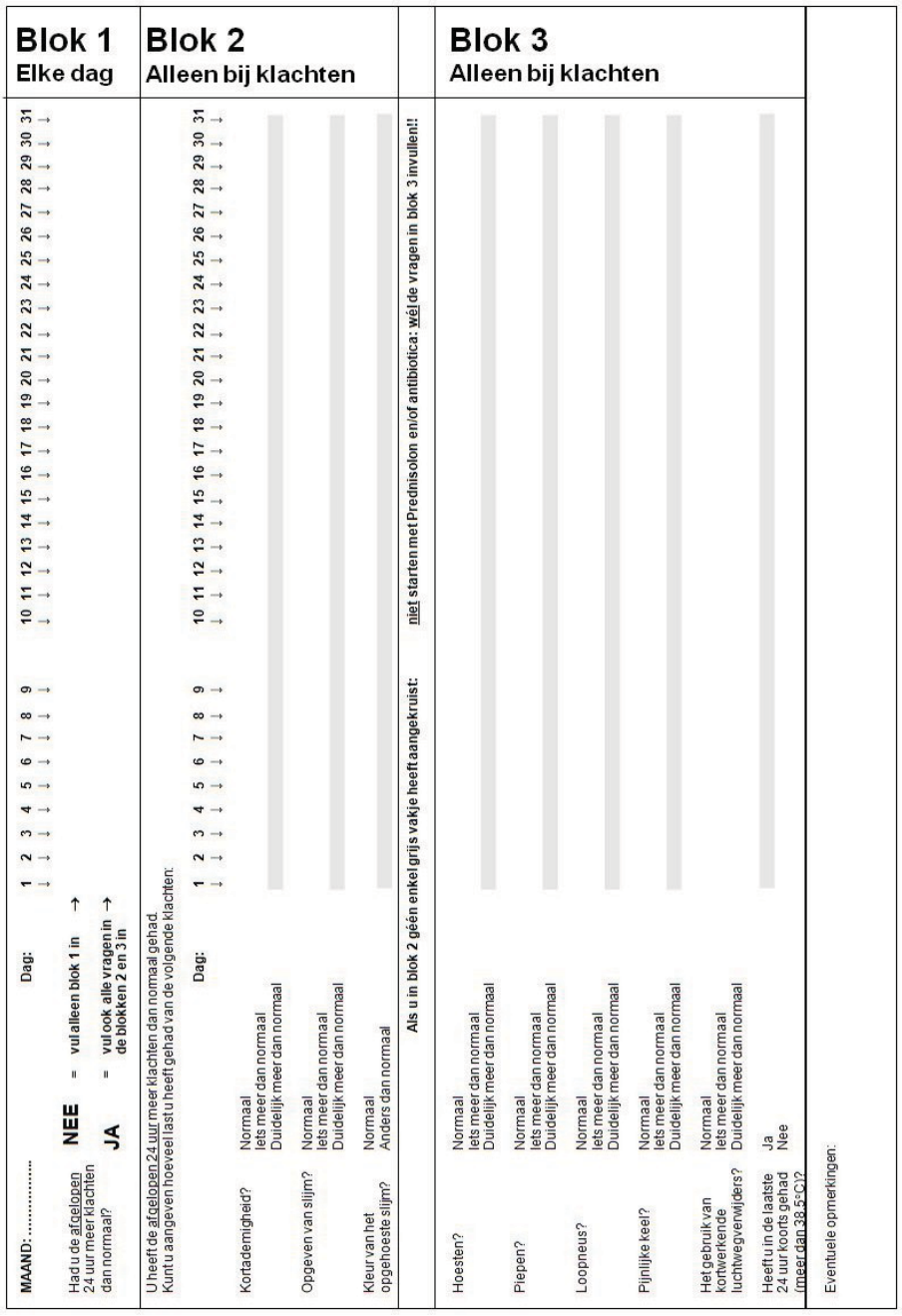


Figure 1.2: COPE II diary

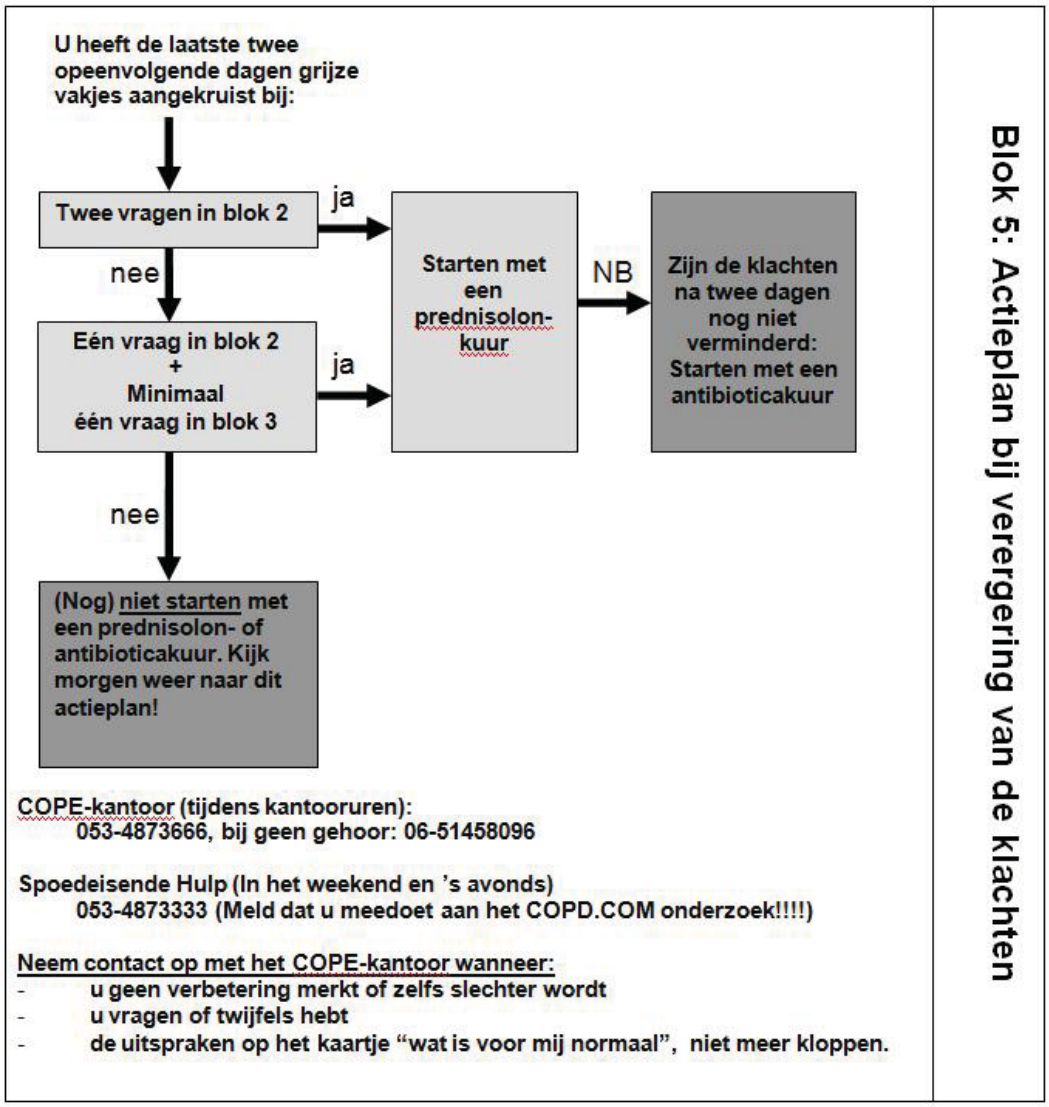


Figure 1.3: Plan of action of the COPE II diary

proposal. The user centered design method is an approach to user interface design and development that involves users of the prospective system in the design process. A result of this research is a prototype of a user interface of the dairy on the COPD home interaction device. The device should support entering diary information and should be very easy to use. This information is subjective and objective information provided by the patient and based on the COPE diary. Interaction between the patient and the health professional is in the form of feedback about this information and is limited to medication advice. Other feedback is out of the scope of this research.

1.7 Research questions

The main research question is *how to design a user interface for the medical diary of the COPD home interaction device and persuade patients for long-term interaction with the COPD home interaction device and change the patients attitudes to their disease?* This research question can be divided into the following sub questions

1 What is the current state of the art systems in telehealth?

   - What are the characteristics of these systems?

2 Which functionalities should be supported by the user interface of the COPD home interaction device dairy function?

   - What should be the questions of the medical COPD dairy?

3 What are the requirements to design the COPD home interaction device?

   - How to design the user interface of the dairy?
   - What data of the dairy have to be stored?

4 How to motivate users to use the COPD home interaction device and complete the dairy every day during a long period of time and change the patients attitudes to their disease?

1.8 Approach

This section will describe the methodology to reach the goal of this master thesis: designing a user interface for the COPD home interaction device. Since the COPD home interaction device should be very easy to use by the COPD patients, the approach to this research will be that of usability engineering and a user centered design process for the user interface of the COPD home interaction device.

In general a user centered design approach consists of four parts. The first part is an analysis of the domain of the COPD dot COM project, the users of the COPD home interaction device and related systems. The second part is the specification of the user requirements. The user requirements can be divided into functional requirements, non functional requirements and context requirements. From the analysis and specification follows a design of the user interface. The last part of the approach is a user evaluation of the user interface.

Since the design of the COPD home interaction device is a user centered design, user evaluation is important. The last parts can be iterative, results from the user evaluation can be used for redesigning the user interface or a reformulation of the specification of the system and interface. An overview of this approach can be found in figure 1.4.

Next to the ease of use of the COPD home interaction device motivation is also an important issue. Patients have to use the COPD home interaction device every day to complete the diary for a long period of time. This period of time is difficult to specify. The patients that are subject of the research are patients with COPD GOLD II and III. So they can start using the COPD home interaction device when they become COPD GOLD II patient and stop using it when they become COPD GOLD VI patient. This worsening of the COPD and the duration of this progress is unique for every patient. To motivate the users of the COPD home interaction device persuasive technology will be used. During this research two prototypes of the diary will be developed. One prototype will have a minimal design to complete the diary. The other prototype will be a diary that uses persuasive technology. These two prototypes of the diary will be evaluated side by side.

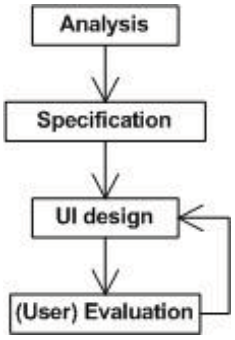


Figure 1.4: Overview of the user centered design approach

The COPD home interaction device should be a very easy to use device. This because the fact of the (in general) advanced age of COPD patients with less or no computer experience, a relative high level of illiteracy and numeracy and users with difficulties with interpreting percentages, risks and information about scheduled appointments [EBV+09]. With these facts in mind, the user interface of the COPD home interaction device need special attention. During the design of the user interface COPD patients and health professionals will be involved.

1.9 User Centered Design method

In daily life people are coming into contact with an increasing number of computer-based technology. Some of these computer systems we use directly, like the personal computer. Other system we use more indirectly like the climate control in your car. When we use a computer system, directly or indirectly, we do so via a user interface. Because of the increasing number of computer-based technology

a good designed user interface is very important.

The question is: What is a good user interface design? *A good user interface encourages an easy, natural, and engaging interaction between a user and a system and it allows users to carry out their required tasks.* [SJWM05]. In the following subsection the definition of usability will be discussed.

1.9.1 Usability

Usability is defined in Part 11 of the ISO 9241 standard as *the extent to which a product can be used by specified users to achieve specified goals with* ***effectiveness***, ***efficiency*** *and* ***satisfaction*** *in a specified context of use* [ISO98]. The bold words in this definition will be explained as follows:

- **Effectiveness** is the accuracy and completeness with which specified users can achieve specified goals in particular environments.
- **Efficiency** is defined as the resources expended in relation to the accuracy and completeness of the goals achieved.
- **Satisfaction** is the comfort and acceptability of the work system to its users and other people affected by it use.

This definition is about specified users and particular environments. Therefore it can be concluded that a user interface is designed and developed for a specified group of users in their work environment [SJWM05].

Nowadays user experience in interacting with a system has taken a great level of importance. Quesenbery [Que03] [SJWM05] established the connection between usability and user experience. Quesenbery's framework for usability, named 'the five E's' consists of five dimensions:

- **Effective:** the completeness and accuracy with which users achieve their goals.
- **Efficient:** the speed (and accuracy) with which users can complete their tasks.
- **Engaging:** the degree to which the tone and style of the interface makes the product pleasant or satisfying to use.
- **Error tolerant:** how well the design prevents errors or helps with recovery from those that do occur.
- **Easy to learn:** how well the product supports both initial orientation and deepening understanding of its capabilities.

When working with the five E's it is important to consider them all together and in balance.

1.9.2 Designing for users

The user centered design method is an approach to user interface design and development that involves users of the prospective system in the process. Consistent with the ISO 13407 *Human Centered Design Processes for Interactive Systems* user centered design method consist of the following four essential human centered design activities:

- Understand and specify the context of use.
- Specify the user and organizational requirements.
- Produce design solutions (prototypes).
- Evaluate designs with users against requirements.

Adopting these activities in the design process will positively influence the usability of the final product.

1.10 The star life cycle model

Telemedicine services must be designed and implemented with the user in mind. Theories of human factors, user centered designs and basic universal design principles have to be applied to design new telemedicine programs and devices. Factors like age, education and technology experience must be taken into account. Beside these factors there are also a range of potential patient impairments. These include problems with language, cognition motor function, vision and voice. Human factors and technology usability play significant roles in the acceptance and utility of telemedicine programs [BB09].

The design of the user interface of the COPD home interaction device will be an iterative design process to ensure that users are involved in the different steps in the design process. One approach to make the design process iterative is the star life cycle of Hix and Hartson [SJWM05].

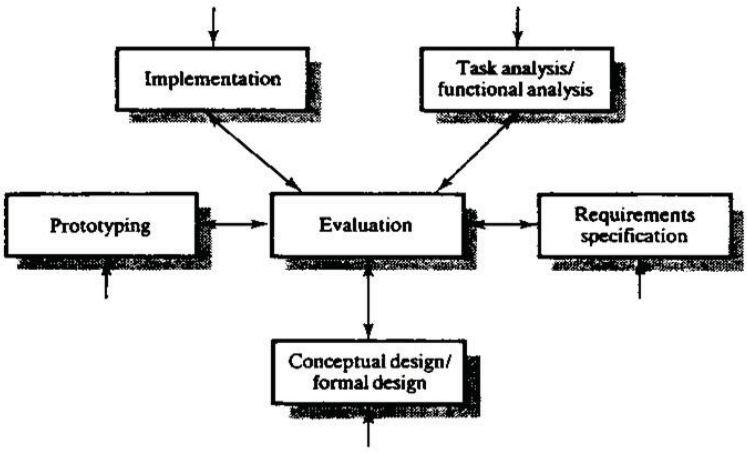


Figure 1.5: Star life cycle

Users of an interface can be divided into primary users and secondary users. Primary users are the 'real' end users of the interface (in this case the COPD patients). Secondary users are not the users who will use the interface, but they can influence the design and development of the interface. An example of secondary a user is the pneumonologist. Desired functionalities that should

supported by the interface of the COPD home interaction device to record subjective data can vary between the primary user and secondary user.

Because the group of primary users is very specific and not always available in great numbers for cooperation in the design process, secondary users (health professionals, computer experts or user experts) will be used when necessary and possible. In all stages of the design process primary user will be involved. The user evaluation will be conducted with the primary users.

Users have to be involved in every step of the user interface design and development life cycle. Users can provide information by defining requirements in the early stage of the design process and testing early prototypes (conceptual designs). They can also provide feedback about problems with the current system. During the design of the prototype users can test different versions of the interface and provide feedback and suggestions.

The result of the user centered design are two prototypes of the COPD diary. These prototypes will be evaluated with real users in the last stage of the design process. The evaluation will focus on the usability of the user interface and investigate the preference of COPD patients for one of the two prototypes. Long-term effects and preference will not be studied in this user evaluation.

1.11 Outline

Chapter 2 describes the related systems and the characteristics of the taget group of this research. Chapter 3 gives an introduction to persuasive technology and the possible benefits for the prototypes of the COPD diary. Based on these two chapters design choices for the user interface of the COPD home interaction device will be made. Chapter 4 discusses the design of the prototypes and the interface of the COPD diary. This prototype will be used in an usability study with COPD patients. The participants will use both prototypes to complete a diary. During the completion the participants will be observed. After this completion users can give their opinion about the prototypes and make clear preference for one of the two systems. The design of the usability study and evaluation will be discussed in chapter 5. The results of this experiment can be found in chapter 6. The conclusions and discussion of the results of the research can be found in chapter 7. Recommendations for future research and the future course of the COPD dot COM project will be given in chapter 8.

Chapter 2

Related systems and User characteristics

This chapter will provide an analysis of related systems and the characteristics of the target group in order to design the prototypes of the COPD diary. Section 2.1 gives an overview of the current state of the art in telehealth systems. Section 2.2 describes the characteristics of the target group. The section discusses designing for elderly and digital illiterates and gives guidelines for designing for the target group. Section 2.3 gives an overview of possible input devices and their advantages and disadvantages will be discussed. Based on this discussion the input device for the COPD home interaction device will be chosen.

2.1 Existing Telehealth Systems

This section discusses related ICT self management programs found on the market at the moment of writing. The goal is to get a quick overview of the possibilities for designing the user interface of the COPD home interaction device. Most of the self management programs are web-based. Users go to a web page on their computer to follow their program. Other systems use special in-home patient Personal Health System (PHS) to follow the program, fill in questionnaires and other biomedical data. In the following three subsection three of these different self management programs will be described: Vital voor COPD-Astma of VitalHeatlh Software [Sof09], the Intel Health Guide for COPD [Hea09a] [Hea09b] and InfoDoc of the Health Agentcy [Age09].

2.1.1 Vital voor COPD-Astma

The Vital for COPD-Astma program is developed by VitalHealth Software. The origin VitalHealth is a cooperation of Mayo Clinic from the US and the Noaber Foundation from the Netherlands. It was launched on 8 November 2007. Vital for COPD-Astma is a web-based software platform to make disease management possible for caregivers and patients. VitalHealth supports patients involvement with the disease management. Patients can enter information about lung functioning, coughing, blood pressure or general well being, all from their homes on a website. With this information health professionals get a better

insight in their patients. Entered information will be checked automatically by the system.

The COPD-Astma module of VitalHealth is based on the most up-to-date guidelines of the Nederlands Huisartsen Genootschap (NHG) and the GOLD guidelines. Based on these guidelines the solution generates relevant checkpoints, recommended actions, treatment advice and referral advice. It also alerts caregivers about results that exeed the norm.

Vital for COPD-Astma supports different disciplines in the care process. Physician, lung specialist, nurse or nurse practitioner, physiotherapist and dietician are supported. These professionals can capture information that is relevant to the treatment of a patient such as, FEV1, FVC, GOLD status and the status related to nutrition, muscle strength, cardiac functioning and overall health. Next to these objective values the system contains some validated questionnaires. The patient can enter lung function values by hand or automatically with a special digital spirometer. All the collected data can be made visible in a report and can be compared to other reports from the past.

The system can identify potential problem in an early stage. Based on a personal model of the patient, the system can recognize out of range test results and alert the caregivers and patient. This makes it possible to detect or prevent exacerbations in an early stage.

To participate in the Viral for COPD-Astma program, the patients are required to have a personal computer with Internet connection. A screen shot of the patient web portal can be found in figure 2.1

2.1.2 Intel Health Guide

The Intel Health Guide PHS6000 is developed by the Intel Digital Health Group. This group is working on research-based innovation for health care. The PHS6000 is the patients station and located at the patients home. The Health Guide supports different disease management programs for different diseases, like COPD and heart diseases. The Health guide allows patients to participate in health sessions. These sessions are personalized for his situation. A health session consist of a measurement of the vital signs, a response to health assessment questions, receive educational information and motivational messages and complete surveys. After the completion of such a session the results will be automatically available for the health professionals. The vital signs can be measured with special devices which can be connected with the patients station. Examples of these measurements are weight scales, peak flow meters and blood pressure monitors. The Health Guide also supports two way video calls between the patient and health professional, a multimedia educational library with video, audio and text about their disease and treatment. The patient device can make appointments with health professionals. Furthermore the Intel Health Guide supports an agenda, audio and visual notifications, reminders and a visual overview of historical vital sign measurements.

The user interface of the device is a result of a patient centered design and focused on the needs of the elderly. The device itself is designed to fit in the home environment: it is a 10.4 inch touch-screen and the possibility of audio and video playback. The interface itself consist of large and strategical placed buttons. The icons are limited and tested for usability.

Figure 2.1: Patient web portal of Vital for COPD

At this moment, the Intel Health Guide is tested in pilots in the UK and the Netherlands.

Figure 2.2: Intels Health Guide

2.1.3 InfoDoc

InfoDoc is developed by The Health Agency. InfoDoc uses Internet-based technology to deliver specific personalized health advice information to patients and their health professionals. InfoDoc consists of different modules;

- Inside the hospital.
  InfoDoc can offer patients personalized information while they are in hospital via in bed systems. Special applications make it possible for patients to enter for example blood and glucose levels, blood pressure diaries and other relevant data dependent to the disease on the patient. Patients can also complete the anamnese form before the first consult.

- Chain care.
  InfoDoc can be used outside the hospital. Other health professionals involved by the follow up care can use InfoDoc by their treatment.

- Home care.
  Patients can receive personalized information via digital television.

- Gaming.
  Young chronic patients become conscious of their diabetes by playing a game. They learn more about their disease and the treatment. The game

is connected to a treatment algorithm. An example of such a game is GRIP. GRIP is an interactive web based self management program for children between seven and eleven years old and their parents. By playing the game they become director of their own virtual life. The game provides personalized information to the patient. The progress of the game is influenced by their behavior such as nutrition and medication.

- Questionnaires.
  Patients can complete web based questionnaires.

- Self management systems.
  Patients and caregivers can enter health data on a personal website. These data can be used by treatment algorithms and advise patients and caregivers in the treatment of their disease.

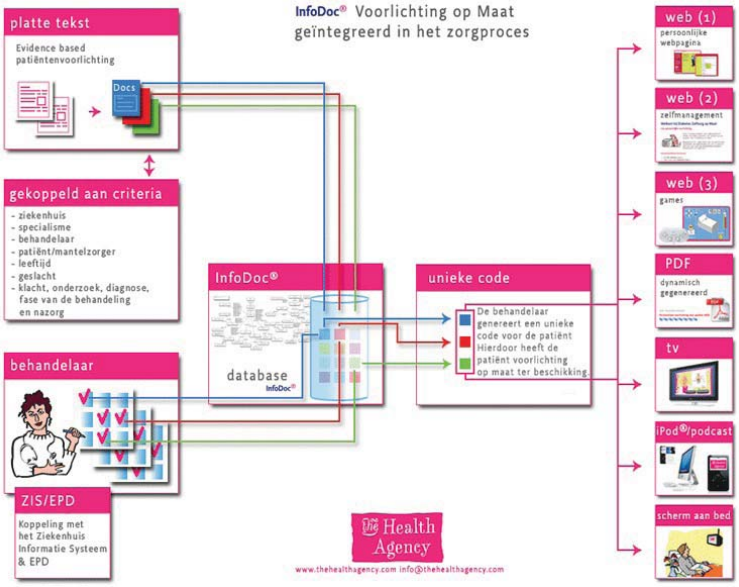


Figure 2.3: Overview of InfoDoc

InfoDoc stores a profile of every patient in the system. Based on this profile the system can provide personalized information to the patient. Information can be provided to the patients by using different output channels such as websites, games and television. For the complete overview of possibilities and functionalities of InfoDoc see figure 2.3.

2.1.4 Conclusion

This section discussed three different state of the art telehealth systems. These systems have some similarity in the fact that they all provide a sort of self management program based on the input of the users. However, they differ in the way of communicating with the patient. The Intel Health Guide is a device designed particularly for telehealth. It uses a touchscreen and a special developed

user interface with special attention for the elderly and usability. Patients and health professionals were involved by the development of the system (patient centered design). Patients can communicate with their health professionals by making video calls, search for background information of their disease and can enter medical data in by hand and through special devices that can be connected to the Health Guide.

Vital Health is a web portal on the Internet. Patients can access the portal on a computer with an Internet browser. Vital Health contains different programs for different diseases. The interface is not designed for a special user group. InfoDoc has as goal to inform patients in hospital and during the treatment. InfoDoc can communicate with patients by many modalities. Patients can access information for example by mobile phone, Internet and games.

The COPD home interaction device will be most similar to the Intel Health Guide. With the special device and the patient centered design approach the Intel Health Guide has two characteristics that plays an important role in the development of the COPD home interaction device.

2.2 Characteristics of the target group

This section will discuss some design guidelines and priciples that are important for the design of the user interface of the COPD home interaction device. The guidelines can be divided into guidelines for the target group (elderly and digital illiterates) and guidelines for the appropriate hardware.

2.2.1 Designing for elderly people

The average age of COPD patients with a COPD Gold II and III is above 50 years. This will have some consequences for the design of a user interface, because of aging related (functional) impairments. Typical limitations that often arise during the normal aging process are vision decline, hearing loss, motor skill diminishment and cognition effects [Arc08].

Vision decline

The declining vision conditions that most older adults naturally experience result in a variety of vision changes. These changes can have influence on the way people use a computer. Vision changes can be divided into four main categories:

- Decreasing ability to focus on near tasks. This also includes a computer screen.
- Pupil shrinkage. Pupil shrinking results in the need for more light.
- Contrast sensitivity. The contrast sensitivity will decrease up to 83% at the age of 83.
- Reduction in visual field. People become presbyopia.

Beside these general age related vision change, elderly typically suffer some common eye diseases [Arc08].

Hearing loss

The majority of people who have hearing loss are older people. Older people have increasing inability to hear high pitched sounds. The Royal National Institute for Deaf People(RNID) estimates for the UK that at around the age of 50 the proportion of deaf people begins to increase sharply and 55% of people over 60 are deaf or hard of hearing [Arc08].

Motor skill

Difficulty with coordination and movements and trembling in the hands and arms are age-related troubles.

Cognition effects

Many elderly do suffer Mild Cognitive Impairment or subjective memory loss. The complaints associated with MCI include:

- trouble remembering the names of people they met recently.
- trouble remembering the flow of a conversation.
- an increased tendency to misplace things.

These complaints are likely to also impact on the use of computers. Other forms of cognitive diminishment may also arise with aging, for example the effects of a stroke can result in conditions similar to intellectual impairment.

2.2.2 Digital illiterates

Digital illiteracy can be a problem under COPD patients. Digital illiteracy involves the lack of use of Information Communication Technology (ICT) for work, leisure and communication. The lack of usage of ICT is supported by a lack of digital skills (digital skill are the use of computers to retrieve, assess, store, produce, present and exchange information and to communicate and participate via the Internet) [Dem07]. Around the turn of the century digital illiteracy or the 'digital divide' was seen as a problem of having access to a personal computer and the Internet [vD07]. Nowadays the possession of ICT of Dutch households is the highest in the world. 92% of the Dutch population have access to a personal computer or laptop [CBS08]. In spite of this high percentage of ICT possession in the Netherlands, 13% of the people in the Netherlands have never used a computer and 26% do not regularly use the Internet (See figure 2.4) Not having access to (physical) ICT is not a the only condition for digital illiteracy. Van Dijk [vD08] distinguishes four kinds of access.

1 Motivation (psychological access)

2 Possession (material access)

3 Digital skills (skills access)

4 Usage opportunities (usage access)

Motivation is the first step to access ICT. The reason of a lack of motivation can vary from not willing to use a computer to a total fear for computers. Through the spread of information technology in the society the fear for computers is decreasing. Possession is about the material access of ICT, like computer hardware, Internet subscriptions and computer software. When people have the motivation and material access to use ICT, they have to learn to deal with the hard- and software. They have to learn digital skills to use ICT. Figure 2.5 gives an overview of the relation between education, age, gender, income and digital skills. From this figure can be concluded that low educated older people are the group with less digitall skills. The actual usage of ICT can be divided into the duration and the frequency of the actual usage.

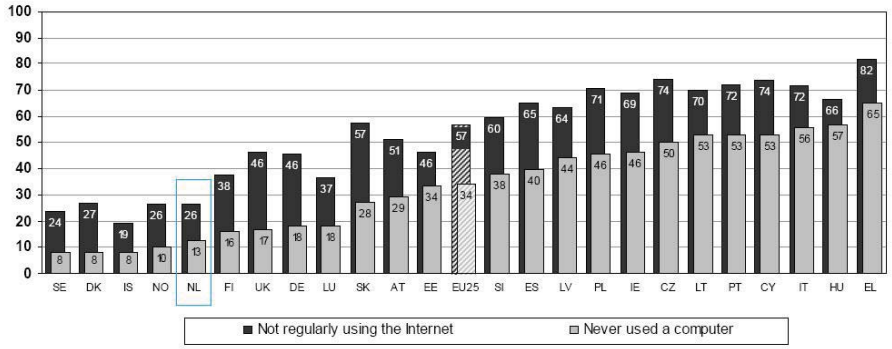


Figure 2.4: Percentages of individuals not using computer and the Internet in the EU. From: Eurostat

	NO OR VERY FEW SKILLS Score 1,0 – 2,0	REASONABLE SKILLS Score 2,1 – 3,5	GOOD SKILLS Score 3,6 – 5,0
ALL	36	52	12
AGE			
18-34 years	27	56	17
35-49 years	37	54	9
50-64 years	48	46	6
65 +	67	31	2
GENDER			
Male	28	55	17
Female	45	49	6
EDUCATION			
Low education	69	25	6
Low middle	49	46	5
High middle	30	58	12
High education	27	55	18

Score on 10 applications: Windows, word processing in DOS and Windows, spreadsheets, drawing/graphics, working with key boards, Internet, programming, e-mail and statistical programmes

Figure 2.5: Relation between education, age, gender, income and digital skills. Numbers are percentages. From: SCP

2.2.3 Design guidelines and principles for elderly people

The typical limitations that often arise during the normal aging process discussed in the previous section can have influence the way people use a computer. When designing user interfaces for elderly people these limitations should be taken into account. Kurniawan and Zaphiris developed a set of research-derived aging-centered Web design guidelines [ZKG07]. These guidelines can also be applied on other user interfaces.

- Older adult should not be expected to double click.
- Graphics should be relevant and not for decoration. No animation should be presented.
- Icons must be simple and meaningful.
- Do not use a deep hierarchy and group information into meaningful categories.
- Avoid scroll bars.
- Language should be simple and clear.
- Avoid irrelevant information on the screen.
- Information should be concentrated mainly in the center.
- Screen layout, navigation and terminology used should be simple, clear and consistent.
- Colors should be used conservatively.
- Background screens should not be pure white or change rapidly in brightness between screens. Also, a high contrast between the foreground and the background should be avoided.
- Use san serif type font of 12-14 point size. Avoid other fancy font types.
- Support user control and freedom.

2.3 Input devices

In general, input device can be divided into two different groups keyboards/keypads/buttons and pointing devices. The first category contains a variety of keyboards and keypads. Individual buttons are also used extensively, especially in embedded computer systems.

Pointing devices can be divided into direct and indirect devices. Direct pointing devices are touch screens and stylus-based systems. Examples of indirect pointing devices are the mouse, trackball and joystick. The standard input devices of many computer systems today is a keyboard and a mouse.

The input device for the COPD home interaction device determines (in main lines) the intuitive use of the dairy. Choosing the right input device is important. The following section gives an overview of possible input devices with their strong and weak points as stated by [SJWM05].

2.3.1 Keyboards, keypads and buttons

Keyboards, keypads and buttons are discrete input devices. These input devices can enter individual items of information like characters and commands. The most famous example of a discrete input device is the QWERTY keyboard, which became an international standard in 1967. The layout of keyboards differ for other languages. Most of the time by simply adding some keys or changing the layout of the keyboards a little, for example the keyboard used for the French language with AZERTY layout and extra é-key. Sometimes a complete full keyboard is not necessary. Many everyday (mobile) devices, like mobile phones use a numeric keypad or small QWERTY keypad; an ATM uses individual keys and a numeric keypad. When choosing a keyboard, keypads or buttons as input device it is important to answer questions like What size do the keys need to be?, What shape should the keyboard have? and How robust should the keyboard be?

2.3.2 Pointing devices

Pointing devices are continuous input devices. Continuous input devices have great advantages for handling tasks that cannot be split into a number of discrete steps. Pointing devices can be divided into indirect and direct pointing devices.

- Indirect pointing devices

  Indirect pointing devices are pointing devices where users need an additional device to move the cursor on a screen. Examples of indirect pointing devices are mouses, joysticks, trackballs and tablets.

- Direct pointing devices

  With direct pointing devices no additional device is needed to navigate over the screen. Most of the time there is no cursor on the screen. Users give input by touching the screen with a finger or stylus. Examples are touch screens and pen systems.

2.3.3 Choosing input device

The choice of the most appropriate input device depends on the potential users of the system, the circumstances in which the system will be used and the tasks that will be executed with the system. Figure 2.6 provides an overview of some advantages and disadvantages of pointing devices. In figure 2.7 the results of a experiment by Baber [Bar97] can be found. On the x-axis different input devices can be found. On the y-axis the ranking of the devices can be found. Higher scores are better. Every input device is examined on accuracy, speed and user preference. In this case, speed refers to the cursor movement and data entry. Because the goal of this research is to develop a very easy to use version of the COPD dairy on the COPD home interaction device, the input device should be easy to learn, quick to use and preferred by users. Looking at the rows of "Hand-eye coordination", "Training requirement" and "Suitability for rapid pointing" in figure 2.6, the pointing devices touch screens and light pens are the best standard pointing devices. From figure 2.7 can be concluded that touch screens are the best pointing devices based on speed and preference.

The conclusion is, based on figures 2.6 and 2.7 that touch screens are easy to learn [SJWM05] and users prefer to work with touch screens as well. Because the goal of this research is to develop a very easy to use version of the COPD dairy on the COPD home interaction device, the best possible input device for the COPD dairy is a touch screen.

Advantages and Disadvantages of Standard Pointing Devices

	Touch Screen	Light Pen	Touch Tablet with Stylus or Puck	Graphics Tablet	Mouse	Track-Ball	Joystick
Hand–eye coordination	+	+	0	0	0	0	0
Training requirements	+	0	0	0	0	0	0
Ability to attend to display	+	0	+	0	0	+	+
Unobstructed view of display	–	–	+	+	+	+	+
Freedom from parallax problems	–	–	+	+	+	+	+
Flexibility of placement in workplace	–	–	+	0	0	+	+
Comfort in extended use	–	–	0	0	0	0	0
Capability to emulate other devices	0	0	+	+	0	0	0
Suitability for							
Rapid pointing	+	+	0	0	+	0	–
Accurate pointing	–	–	0	+	+	+	0
Pointing with confirmation	–	0	0	+	+	0	0
Drawing	–	0	–	+	0	–	–
Tracing	–	–	–	+	–	–	–
Continuous tracking, slow targets	0	0	+	+	+	+	0
Continuous tracking, fast targets	–	–	0	0	0	0	–
Alphanumeric data entry	0	–	–	0	–	–	–

+ = Advantage; 0 = Neutral; – = Disadvantage.

Figure 2.6: Advantages and disadvantages of standard input devices. From [Bar97]

2.3.4 Designing for touch screen

Because of the fact touch screens are operated with a stylus or a finger the design of the graphical user interface needs some special attention. General user interface design guidelines can also be applied to touch screen design. The interface has to be a simple point and click interface. Some issues which are more important when designing for touch screens are [Wal00]:

- Applications with a touch screen interface have to run in full screen mode.
- The size of buttons and the space between the buttons have to have a minimum size to secure finger input. The measurements of a button have to be at least two by two centimeters. Targets have to be large when designing for finger operated touch screens.
- Divide the screen in functional areas. Different areas have different functions. Use functional areas consistent. Use fixed areas for data display, input, buttons (especially keep the navigation buttons constant), and status display. This also applies for the other graphical user interface elements.

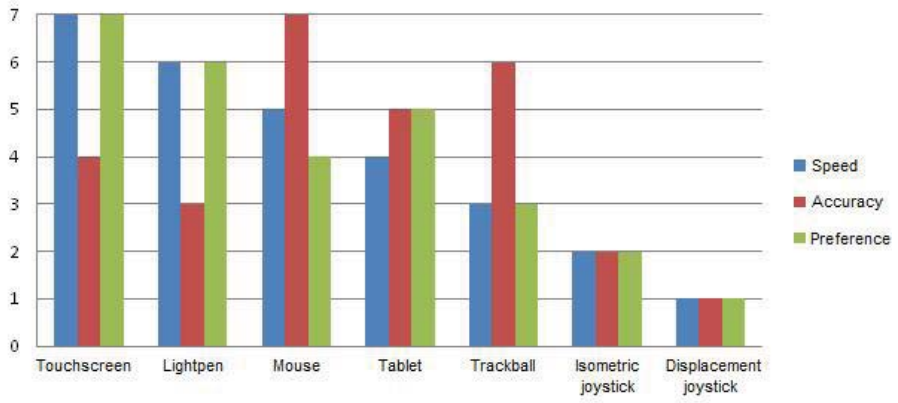


Figure 2.7: Comparison of pointing devices. Based on [Bar97]

- Elements on the screen have to be grouped. Methods that can be used are arrangement, frames, shape, foreground color, background color/texture, text size, text attributes.
- Do not use scrollable or multiple window interface.
- The input of values and characters can become tedious on touch screens. Possible interaction modes are; clicking on predefined values (options), clicking repeatedly on certain controls (e.g. to increment or decrement values), dragging sliders or similar controls, entering digits or numbers through a keypad or keyboard.
- Do not use dragging, double-clicks, scroll bars, drop down menus, multiple windows, or other elements that can confuse the common user and interfere with usability and efficiency.
- Keys for number input on the screen must be in the arrangement of telephone or numeric pad keypad.
- Buttons have to give some kind of feedback when they will be touched. Methods that can be used are:
  - Immediate feedback: Critical to reassure the user that their touch is registered.
  - Visual feedback: In response to button presses.
  - Auditory feedback: In response to button presses.
  - Screen changes: The display clears immediately and displays an hourglass while loading the next screen.
  - Digitized speech: Can help users through applications.

2.4 Conclusion

Section 2.1 gave an overview of three different state of the art telehealth systems. All the systems are designed in cooperation with health professionals and provide a sort of self management program. The way in which these three telehealth systems communicate with their users differ from a web based system to mobile phones and systems on a "patient centered designed" home device. The COPD home interaction device will be most similar to the system with the patient centered designed home device. In section 2.2 characteristics of the target group were discussed and design guidelines for these group were presented. The input device for the COPD home interaction device will be a touch screen. Section 2.3 discussed some advantages and disadvantages of input devices. Touch screens are easy to learn, quick in use and preferred by users. This makes the use of touch screens the best basis for a very easy to use COPD home interaction device. The guidelines presented in this chapter will be followed during the design of the two prototypes in chapter 4.

Chapter 3

Persuasive Technology

3.1 Persuasive Technology

Persuasive technology can be defined as any interactive computing system designed to change peoples attitudes or behaviors [Fog03] and can be useful to motivate COPD patients to complete their diary and change the patients attitudes to their disease. Traditional most computer systems are designed for handling large amounts of data, not to persuade. Today, more and more computer systems are taking different roles as persuaders. These roles were traditionally filled by teachers, coaches or doctors etcetera.

The first persuasive computer systems appeared in the 1970s and 1980s. These systems were designed to promote health and increase workplace productivity. Until the late 1990s the design and development of persuasive computer systems was limited. Most of the systems were focused on adolescent health issues and the treatment of psychological disorders.

With the rise of the Internet in the late 1990s the development of persuasive technologies became more general. Websites are the most common form of persuasive technology today. Beyond the web, persuasive technology can take many forms. These forms can vary from mobile phone to smart toothbrushes with timers. With the emergence of embedded computing, persuasive technology will become more diverse and more integrated into everyday life. Persuasive technology will become invisible. The use of persuasive technologies will also expand in the coming decade [Fog03]. In figure 3.1 the overlap of computer technology and persuasion is displayed.

Computer technologies can persuade in different ways like computers can have different functional roles. Computers can serve as a tool, they makes activities easier or more efficient. Computers can function as media, they can function as symbolic media (displaying text, graphics and icons) and sensory media (providing video and audio). A third possible role of a computer is the role as social actor. When people use interactive technology, they often respond to it as if it was a human being [RN96]. When designing a persuasive computer system, it is important to have the role of the system clear.

The use of computer systems as persuader have some advantages over human persuaders. Advantages of computer persuaders over human persuaders are listed below [Fog03].

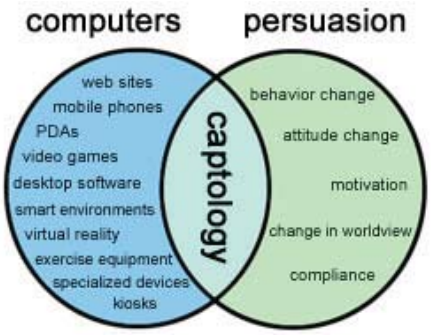


Figure 3.1: The overlap of computer technology and persuasion. From [Fog09]

- Are more persistent than human beings. An example of such a system is a speed warning function in cars. Every time the driver exceeds the maximum speed he gets a warning through a visual and audio signal.
- Offers greater anonymity. Computer technology can provide greater anonymity. People can be anonymous on the Internet and search for information. Anonymity overcomes social forces and can make it easier for people to change.
- Manages huge volumes of data. Computer systems are able to store, access and manipulate huge volumes of data by which they are able to present the right facts at the right time and can help to persuade more effectively than a human could.
- Uses many modalities to influence. Computers can present data in graphics, audio, video, animations, text and many more modalities. These modalities can also be combined for an optimal persuasive impact.
- Scales easily. For human persuaders it is difficult to reach millions of people. Persuasive technology (especially persuasive Internet technology) can reach a large group of people relatively easily.
- Goes where humans cannot go or may not be welcome. Computer systems can be ubiquitous and can be embedded in everyday objects and environments, such as inside clothes, in bathrooms and automotive systems for safety and eco-friendly behavior.
- Are available 24 hours, seven days a week. People can interact with computer systems 24 hours, seven days a week at the time they want the interaction instead of human persuaders.

3.1.1 Computers and social actors

Face to face interaction with a health provider is widely acknowledged to be the "golden standard" for providing health education and health behavior change [BG06]. A lot of research has been conducted into the automatic generation

Cue	Examples
Physical	Face, eyes, body, movement
Psychological	Preferences, humor, personality, feelings, empathy, Im sorry
Language	Interactive language use, spoken language, language recognition
Social dynamics	Turn taking, cooperation, praise for good work, answering questions, reciprocity
Social roles	Doctor, teammate, opponent, teacher, pet, guide

Table 3.1: Different types of social cues.

of static media to provide health communication to patients and consumers [dVB99]. The approaches are effective, but have some shortcomings. The media is static and cannot be rephrased. Because of this static media, there is a growing need for automated systems that can interview patients, take questionnaires and provide health education and behavior change using natural language dialog. As mentioned in the previous paragraph, computers can take the role as a social actor. A computer system which simulates the role of a health professional can take health dialog system a step closer to the "golden standard". A computer system that can take over the role of a health professional is a rational agent. Rational agents are computational artifacts designed to build and maintain long-term social-emotional relationships with users [BCCGH05]. Rational agents can use simulated face to face conversations as the primary communication medium and for applications in which repeated (daily) interaction over long time is required [BCCGH05]. Rational agents can have different social cues. Table 3.1 shows different social cues of a rational agent and possible examples. Rational agents can be purely software animated agents, but can also be embodied in different physical forms including robots, wearables and hand held computers. They can use spoken language and facial expressions or text for communication.

Bickmore et al. described in their research some principles for designing of rational agents for older adults. The overall goal in designing such systems is to make them continually engaging to use, so people want to keep using them over and over again. Other principles are the use of rational behavior. Rational behavior can be used by an agent in an attempt to manipulate and maintain the relationship with the user. Empathy is an important factor in establishing a working alliance, which is very import in systems developed for older adults because they are more reserved about some personal information.

Another crucial factor in a rational agent system is the memory of past interactions with the user. Examples are the remembering of the name of the user, favorite hobbies and some facts and results of the last interaction(s). Variability in agent behavior is also an import principle in rational agents design. People continuously change their language depending on context, mood or relationship with the listener. A rational agent should also present this kind of behavior. There are different techniques to build a dialog between the user and the system, the simplest is a linear script. A linear script exactly specifies the sequence of the dialog. Other systems are Pattern-response dialog systems, state-based dialog systems, plan-based systems.

The basic version of the COPD dairy is a simple question - answer interface.

The possible answers are static. An approach for the persuasive version of the dairy can be the design of a rational agent. Questions can be asked by a character on the screen. People react the same on interactive media as on real social characters. The formulation of the questions will be more social and will be asked in the form of a chat. In this chat, the history of the dairy can be used to make it more personal. The design of the prototype of the persuasive diary will be discussed in chapter 4.

3.1.2 Example: Persuading users through counseling dialog with a conversational agent

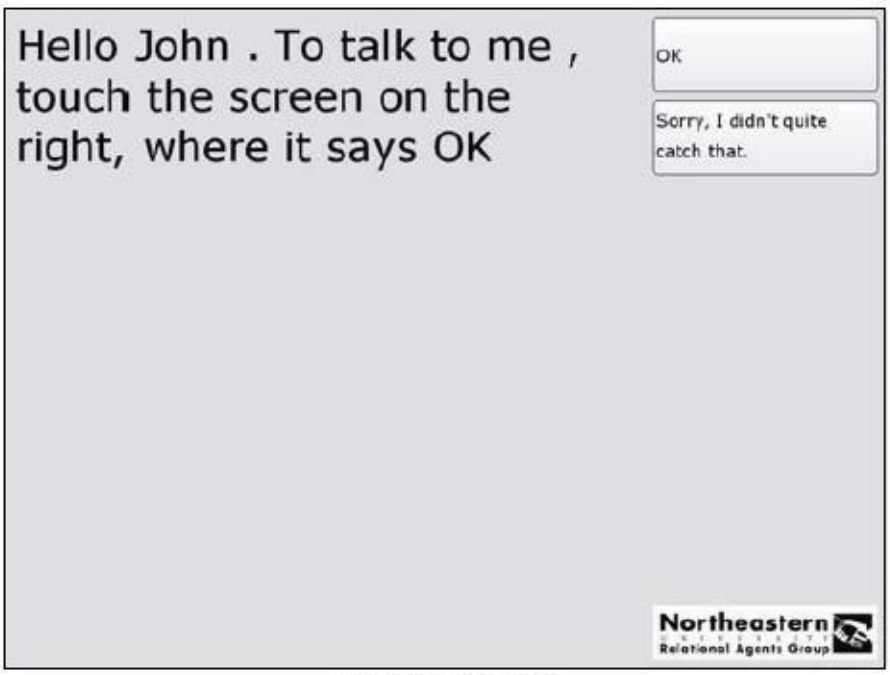
Schulman and Bickmore [SB09] studied the effect of a computer agent to engage a user in a persuasive dialog on attitudes toward regular exercise. To investigate the effect of the computer agent they designed an experiment. The goal was to investigate how closely the simulated human conversation was using an embodied conversational agent (ECA) or a text-only agent. The a second experiment an agent was used that attempted to build a relationship with the user through social dialog. In figure 3.2 the ECA and the text-only agent can be found. The participants of the experiment demonstrated a significant increase in positive attitudes following the persuasive dialog. This change was significantly smaller when the agent used a social dialog. Patients perceptions of the dialog were most positive for an ECA with social dialog or a text-only agent without social dialog.

Schulman and Bickmore concluded their experiment with the remark that a conversational interface is a useful design choice for persuasive technology. But there is a difference between short-term compliance and long-term adherence. They mentioned that the use of a social dialog may be appropriated only in long-term interventions. Successful use of social social dialog and other relationship-building tactics in persuasive technology may require an interface designed to replicate face-to-face conversations more closely.

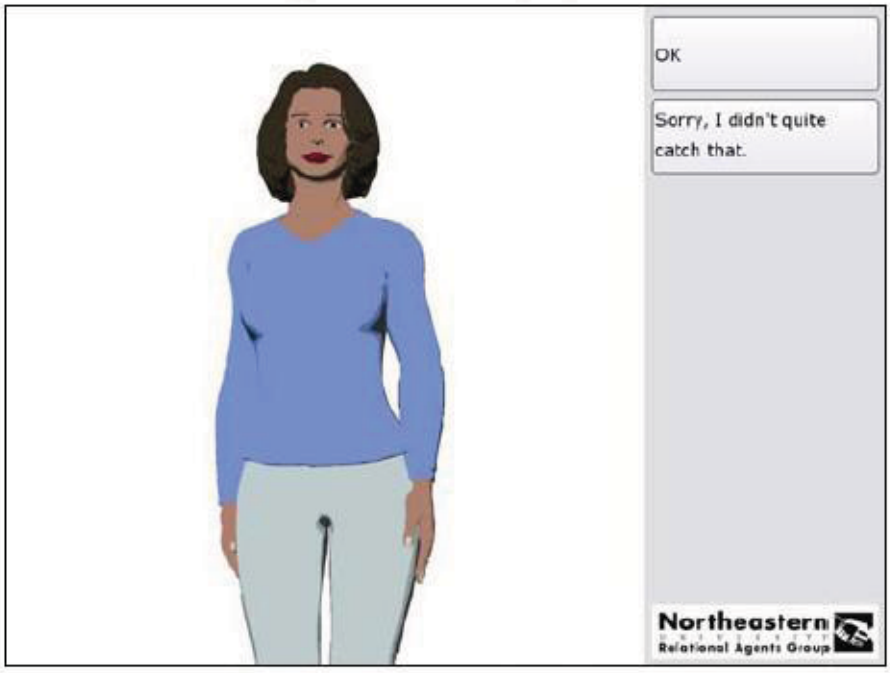
3.1.3 Example: MIT FitTrack

The FitTrack system was developed to investigate the ability of an embodied conversational agent to establish and maintain a long-term therapeutic alliance with users, and to determine if these relationships could be used to increase the efficacy of health communication and health behavior change programs delivered by the agent [BG06]. In figure 3.3 a screen shot of the FitTrack system can be found. The name of the character on the screen is Laura. Laura is a physical exercise advisor who tries to motivate people to obtain at least the minimum level of physical activity recommended the public health guidelines during a two month period of time. Input by the user is given by predefined multiple choice input. Laura uses synthesized speech and synchronized nonverbal conversational behavior as output to the user. The system was designed to run on normal standard personal computers so that participants of the program can interact with the system on a daily basis at home. This interaction takes approximately ten minutes.

The design of the system was based on studies of interaction between professional exercise trainers and clients, surveys of representative participants, literature reviews of therapist-client and physician-client interactions and health



Text-only agent



Embodied conversational agent

Figure 3.2: The text-only agent and embodied conversational agent (ECA). From [SB09]

behavior change methodology. The technical design of the system was a client-server architecture. The client was running on the participants' computer and was as lightweight as possible. The agent uses speech synthesis and synchronized nonverbal behavior. The nonverbal behavior includes hand gestures, body postures, gazing, eyebrow movements, nods and four different facial expressions. The dialogs are scripted and user input is stored in a database, which makes it possible to recall user input from the past and refer back to this in conversations.

FitTrack is successfully tested on two clinical trails with different populations. One group consists of MIT students, the other group consists of an older adult population. For the trail with the older adult population FitTrack was adapted because of the age of the participants, 65 years and older and the lack of previous computer experience. The system was redesigned to be easy to use with a very consistent and intuitive user interface. The differences of this redesigned version of FitTrack with regard to the original is the choice of the input device, a 17" touch screen instead of a normal monitor with keyboard and mouse, the appearance of Laura was enlarged and filled most of the screen to overcome visual impairments and the scrolling list at the bottom of the screen is replaced by a non scrollable list of large buttons with enlarged text at the right of the screen. Laura is replaced by graphs or other educational content on the screen when necessary in order to maintain large font sizes. For the daily entering of the pedometer information, a numeric keypad appeared on the screen in the same area as all other inputs. The adapted version of FitTrack can be found in figure 3.4.

3.2 Long term human-computer relationship

Designing for long-term interaction is considered to be a problem. In one of the experiments with the FitTrack system [BP05], 101 users interact daily during a month with the FitTrack system. Another group of users also used the system on daily basis during one month. This system was equivalent to the task-oriented agent system, but without the social-emotional and relationship-building skills. The results of this experiment shows that, even after a one month during interaction, the FitTrack system with the social-emotional and relationship-building skills, compared to the system without these skills, was respected more, liked more and trusted more. Another result was the fact that the users expressed a significant greater desire to continue working with the rational agent version of FitTrack after the experiment.

3.2.1 Example: Realistic agent in an advice-giving task

The aim of this study by Berry et al. [BBdR05] was to evaluate interaction with an embodied conversational agent named GRETA. GRETA had to present a healthy eating message. The study had to answer two questions: What are the benefits of presenting information via an animated agent in a persuasion task and how important are emotional expressions that are added to the message? To answer these questions different versions of the healthy eating message was created. One was presented via GRETA, one via a matched human actor, one by GRETAs voice only and one via text only. Further more versions of GRETA were created which displayed emotional facial expressions. These dif-

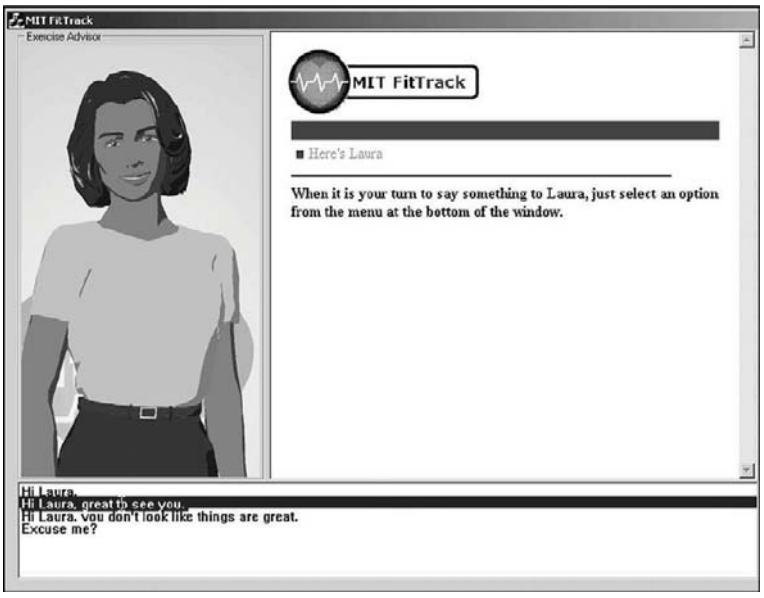


Figure 3.3: Screenshot of the MIT FitTrack

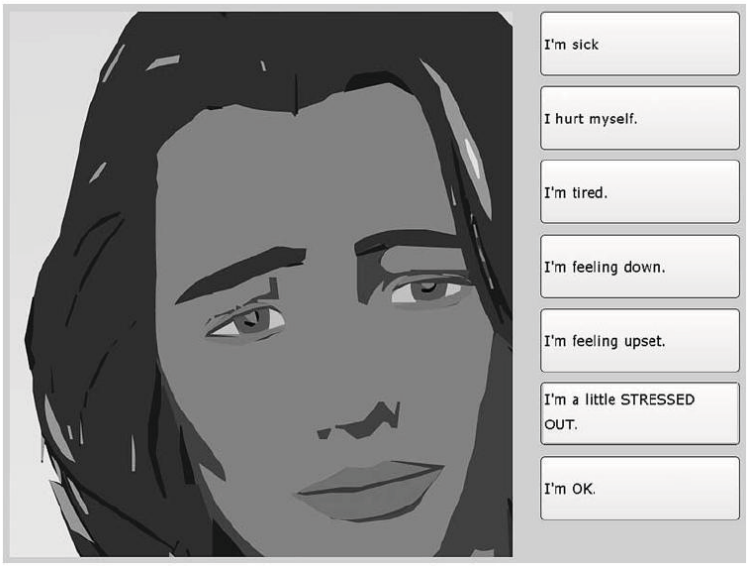


Figure 3.4: Screenshot of the MIT FitTrack

Figure 3.5: Screenshot PDA-based health advisor.

ferent versions of the message were tested during a user experiment with 144 participants. The results of these experiments were that GRETA (the embodied conversational agent) received the highest ratings for helpfulness and likability, except from the human actor. Presenting the message via GRETA led to the poorest memory performance among users. The memory effect disappeared by adding emotional expressions that were consistent with the verbal message.

3.2.2 Example: Persuasion, Task interruption and health regimen adherence

During this study [BMCB07] a mobile, PDA-based health advisor was developed that is able to provide real-time reminders and conversational counseling to help users change their health behavior, see figure 3.5. The system is used in an experiment to explore different interruption modalities and strategies that can be used by the advisor to persuade users to perform a healthy behavior while they are working. This experiment was a short term experiment. Results of this study can be used in a long term experiment. The experiment evaluated the relationship between politeness of interruption and compliance holding as many factors as constant as possible. The authors hypothesize a curvilinear relationship between the perceived politeness of interruption strategies and health behavior adherence. The result of the experiment supports the hypothesis regarding the relationship and compliance. This study indicates that an appropriate level of politeness must be used when interrupting and persuading users in order to maximize long-term effectiveness.

3.2.3 Conclusion

Persuasive technology can be defined as any interactive computer system designed to change peoples attitude or behavior [Fog03]. Computer systems can persuade in different ways and can have many advantages over human persuaders. One way computers can persuade is that it can take the role of a social actor (for example a doctor). A social actor can be a rational agent. A rational agent is designed to build and maintain long-term social-emotional relationships with users. Experiments with the FitTrack system and GRETA shows a greater desire to continue working with such a system. Users liked such a system more, respected it more and trusted it more [SB09] and [BBdR05]. The design of the prototype of the persuasive diary will be a design with a rational agent. In the next chapter the design of the prototype of the persuasive diary will be discussed in more detail.

Chapter 4

Design of the COPD diary

In this chapter the choice of the COPD home interaction device, specifications of the requirements and the design of the prototypes will be described. The choice of the COPD home interaction device is based on the results of chapter 2. The requirements of the system are formulated based on interviews with health professionals and patients, workshops with project members, guidelines from chapter 2 and the COPD dot COM project proposal. The fundamentals of the design of these prototypes can be found in the previous chapters. The design can be divided into two parts. First there is the user interface of the diary with which the users will interact with the COPD home interaction device. Second there is a simple application behind the user interface. In the following sections the design of the system and the design of the user interface will be discussed.

4.1 COPE diary

The COPD diary is developed and tested during the COPE II study discussed in section 1.4.2. The diary consists of ten questions and should be completed every day. In figure 1.2 the ten questions can be found. In the best case scenario, that is when a patient did not have more complaints than normal in the past 24 hours, the patient only has to answer question one with "Nee". When he did have more complains than normal, all the other question have to be answered. All question are multiple choice question and are on basis of the normal complains of a patient. If a patient is always short of breath than this is a normal situation for the patient.

When the patient is finished completing the diary he has to look at the scheme at the back of the diary to see if and which medicine he has to take. This scheme can be found in figure 1.3. When a patient did have more complaints for two days in a row and answered two questions from block two or one question from block two and at least one question from block three with a answer highlighted in grey (see scheme in figure 1.3), they have to start with prednisolon. When the complaints did not decline during two days, the patient also had to take antibiotic.

4.2 Requirements

In section 1.10 the star life cycle model is described. One part of the model is requirement specification. Requirements can be found through user studies like interviews, discussions with parties in question and looking at interface standards [SJWM05]. Section 2 discussed background information about the COPD patients and interface design guidelines from which requirements can be specified. Other requirements will be specified from interviews with health professionals and workshops with project partners and the COPE diary (see section 1.4)

Requirements can be divided into[RR06]:

1 Functional requirements;
Functional requirements specify the functions of the system: how it records, computes, transforms, transmits and output data.

2 Non-functional requirements;
Non-function requirements are requirements that judge operations of the system, rather than specific behaviors of the system. In the case of the COPD diary, important non functional requirements are requirements about the hardware and the usability. Usability requirements are requirements that make the interface usable and ergonomically acceptable to its primary users. Usability requirements contains ease of use requirements (efficiency of use, ease of remembering, overall satisfaction), learning requirements and accessibility requirements.

3 Context requirements User requirements specify criteria to the context of the system in which the system will be used.

Functional requirements

FR1 The COPD diary should support all the questions from the COPE diary.
All the questions of the COPE diary discussed in section 4.1 should be translated into the digital version of the diary.

FR2 The COPD diary should support the input of lung volume.
Patients have to enter their lung volume at least on time per week. The lung volume is measured using a peakflow meter and quantified in liters.

FR3 The COPD diary should give advice about self management of medication.
The triage protocol from figure 1.3 should be implemented in the diary.

FR4 The COPD diary should record the diary data of a patient.
Answers to the questions of the COPE diary should be stored per day and patient in a database.

FR5 The COPD diary should record the date and time of medication advices.
When the system gives an advice to start some medication, this advice should be stored in the database.

Extra functional requirements for the persuasive diary

eFR1 The COPD diary should show the head of the rational agent.

eFR2 The COPD diary should use a dialog form by text.

eFR3 The rational agent should react on the input of the patient.

eFR4 The COPD diary should remember the name of the patient.

eFR5 The COPD diary should remember the number of complaint-free days.

eFR6 The rational agent should reward the user when the diary is completed.

Non-functional requirements

NFR1 The COPD home interaction device should be a touch screen device.

NFR2 The user should not double click.

NFR3 The diary should be designed for a resolution of 1366 by 768 pixels.

NFR4 Information on the screen should be concentrated in the center.

NFR5 Screen layout, navigation and terminology used should be consistent.

NFR6 The type font used in the diary should be at least 14 point size.

NFR7 The type font used in the diary should be clear.

NFR8 Buttons on the screen should be at least two by two centimeters.

NFR9 Buttons should give some feedback when touched.

NFR10 The system should provide an indication of progress.

NFR11 Number input on the screen must be arranged by a phone or numeric keypad.

NFR12 The screen of the diary should be divided into functional areas. These areas should be used consistently.

NFR13 Input of values should be done by clicking repeatedly on certain controls.

NFR14 The completion of the diary should take one click in case of no worsening of complaints.

NFR15 The graphical design should not contain unnecessary items.

NFR16 The training to use the system should be half a hour.

NFR17 Language of the system should be simple and clear.

NFR18 Background of the system should not be purely white.

NFR19 The COPD diary should present the questions in text.

Context requirements

CR1 The COPD home interaction device will be placed in the home environment of the patient.

CR2 An Internet connection should be available.

4.3 The COPD home interaction device

The chosen COPD home interaction device will be the Asus EeeTop. The EeeTop is a all-in-one computer with a touch screen. This device meets the requirements for the device from section 4.2 of the use of a touch screen and does not look like a normal computer. The Eeetop is based on Intels Atom platform for economical power consumption and runs on Windows XP Home for nettops. The screen has a size of 15.6" with a resolution of 1366 by 768 pixels. The device contains six USB ports, a LAN connection and a wireless network card. It is delivered with a mouse and keyboard, but can be completely controlled by the use of the touch screen. In figure 4.1 a picture of the device can be found.

Figure 4.1: The Asus EeeTop.

4.4 System

The COPD diary will be one of the modules of the COPD home interaction device. The COPD home interaction device will be part of the COPD dot COM architecture. In this architecture data of different sources will be available for different viewers. Health professionals and patients can complete and access these data. These data can be located in the 'Ziekenhuis Informatie Systeem' (ZIS), the 'Elektonisch Patienten Dossier' (EPD) and on the COPD home interaction device. The architecture of COPD dot COM was in development at the start of this project. The architecture was not availible for the COPD diary. To overcome this problem the COPD diary system will use a local database. The

database contains necessary information from the diary and input given by the users.

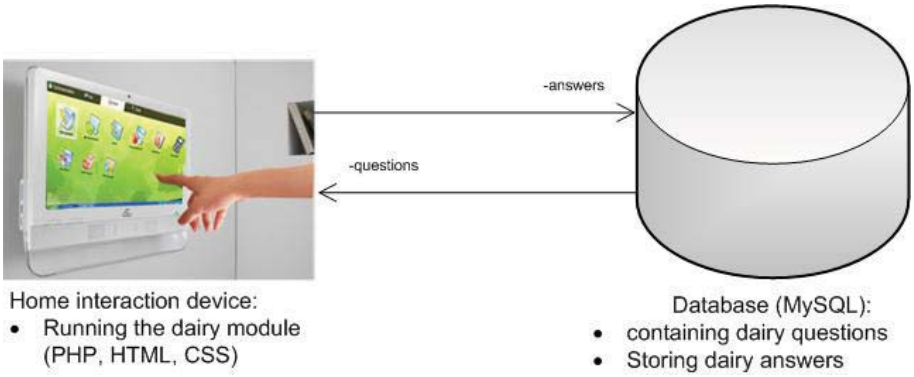


Figure 4.2: Overview of the diary system.

The diary is developed using MySQL, PHP, HTML and CSS. The MySQL database contains the questions of the COPD diary and stores the answers of the patients. PHP is used to process the data and the communication between the diary and the database. HTML and CSS are for the design of the user interface. Figure 4.2 gives an overview of the system.

4.5 User interface

Patients can complete the diary using the user interface of the diary. On basis of the guidelines from chapter 2 and the requirements from 4.2 the user interface of the diary is designed and developed. In this section the design and development of the user interface will be discussed. The first step is the conceptual design of the interface. The conceptual design is a first attempt of a translation of the requirements and the COPE diary to a diary on the COPD home interaction device. The final design section will describe the final design of the interface of the diary.

4.5.1 Conceptual design

The screen of the COPD home interaction device is a wide screen. The first drafts of the interface was designed in the width of the screen because of the available screen space. The first drafts of the interface can be found in figure 4.3 and 4.4. All other questions of the diary are represented in the same format.

The design shown in figure 4.3 and 4.4 meets the non functional requirements 2, 3, 4, 6, 7, 8, 10, 17 and 18 of section 4.2. The answers are single click buttons (2). The dimension of the screen is 1366 by 768 pixels(3). The information on the screen is concentrated in the center and the screen is divided into consistent functional areas(4 and 12), questions, answer buttons and the progress bar are located on different areas on the screen and will be at the same location. The type font used in the design is Calibri with size 13,5 (6 and 7). Calibri is the new standard font of Microsoft Windows Vista, Windows 7 and Office 2007 and is an

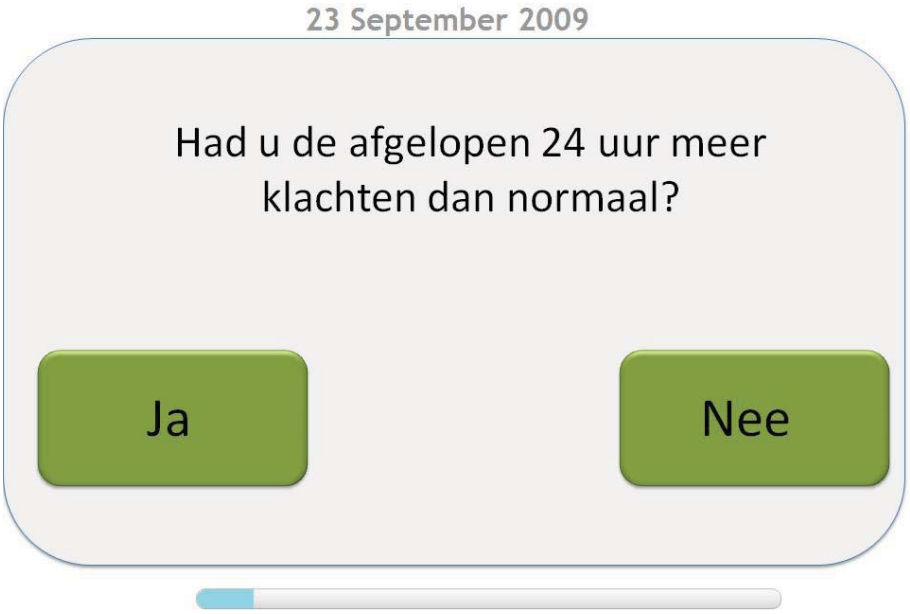


Figure 4.3: First screen designs of the diary interface.

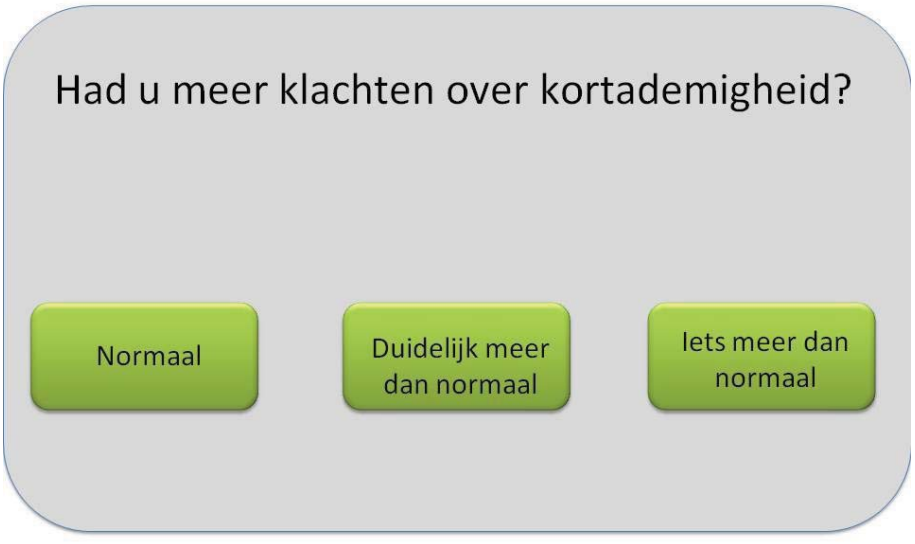


Figure 4.4: First screen designs of the diary interface.

award winning font [Clu09]. The buttons have a dimension of 165 by 335 pixels (8). A progress bar in available on the screen for giving feedback about the progress (10). All the items on the screen are necessary to complete the diary (Questions, answers and date) or meet one of the requirements (progress bar). The language used in the design is the same as the language of the paper version of the COPE diary (17). The background is light gray (18). Other requirements are related to interaction with the system and could not be designed on paper. entering of the lung capacity two different methods were developed. The lung capacity is measured in liters, have one digit before the comma and two digits after the comma. These methods are based on the guidelines from section 2.3.4. The first method uses a on-screen keypad for completing the long capacity into fields on the screen. The other method uses controls to manage each field, Figures 4.5 and 4.6 show the two different methods. The three different fields for entering the lung capacity help the user the complete the lung capacity in a correct notation.

Figure 4.5: Controls to enter lung capacity.

These conceptual designs are evaluated with ICT experts, medical experts and usability expert. An interactive version of the normal prototype was demonstrated during a workshop of the COPD.com project with ICT and medical experts. During the workshop the first screen design of the persuasive version was shown. This screen shot can be found in figure 4.7.

The first prototypes exist of all the COPE diary questions and the lung capacity question. The persuasive prototype uses a scripted dialog. The dialog used in the persuasive prototype is inspired by observations of the consultation of patients with a pneumonologist during a in-house day at the hospital in Enschede. A description of such a consult can be found in appendix D. This dialog will be generated dependent on the answers given by the patient. The database contains different variations of the diary questions. The formulation

Figure 4.6: On screen keypad for completing lung capacity.

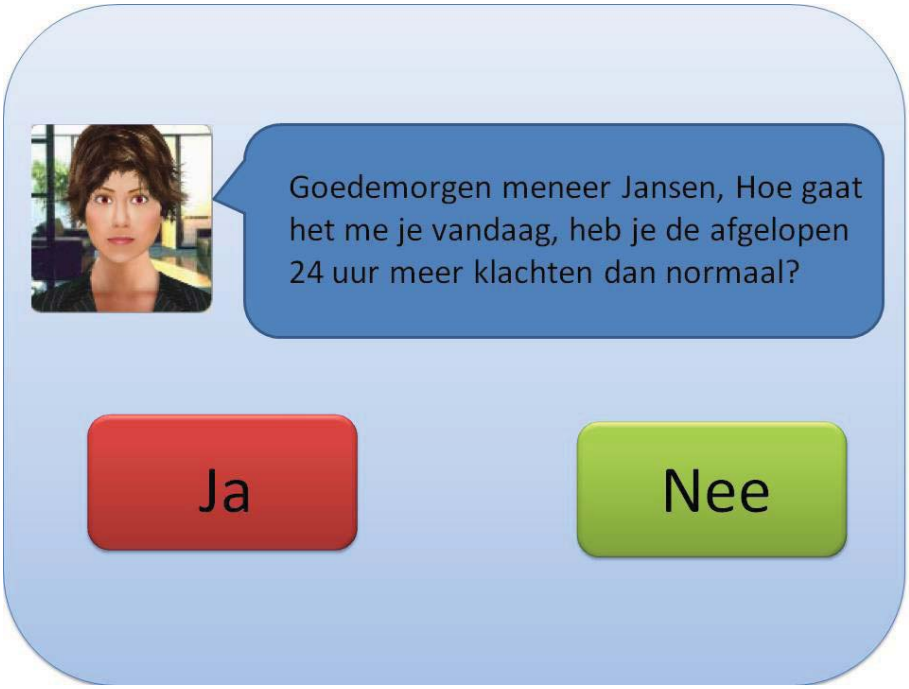


Figure 4.7: First screen design of the persuasive version of the diary interface.

of the question is dependent on the answer given by the patient and will be randomly selected from the database. The answer of the previous question can be randomly used in the next question. The output of the agent is text. The text is presented on the screen and placed in a text balloon, see also figure 4.7.

For the design of the agent a male character is chosen. From Fogg [Fog03] it is known that simply having physical characteristics is enough for a technology to convey social presence. He suggests that a visually more attractive computer technology is likely to be more persuasive as well. For the design of the character on the screen of the COPD diary is chosen for a more reserved character. This because of the medical nature of the diary.

The expression of the rational agent will also be influenced by the answers of the patient. Dependent on the answer (normal complaints, some more complaints or obviously more complaints) the agent will react with a smile, neutral or questionable expression. The different expressions can be found in figure 4.8. The expressions of the character are also considerate of nature because of the medical nature of the diary. The dialog will also include the name of the patient and the number of complaint-free days. At the end of the interaction, when the patient is finished completing the diary, the agent gives a fact of the day and greets the patient to bring the interaction to an end. These two prototypes were evaluated with two COPD patients, ICT, medical and usability experts

Figure 4.8: Expressions of the character; questionable, neutral and smile.

Comments and recommendations from these evaluations with and COPD patients can be found in the list below.

- Reformulation of the questions of the COPE diary.
- Gray background color was not preferred.
- The use of controls for entering lung capacity was preferred.
- No possibility to go back to the previous question(s).
- Approaching patient by first name is inconvenient.
- Patients had no preference for a special character as agent.
- Both prototypes are very easy to use.

These comments and recommendations was used to redesign the prototypes to a final prototypes of the diary which was used in a larger user evaluation. The redesign will be discussed in the next section.

4.5.2 Final design

The screen design of the COPD diary is developed in HTML and CSS, which makes it possible to quickly design and layout the screen layout. The main screen of the system is an overview of the available modules on the home interaction device. The final designs of the two prototypes of the diary are based on the conceptual design and results of the evaluation of the earlier designs from section 4.5.1. Figure 4.9 shows a picture of the COPD home interaction device in action.

Figure 4.9: The COPD home interaction device in action.

The medical experts mentioned that the questions of the diary seem a little strange when they are presented one by one on the screen. The questions are rephrased without changing the purpose of it. The gray background will be replaced by a light green background as well as green buttons. Green is seen as a calm and close to nature color [SJWM05] and [Sch61]. Green seems to be

a good choose for the background because the COPD home interaction device will be located at home by the patient.

The entering of the lung capacity will be done by the use of controls. The lack of a "go back" possibility was a design choice. From the combination of the requirement of a very easy to use user interface and a maximum of three multiple choice buttons to answer concluded to leave a go back possibility. The lack of this possibility is only noticed by the ICT expert and not by the two patients. One of the two patients noticed that it was not appropriate that the character welcomed him by his first name. Instead of using the first name, the patient will be welcomed using the last name. The character in the persuasive version was a portrait of a man. Patients did not indicate a preference for a special character. The portrait of a man (see figure 4.8) will stay the same in the final design. The general layout of the interface and the interaction with the COPD home interaction device will stay the same.

The screens of the complete diaries can be found in appendix A and B. In appendix A all the screens of the basic prototype of the diary can be found. Appendix B shows all the screens of the persuasive prototype of the diary.

4.5.3 Conclusion

This chapter described the design of the two prototypes that will be used in the user experiment. The conceptual designs were based on requirements and tested with experts and COPD patients. The results of these tests were used to design the final prototypes of the diary that can be used for the user experiment. Before the user experiment with these prototypes can start, it is important that the prototypes meet all the requirements from section 4.2. Table C.1 in appendix C presents an overview of the requirements and their fulfillment in the final designs. As can be seen in the table, most of the requirements are fulfilled. Requirement NFR11 is not fulfilled because users preferred the use of controls for entering the lung capacity. Requirements CR1 and CR2 could not be tested. The fulfillment of these requirements should be arranged in a later stadium of the project and are out of scope for this evaluation.

Chapter 5

Usability study en evaluation

The last part of the user centered design method is a user evaluation. During this user evaluation the usability of the designed prototypes will be tested. The participants were interviewed about their opinion about the prototypes and were asked to think aloud during the actual completion of the dairies.

5.1 Participants and Methods

The recruitment of participants was initially realized in the MST hospital and later on by physiotherapist practice FitClinic in Enschede where COPD patients follow a special fitness program in groups (COPEactief). The participants were invited in cooperation with their physiotherapist to participate during their fitness program. The participants in the experiment were COPD patients who meet the requirements of the target group. The participants should have a GOLD classification II or III, the age of the participants should be between the 40 and 70 year and the participants should be able to read the Dutch language. 22 participants were recruited for the final usability study and evaluation.

5.2 Procedures and Instruments

The experiment existed of an interview and an evaluation of both the prototypes on basis of a scenario. The experiment and evaluation existed of qualitative and quantitative questions. Quantitative questions were statements where participants can shows their opinion (agree or disagree) on a five point Likert scale. Participants were observed during the evaluation of the prototypes. During the observations attention was paid to the way the participants worked with the prototypes (what went well and wat did go wrong). The interviews and evaluation were recorded on tape and notes were made.

During the interview the following subjects were discussed:

- Personalia.
  - Gender.

  - Age.
  - (Last) Job.
- Experience with technologies.
  - Experience with configuration of televisions.
  - Experience with computer usage.
  - Experience with mobile phones.
  - Experience with touch screens.
- Experience with the COPE diary from the past.
- The consultation with their pulmonologist.
- Possible new functionalities for the diary.
- Statements about:
  - Technology acceptance.
  - Usability issues.
- General experience with the prototypes.
- The look of the agent.
- General preference of the patient.

The complete list of interview and evaluation subjects can be found in appendix E. Parts of the questions are specially designed for this interview. The statements about technology acceptance and usability issues are selected from standard questionnaires [Nov09]. The questionnaire is limited because the limited time for the interviews and evaluations.

The participant works with both prototypes of the diary during the evaluation. During the evaluation the participant completes the basic and persuasive prototype of the diary according to a scenario. This scenario directs the participant to the complete diary and end with an advice to take a prednisolon cure. In table 5.1 the scenario of the evaluation can be found. The presentation of the two different prototypes of the diary is counterbalanced. The participant is asked to think aloud and can ask for help anytime.

5.3 Data analysis

The interviews were transcribed afterwards. After the transcription the anlysis will took place. First the interview will be summarized and the answer per question will be formulated. The same procedure was executed for the observations during the evaluations. The statements of the two prototypes were compared with the results of the quantitative questions of the usability study and evaluation with a paired sample t-test.

Question	Answer
Had u de afgelopen 24 uur meer klachten?	Ja
Had u klachten over kortademigheid?	Normaal
Had u klachten over het opgeven van slijm?	Duidelijk meer dan normaal
Wat was de kleur van het opgehoeste slijm?	Normaal
Had u klachten over hoesten?	Iets meer dan normaal
Had u klachten over piepen?	Duidelijk meer dan normaal
Had u klachten over een loopneus?	Normaal
Had u klachten over een pijnlijke keel?	Iets meer dan normaal
Heeft u gebruik gemaakt van kortwerkende luchtwegverwijderaars?	Normaal
Heeft u de afgelopen 24 uur koorts gehad? (meer dan 38,5 graden)	Ja
Wat is uw longinhoud	3.44 liter

Table 5.1: Scenario to complete the diary. (In Dutch)

Chapter 6

Results

This chapter discusses the results of the interviews and evaluations of the two prototypes described in the previous chapters. Twenty two participants were recruited during COPD group fitness sessions. Participants ranged in age from 50 to 77 years old. The majority was over 59 (mean = 66,82, SD = 7,14). Eleven were female and eleven were male. First the results of the interviews will be discussed followed by the results of the evaluation of the prototypes. Conclusions based on these results will be discussed in chapter 7.

6.1 Interviews

This section will discuss the result of the interviews with the participants of the usability study and evaluation.

6.1.1 Personal characteristics

Six participants indicated that they had no experience using computers. The other part of the participants use the computer for surfing the Internet, email, music and photos. All participants had experience working with more accessible technology like mobile phones and the configuration of television, but noticed that they have no motivation to explore any furture possibilities of these technologies. These statements are supported by the results of technology acceptance questions. The participants were asked to indicate their level of agreement to subjects like: searching for possibilities to experiment with new technology, the fun to experiment with new technology and the hesitation to work with new technology. In table 6.1 the average scores of the participants technology acceptance can be found.

Ten of the participants stated to have no or minor knowledge about (home) electronics, have no interest in computer technology and they do not want to know anything about these technologies. They indicated to disagree with the statements "When I hear about new information technology, I search for opportunities to experiment with it" and "I like it to experiment with new information technology" and agree with the statement "In general, I am hesitating to try out new information technology". These participants were the older part of the participants (average age of 71 years) and were not put in touch with electronics

Statement	Avg. score	Std. Deviation
When I hear about new information technology, I search for opportunities to experiment with it.	2,82	1,71
I like it to experiment with new information technology.	2,86	1,70
In genereal, I am hesitating to try out new information technology.	3,50	1,65

Table 6.1: Statements about technology acceptance and their score. Scores range from 1 (disagree) to 5 (agree)

and information technology during their professional life. All the participants did have experience in working with touch screens because the fitness devices at FitClinic are operated by a touchscreen.

6.1.2 COPE dairy

Three of the participants had joined the COPE studies and had experience with the COPE diary from the past. The opinion of these three participants was that the COPE diary was easy to use, was logically composed and there was no lack of subjects in the diary. The participants do not use the COPE diary anymore. Two participants keep up some sort of diary on their own. They note complaints and general comments per day. Participants that were not familiar with the COPE diary get a short explanation of the COPE diary.

6.1.3 Consultation with health professionals

On average the participants consult their lung specialist about three times a year. Participants are satisfied about the contact with the specialist. During a consult the patient discusses some general experiences during the last period. After this the patient and specialist talk about the number and character of the complaints and the medication will be discussed. During such a consult the specialist will give some feedback and suggestions about condition, complaints and medication. About the half of the participants mentioned that they go to a consult with some questions prepared. They have an active attitude and want to discuss these questions with the specialist. The other participants have a more passive attitude.

6.1.4 Extra functionalities

During the interview some (possible) functionalities of the diary were discussed. These functionalities were extras next to completing the diary. Possible functionalities can be an overview of the medical history of the patient, for example a graph which shows the progress of the lung capacity and other complaints, and a reminder system that helps participants to take their medication, recall appointments with specialists and remind the patient to complete the diary

every day. The reactions towards these possible features of the COPD home interaction device were diverse.

Medical history

Nine of the participants like the idea to have access to their own medical history. The other thirteen participants do not want to see their own history. The motivation for the choices of the participants can be divided into two groups. The participants who think it is a good idea to see their own history and mentioned that they like the possibility to see the progress of their COPD and the therapy and to compare their condition over time to get a better insight in their disease. According to the opinion of these participants this kind of information will help the therapy and the awareness of the disease. The other thirteen participants do not like the idea to have access to their own medical data. They do not want to face their disease. Facing their medical history will not help to recover from their complaints. Some participants mentioned that facing their problems and worsening of their condition will make it all worse. These participants think that they know their troubles and discuss these problems with their specialists.

Reminder systems

The reminder systems that were discussed during the interviews could be divided into reminders for medication, appointments with health professionals and the completing of the diary. Most participants indicated that they were able to manage these appointments by their own. Only three of the twenty two participants like the reminder system for medication. All the participants indicate that taking their medication is not a problem. They take their medication every day at the same time. When they forget their inhalers the effect will be shortness of breath. Four of the participants like the idea of reminders for appointments with health professionals. All the participants pointed out that they have an agenda to register their appointments. The MST also sends letters to the patients as a reminder for appointments with health professionals. Sixteen participants indicate that there was no actual need for reminders to complete the diary. If they have to complete the diary every day, they will do it. Six participants mentioned that it will be a really good idea to have reminders for the completion of the diary.

All together it can be concluded that there was less need by the participants for extra functionalities of the diary.

6.2 Evaluation

After the first part of the interview the participants started working with the prototypes. After a short introduction about the scenario the participant can practice with the COPD home interaction device by completing the dairy for the actual day. In all the cases the patient had no more complaints than normal. The only introduction about the control and interaction with the COPD home interaction device was the notification that the device is a touch screen device. All the participants were able to complete this first task with the COPD home interaction device.

After this introduction the actual evaluation of the prototypes starts. The order of the prototypes is altered between the different participants. The scenario tells the patient which answer they have to choose to see all the questions and screens and get an advice to start a prednisolon cure. When the participant was finished working with one of the prototypes he will be interviewed about the prototype. The questions were about things they like or dislike during the usage of the prototype. In addition these questions the participant has to indicate his level of agreement to the statements about the usability. In table 6.2 the average scores of the participants to these statements for the basic and persuasive prototype and the result of a paired sample t-test can be found. The paired sample t-test was used to compare the statements of the two prototypes. From the results of the t-test can be concluded that there are no significant differences between the scores of the statements of the two prototypes.

After working with both prototypes, the participants are asked which diary they prefer. Eight participants choose the basic diary, eight participants choose the persuasive diary and six participants did not have a preference and choose one of the two because they had to give an answer. The most heard motivations to choose for the basic diary was the fact that they liked it because it was quick and short to use. The persuasive diary was more extensive in their opinion. The basic diary was also less distracting. Participants had a lot more trouble to express the motivation to choose for the persuasive diary. The most heard motivations can be summarized as a feeling. The participants mentioned that the persuasive diary was more pleasant and fun to use and in some cases more clear. The participants who did not want to choose between the two prototypes mentioned less differences between the two prototypes of the diary in functionality, but mentioned the difference in being quick and short versus a more friendly style.

6.2.1 Observations

The participants were observed and asked to use the 'think aloud' method during the evaluation. The results of these observations will be discussed in this section.

The first observation during the evaluations was the fact that all participants were able to work with the interface of the COPD home interaction device. At the beginning of the actual evaluation and the practicing part, the COPD home interaction device shows the "home screen" of the system. The patient had to click on the medical diary button to start completing the diary. The buttons and text on the screen were readable, even without reading glasses. All the participants reacted positive on facts like simplicity and clarity of the diary and the time to complete the diary in worst case scenario. Participants were also positive about the time to complete the diary in case of no complaints. The participant liked the COPD home interaction device and did not associate it with a personal computer.

Most participants were skeptical about working with the COPD home interaction device before the evaluation started. They were afraid to have too little computer experience and to do things wrong. After the evaluation participants were all positive about the ease of use of the prototypes of the diary. An often heard reaction from the participants is "is this all?" and "I have done more difficult things!".

The scenario that the participants had to use to complete the diary was

Statement	Mean basic prototype (Std. Deviation)	Mean persuasive prototype (Std. Deviation)	Sig. (2-tailed)
The diary is pleasant to use.	4,25 (0,75)	4,36 (0,73)	t(21) = 0,548, p >0,05
The diary is efficient to use.	4,48 (0,79)	4,45 (0,74)	t(21) = 0,907, p >0,05
The completion of the diary is an easy way of working.	4,68 (0,65)	4,68 (0,89)	t(21) = 1,000, p >0,05
The diary motivated me to complete it.	3,55 (1,30)	3,77 (1,44)	t(21) = 0,204, p >0,05
The usage of the diary is easy to learn.	4,77 (0,43)	4,63 (0,95)	t(21) = 0,378, p >0,05
The diary is understandable.	4,86 (0,35)	4,81 (0,50)	t(21) = 0,576, p >0,05
The diary is clear.	4,77 (0,53)	4,86 (0,35)	t(21) = 0,427, p >0,05

Table 6.2: Comparison of the two prototypes on statements about usability using a paired sample t-test and their score. Scores range from 1 (disagree) to 5 (agree).

confusing for some participants. It was difficult for them to imagine to have the scripted complaints, which makes them hesitating to answer the questions from the diary. Another problem was the reaction on and the faith in the medical advice of the diary. Participants did not understand the advice to take prednisolon while they did not have complaints.

During the evaluation two items that need attention were observed. The first is the entering of the lung capacity. Most participants try to touch the numbers on the screen to enter the lung capacity. After some attempts the participant noticed the "plus" and "minus" button and start using it to enter their lung capacity. None of the participants asked for help with entering the lung capacity. Another point of attention was the fact that in some cases the user would touch the screen two times very fast successively. In such a case they answer the next question without seeing or reading it. This happened three times during the evaluations. The participants in question did not noticed they "skipped" one question.

Other notable observations are about the persuasive diary. When some participants talk about this diary they were talking about a person. For example, "*He* advices me to take a prednisolon cure...". Most of the participants have to laugh about the fact of the day. The participants did not have a clear preference for the character on the screen in the persuasive diary and stated to have faith in the medical advice given by the diary.

6.3 Summary

This chapter presented the results of the experiment and evaluation of the two prototypes of the diary with the twenty two participants. The first conclusion is that the prototypes are both very easy to use. All the participants were able to work with the prototypes of the diary and could complete the diary with hardly any training or instruction. Sixteen participants own a personal computer, so most of them have access to information technology but have a lack of motivation to try and experiment with new information technology. From the interviews can be concluded that a part of these participants have little interest in information technology and new developments in this area. This group of participants was older than the average age of the group and had no experiences with technology during their professional life which can be an explanation for the lack of interest in information technology.

Most participants were not familiar with the COPE diary. Only three participants were familiar with it, which could be a cause for the problems during the execution of the scenario to complete the diary during the evaluations. An advantage of this is the fact that the diary was completely new for them and the participants were not prejudiced.

The participants differ in their opinion about the possibility to have access to their own medical history. Nine of the participants were enthusiastic about this extra functionality. The other participants were less enthusiastic about this extra functionality. Some participants stated they could imagine the benefits of this functionality but they had no interest in seeings their own history. The group who do not like the idea of the possibility to see their own medical history mentioned that they do not want to faced with their disease and disturbances.

The participants were not interested in reminders from the diary. Only three

of the participants liked the idea of reminders for medication. The participants are used to take their medication on fixed moments of the day. Reminders for appointments were supported by four of the participants. The participants mentioned they are used to note their appointments into their agenda and calenders. The MST send reminders for appointments by mail. Reminders for completing the diary is a good function according to only six of the participants.

From the evaluations of the prototypes can be concluded that the interfaces are very easy to use. The participants did not missed the functionality to go back to the previous question. Most of the participants had some trouble with the input of the lung capacity. They tried to push the numbers on the screen. When they realized that the system did not react, they noticed the plus and minus buttons and started using them. All the participants were able to enter the lung capacity without any support or extra explanations. Finally the conclusion is that the use of controls to enter the lung capacity is a usable method. Designing three-dimensional buttons for the plus and minus could solve the troubles with the input of the lung capacity.

The participants did not have many comments on the character on the screen and the dialog of the persuasive diary. One participant did not noticed the avatar on the screen. The participants did not have a preference for the appearance of the avatar. Some of them mentioned that the appearance can play an important role during the interaction with the diary. Participants who prefer the basic diary designated the character as unnecessary.

There was no measurable difference between the two prototypes on statements about usability. The basic and persuasive diary are compared on basis of the scores on statements and on basis of the opinion of the participant. The scores of the statements were compared with a paired sample t-test. From this test it can be concluded that there was no measurable difference between the two prototypes of the diary. From the comparison of the two prototypes of the diary by the participants opinions it can be concluded that they did differ. The persuasive diary is defined as more friendly while the basic diary is defined as quick and short. The participants did have some difficulties to express their opinion about the persuasive diary, they could not define the experience and talked about a feeling.

6.4 Reflection

This section gives a reflection of the results of the experiments in this study and experiments of other studies.

In a similar study by Holzinger [Hol02] a digital questionnaire for oncology patients was developed. This system was primarily designed for elderly people. The result of a user experiment with twelve patients with absolutely no experience with computers was that most of the patients reported that they "liked this kind of computer" and all patients found the touch screen interface simple and easy to use. This kind of result was also found in this research.

The persuasive prototype of the diary is not unique but new in the self management of COPD patients. In studies by Bickmore [BCCGH05], [BP05], [BG06] and [BMCB07] the use of persuasive technology has proven to be successful. Users of the systems in the studies liked these systems better, had more respect for the system and had more trust in such systems compared with a

system without a persuasive technology even after a month of daily interaction. Users expressed a significantly greater desire to continue working with a persuasive version of a system. The results of this current experiment did not show significant measurable differences between the basic and persuasive prototypes. A possible explanation for this result can be the fact that the experiments conducted in this study were short term experiments of 30 to 45 minutes. The experiments by Bickmore were conducted over a certain period of months. During the interviews with participants a similar result was found. This could be an indication for measurable difference during a long-term experiment.

Chapter 7

Conclusion and discussion

The goal of this research is to design and evaluate a user interface for the COPD home interaction device to support the registration of subjective and objective information of the health status. The user interface aims to persuade patients for long-term interaction with the COPD home interaction device and change the patients attitudes to their disease. To reach this goal the following research question was formulated. *How to design an user interface for the medical diary of the COPD home interaction device and persuade patients for long-term interaction with the COPD home interaction device?* This chapter will give an overview of the conclusions that can be drawn from this study. The research questions will be answered and discussed.

The main research question was divided into the following sub-questions

1 What is the current state of art systems in telehealth?

  In section 2.1 the characteristics of three different state of the art systems in telehealth were discussed, namely Intels Health Guide, Vital for Astma - COPD and InfoDoc. Among these systems some similarities and differences could be noticed. All these systems were developed with support of health professionals and encompassed a self management program for COPD. The Intel Health Guide was the only system that was developed with support of patients. The modalities in which these telehealth systems are available differ between these system. Intels Health Guide is a special device with a touchscreen and developed for telehealth applications. Vital for Astma - COPD is a web application that is accessible from every computer with an Internet connection and browser. InfoDoc has many different modalities to communicate with their users. The design of the COPD home interaction device will be most similar to the Intel Health Guide. The user interface was designed in cooperation with patients and the diary works on the special COPD home interaction device.

  Next to a discussion of state of the art telehealth system with self management programs, systems that are designed to persuade healthy behavior and change attitudes of the patients were discussed. From studies by Bickmore et all. can be concluded that users preferred these systems, had more respect for the system and had more trust in such systems compared with a system without a persuasive technology, even after a month of daily interaction. Users expressed a significantly greater desire to continue working

with a persuasive version of a system.

2 Which functionalities should be supported by the user interface of the COPD home interaction device dairy function?

The COPD diary on the COPD home interaction device should at least support the COPE diary. The COPE diary contains ten questions about typically complaints of a COPD patient, for example questions about coughing and sputum. The home interaction device should support the registration of the lung capacity of the patient in case of complaints or once a week when the patient does not have complaints. From the interviews with patients can be concluded that participants were less interested in the possible extra functionalities of the dairy. They do not want to see their own medical history and to be faced with their disease and declining condition. An extra functionality of the COPD home interaction device could be a reminder for medication, appointments with health professionals and the completing of the diary. From the interviews it became clear that patients were able to manage these situations on their own. The patients indicated that they were not interested in such a reminder system.

3 What are the requirements to design the COPD home interaction device?

The requirements for designing the user interface of the COPD home interaction device were divided into functional requirements, non functional requirements and context requirements. These requirements were discussed in section 4.2. The most important requirements were: Data that should be stored by the diary are the answer on the diary questions and the lung capacity of the patients per day. Based on these answers the diary gives an advice about medication. When the diary gives the advice to take antibiotics or prednisolon, the diary should store this advice with date and time. All the data will be stored in a database.

The input device of the COPD home interaction device should be a touch screen. The diary has large font and large single click buttons. The complete list of requirements can be found in section 4.2.

4 How to motivate users to use the COPD home interaction device and complete the dairy every day during a long period of time and change the patients attitudes to their disease?

To motivate and persuade patients to complete the diary every day during a long period of time and change the patients attitudes to their disease, a persuasive prototype of the diary was designed next to the basic prototype. The persuasive version encompasses the same eleven questions and answers as the basic prototype. These questions were asked by a rational agent. The rational agent uses a question-answer dialog. The dialog was more personal and the agent reacted on the answer given by the participant by showing sympathy and facial expressions.

From literature was known that rational agents are able to maintain and manipulate relations with users and are able to persuade users attitude or behavior. Experiments with the FitTrack system and GRETA shows a greater desire to continue working with such a system. Users preferred these systems more, respected it more and trusted it more.

The two prototypes (basic and persuasive) were evaluated with 22 COPD patients. During these evaluations no significant measurable difference between the two prototypes on statements about usability was found using a paired sample t-test. From reactions and interviews with the participants some differences between the two prototypes were found. The persuasive prototype of the diary was defined as more friendly while the basic prototype of the diary was defined as quick and short. The participants did have some difficulties to express their opinion about the persuasive prototype, they could not define the experience and talked about a feeling.

From the results of the experiments could not be concluded that the approach to motivate the patients to use the COPD home interaction device and complete the diary every day during a long period of time by using persuasive technology had worked. In the next chapter some recommendations will be made about further experiments to find possible measurable results.

With the answers and conclusions to the subquestions, the answer to the main research *"How to design an user interface for the medical diary of the COPD home interaction device and persuade patients for long-term interaction with the COPD home interaction device?"* question can be derived.

The user centered design (UCD) of the user interface of the medical diary on the COPD home interaction device turned out to be a useful method to design the interface of the diary. During this UCD primary and secondary users were involved. Applying design guidelines and principles for elderly people and touch screens and taking into account characteristics of the future users of the system resulted in a usable user interface of the diary for all the participants of the experiment. The COPE diary was the basis for the digital COPD diary.

A general and last conclusion that applied for both prototypes was that the use of the user interface of the COPD home interaction device was a very easy way of completing the diary. All the 22 participants were able to complete the diary without any training. This was also mentioned by the participants. In the next chapter some recommendations for the COPD dot COM project and further research will be given based on the conclusions of this research.

Chapter 8

Recommendations and future research

Referring to the results and conclusions of this research this chapter gives some recommendations for the COPD dot COM project and further research. These recommendations can be divided in three categories: The choice between the two prototypes of diary for further implementation, further user experiments and the integration of the COPD home interaction device in the COPD dot COM architecture.

Choice of the diary

Although there was no measurable difference found in the user experience between the basic prototype and the persuasive prototype, the advice of this research is to choose the persuasive diary. From the results of studies by Bickmore [BCCGH05] and Fogg [Fog03] can be concluded that the use of persuasive technology can be successful. Schulman and Bickmore [SB09] found in that a conversational interface is a useful design choice for persuasive technology. The use of a persuasive user interface was respected more, liked more and trusted more after a one month during interaction. Another result was the fact that the users expressed a significantly greater desire to continue working with the rational agent [BP05]. Next to the results of these other studies, the results of this study gives some indications that a persuasive diary is preffered more by the patients who participated the user experiment. None of the participants disliked the persuasive diary.

The persuasive design of the diary can also be used for the other future modules of the COPD home interaction device. An example of one of these future modules is the module for physiotherapy. Physical exercises is one of the most studied examples in persuasive technology research.

Another recommendation for further implementation of the persuasive diary is to use user profiles. User profiles are useful for remembering for example the the name of the patient, their hobbies or interests and the brand of their medicines. Users can have some preferences in for example starting a dialog with the agent by calling his first or last name. Their hobbies or interests can be used to present facts on the end of the interaction with the diary. The general facts

used during the experiment can be substituted by these facts, or more general, facts about COPD.

The consideration in choosing the diary is based on the goal to persuade and motivate patients to use the diary every day for a long time. Another criteria to decide which diary should be chosen is the effort of the development and maintenance costs. The persuasive diary is more complicated to design and maintain because of the dialog that should be generated. The persuasive diary has to store more facts about the patient and their COPD compared to the basic diary.

Future user experiments

During the pilot with the COPD home interaction device as part of the COPD dot COM project, it is recommended to perform a longitudinal user experiment. The small and short-term user experiment of this research indicates some promising results of a long-term user experiment. The future experiment could confirm or disprove the indications that are found in this research.

The design of a long-term experiment will be different than the design of the experiment in this study. The participants of the experiment will work with one version of the diary for a certain period of time. The duration of the experiment should be at least one month, similar as in studies by Bickmore. Interviews with the participants can take place before and after the experiment. During the experiment logs of the actual usage of the diary, like the moment and duration of the completion, can be made to observe the completion process of the diary. The subjects of the experiment are COPD patients with a GOLD II and III indication. Because the progress of COPD is different for every patient and difficult to predict it can be difficult to find proper participants for the long-term experiment. The advise is to do the recruitment of participants in cooperation with the health professional or physiotherapist. These professionals have insight in the condition of the patient.

Another possible future research can be a redesign of the rational agent of the persuasive diary. In future research the effects of this redesigned agent on the persuasion of the COPD patients can be studied. The rational agent in this experiment was a simple and static picture of a male character. The agent was able to show three (static) expressions. A future design of the agent can be an agent with more personality. The agent can use for example gaze behavior during the dialog to influence personality [PHN+09], use speech synthesis to pronounce the dialog and can react polite and empathetic to the input of the user. The result of an experiment by Liu and Picard [LP05] was that an empathetic system can facilitate a more enjoyable user experience. The generation of the spoken, polite and empathic dialog can be a lot of work. The dialog for the COPD diary is limited to the eleven questions and static answers and therefore the generation of this dialog should be realazible.

The previous recommendation for choice of the persuasive diary is mainly based on proven results from literature and indications from the interviews during the user experiment. The choice of the diary may change after future longitudinal user experiments. When the results of this experiment indicates that the users do not experience any difference between the persuasive and basic diary or that no significant greater desire to continue working with the persuasive diary is found, the basic diary will be as good as the persuasive diary.

COPD home interaction device in the COPD dot COM architecture

At the start of this research the COPD dot COM architecture still had to be designed. This section will provide a possible way to design the architecture to share different kinds of data with different users. The users of the data are the health professionals, the nurse partitioner, the physiotherapist and the COPD patient. All the users have a different view of the data that will be available through a portal.

A possible way to design the COPD dot COM architecture is to link the data from the COPD dot COM project to the available systems in the hospitals, such as the Ziekenhuis Informatie Systemen (ZIS) through the Electronisch Patienten Dossier (EPD). These systems contain objective data of patients. The COPD dot COM project combines objective data with subjective data from the patient. The data from the COPD dot COM project should be linked to these available systems. In figure 8.1 the overview of a possible architecture can be found.

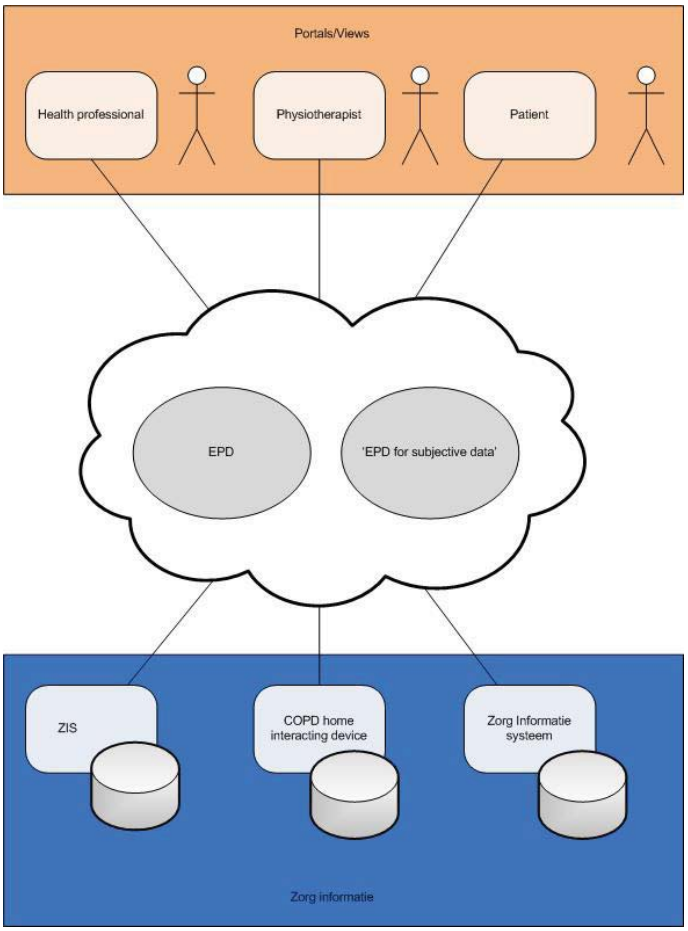


Figure 8.1: The overview of a possible COPD dot COM architecture

A last and general recommendation concerns the COPD patients. The experience in this study was that these patients are willing to cooperate in the

experiment, but they are very afraid for new things and technology. Their opinion is that they are not able to handle these kind of 'computers'. After the explanation that they can not do anything wrong they are willing to participate. After the interaction with the COPD home interaction device all the patients were positive about working with the device. So the recommendation is to involve patients in further developments of the project and let them experiment with ideas and prototypes to get the most useful feedback.

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Appendix A

Screens standard diary

Figure A.1: First screen of the basic prototype of the diary.

Figure A.2: Second screen of the basic prototype of the diary.

Figure A.3: Third screen of the basic prototype of the diary.

Figure A.4: Fourth of the basic prototype of the diary.

Figure A.5: Fifth of the basic prototype of the diary.

Figure A.6: Sixth screen of the basic prototype of the diary.

Figure A.7: Seventh screen of the basic prototype of the diary.

Figure A.8: Eighth screen of the basic prototype of the diary.

Figure A.9: Ninth screen of the basic prototype of the diary.

Figure A.10: Tenth screen of the basic prototype of the diary.

Figure A.11: Eleventh screen of the basic prototype of the diary.

Figure A.12: Twelfth screen of the basic prototype of the diary.

Appendix B

Screens persuasive diary

Figure B.1: First screen of the prototype of the persuasive diary.

Figure B.2: Second screen of the prototype of the persuasive diary.

Figure B.3: Third screen of the prototype of the persuasive diary.

Figure B.4: Fourth screen of the prototype of the persuasive diary.

Figure B.5: Fifth screen of the prototype of the persuasive diary.

Figure B.6: Sixth screen of the prototype of the persuasive diary.

Figure B.7: Seventh screen of the prototype of the persuasive diary.

Figure B.8: Eighth screen of the prototype of the persuasive diary.

Figure B.9: Ninth screen of the prototype of the persuasive diary.

Figure B.10: Tenth screen of the prototype of the persuasive diary.

Figure B.11: Eleventh screen of the prototype of the persuasive diary.

Figure B.12: Twelfth screen of the prototype of the persuasive diary.

Figure B.13: Thirteenth screen of the prototype of the persuasive diary.

Figure B.14: Fourteenth screen of the prototype of the persuasive diary.

Appendix C

Requirement fulfillment

Requirement	Status	Comments
FR1	✓	All question of the diary in figure 1.2 are supported by the interface, see A and B.
FR2	✓	Lung capacity can be entered, see figure A.12 and B.12.
FR3	✓	Triage protocol is implemented. The system checks the answers given by the patient, also from the past.
FR4	✓	Answers are stored in a database.
FR5	✓	When the diary gives the advice to start taking medication, this will be recorded in the database with report of date and time.
eFR1	✓	The diary displays an agent. See screens in appendix B.
eFR2	✓	The agent will use a dialog to ask questions and interact with the patient. See also appendix B.
eFR3	✓	Answers of the patient are used in the definition of the questions. The expression of the agent will also react on the answers given by the patient. See section 4.5.1 and the screens in appendix B.

Requirement	Status	Comments
eFR4	✓	The name of the patient will be stored in the database and used to welcome the patient.
eFR5	✓	The diary will calculate the number of complaint-free days. This can be used in the dialogue with the patient.
eFR6	✓	When the patient is finished with completing the diary the agent tells a fact of the day. The agent in the prototype will tell a general fact.
NFR1	✓	The COPD home device is the Asus EeeTop with touch screen. See section 4.3.
NFR2	✓	All the buttons in the interface are single touch buttons.
NFR3	✓	The screen are designed for a resolution of 1366 by 768 pixels.
NFR4	✓	Questions of the diary are placed somewhat above the center of the screen, the answers somewhat under the center. See screens is appendix A and B.
NFR5	✓	Only the text of the questions and answers differ between the different screens. Colors and layout of screens stay the same.
NFR6	✓	Font size of the questions, dialog and answers is 14 piont size.
NFR7	✓	The font of the diary is Calibri, see section 4.5.1.
NFR8	✓	The buttons have a dimension of 165 by 335 pixels.
NFR9	✓	The color of the buttons become darker when touched.
NFR10	✓	The diary interface contains a progress bar. See screens is appendix A and B.
NFR11	✗	Not preferred by users in first evaluations. See section 4.5.1.

NFR12	✓	Questions, (answers)buttons, progress bar and agent are distributed over the screen and have the same positions in all the screens. See screens is appendix A and B.
NFR13	✓	Lung capacity can be entered by pressing the plus and minus buttons in screens A.11 and B.11.
NFR14	✓	When the first question is answered with "No", the diary will return to the start screen.
NFR15	✓	All items in the screen have a function to fulfill one of these requirements.
NFR16	✓	First evaluations with experts and patients demonstrate a training time less than five minutes. The diary can be used with a minimum of explanation.
NFR17	✓	The language used in the prototypes of the diary are almost the same as the diary on paper. The dialogue is inspired by "patiënten-arts gesprekken".
NFR18	✓	The background of the diary is light green. See screens is appendix A and B.
NFR19	✓	Questions and dialogues are presented in text. See screens is appendix A and B.
UR1	✓	Patients are recruited to match this requirement.
UR3	✓	Patients are recruited to match this requirement.
CR18	✗	Cannot be tested.
CR19	✗	Cannot be tested.

Table C.1: Fulfillment of requirements

Appendix D

Consultation with pneumonologist

A COPD patient meets the pneumonologist (or nurse practitioner) two to four times a year. An in-house day at the lung department of the Medisch Spectrum Twente was a good opportunity to get some insight in COPD and the treatment of COPD. The day started with a visit of the lung department in the morning. During the afternoon there were some regular consultations.

During such a consult attention is paid to:

- Complaints.
- Lung function test.
- Co morbidity.
- Adherence to therapy and medication.

At the beginning of a consult the patient takes a seat in the consulting-room. The medical practitioner asks the patient how life is and about their condition. The patients are called by name. After this, the progression of the complaints from the last consult are discussed a new complaints and questions from the patient will be discussed and answered. The medical practitioner will talk about the medication and asks the patient if there are some difficulties with taking the medication. The consultation will be concluded with some small medical examinations.

Appendix E

Interview and evaluation list

Persoonsgegevens

Geslacht?

- Man
- Vrouw

Leeftijd?

Wat is of was uw beroep?

Heeft u ervaring met het gebruik van televisie(meerdere antwoorden mogelijk)?

- Ja
- Nee
- TV kijken
- Teletekst
- Beel en geluid instellen
- Zenders zoeken
- Anders...

Heeft u ervaring met het gebruik van een computers(meerdere antwoorden mogelijk)?

- Ja
- Nee
- Internet
- Email
- Office
- Anders...

Heeft u ervaring met het gebruik van een mobiele telefoons(meerdere antwoorden mogelijk)?

- Ja
- Nee
- Bellen
- SMS
- Fotograferen
- Muziek luisteren
- Internet
- Anders...

Heeft u ervaring met het navigatiesystemen als TomTom?

- Ja
- Nee

Heeft u ervaring met het digitale zakagendas (PDA-achtigen)?

- Ja
- Nee

COPE dagboek

Bent u bekent met het COPE dagboek?

- Ja
- Nee

Wat beviel u aan het gebruik van het dagboek?

- Wat precies en waarom?

Wat beviel u niet aan het gebruik van het dagboek?

- Wat precies en waarom?

Wanneer vulde u het dagboekje in?

- Elke dag?
- Waarom wel of waarom niet?
- Motivatie om het wel of niet in te vullen.
- Meerdere dagen in een keer?

Gebruikt u het dagboekje nog steeds?

Mist u iets in het dagboek?

Wat voor nieuwe dingen zou u terug willen zien in een dagboek?

Contact met arts(en)

Hoe ervaart u het contact met uw (long)arts?

- Hoe is uw relatie met uw arts?
- Wat vindt u van de tijdsduur van een consults?
- Wat vindt u van de frequentie van de consults?
- Wat vindt u van de kwaliteit van de consults?

Hoe begint u een gesprek met uw (long)arts?

Krijgt u wel eens tips van uw (long)arts?

- Altijd of alleen als het goed of slecht gaat met uw gezondheid?

Wanneer krijgt u deze tips? (altijd, als het goed/slecht gaat met uw gezondheid)

Mogelijke functionaliteiten COPD dagboek

Vergeet u weleens uw medicijnen te slikken?

- Wat is de motivatie om het wel of niet in te nemen?

Zou u uw eigen (medische) geschiedenis terug willen kunnen zien?

Zou u herinnerd willen worden voor het invullen van het dagboek?

Zou u nog aan andere zaken herinnerd willen worden?

- Medicijnen?
- Afspraken in het ziekenhuis?

Stel u bent een keer het dagboek vergeten in te vullen, zou u dit achteraf nog in willen kunnen vullen?

Stellingen over het COPE dagboek (Indien van toepassing)

Het oude dagboekje was prettig. (Oneens 1 2 3 4 5 Eens)

Het 'oude' dagboekje was efficient in gebruik. (Oneens 1 2 3 4 5 Eens)

Het oude dagboekje was een makkelijke manier van werken. (Oneens 1 2 3 4 5 Eens)

Het oude dagboekje motiveerde mij om het in te vullen. (Oneens 1 2 3 4 5 Eens)

Het oude dagboekje was begrijpelijk. (Oneens 1 2 3 4 5 Eens)

Het oude dagboekje was duidelijk. (Oneens 1 2 3 4 5 Eens)

Stellingen over technology acceptance

Als ik over nieuwe informatietechnologie hoor, zoek ik naar mogelijkheden om er mee te experimenteren. (Oneens 1 2 3 4 5 Eens)

Ik vind het leuk om met nieuwe informatietechnologie te experimenteren. (Oneens 1 2 3 4 5 Eens)

Over het algemeen ben ik aarzelend met het proberen van nieuwe informatietechnologie. (Oneens 1 2 3 4 5 Eens)

Vragen en stellingen over het basis COPD dagboek

Wat beviel u aan het gebruik van het dagboek?

- Was het eenvoudig?
- Wat vond u van de tijd dat u kwijt was?
- Was het duidelijk?
- Miste u iets of juist niet?

Wat beviel u niet aan het gebruik van het dagboek?

- Was het eenvoudig?
- Wat vond u van de tijd dat u kwijt was?
- Was het duidelijk?
- Miste u iets of juist niet?

Het nieuwe dagboekje is prettig. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje is efficint in gebruik. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje is een makkelijke manier van werken. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje motiveert mij om het in te vullen. (Oneens 1 2 3 4 5 Eens)

Het gebruik van het nieuwe dagboekje is makkelijk te leren. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje is begrijpelijk. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje is duidelijk. (Oneens 1 2 3 4 5 Eens)

Vragen en stellingen over het persuasive COPD dagboek

Wat beviel u aan het gebruik van het dagboek?

- Was het eenvoudig?
- Wat vond u van de tijd dat u kwijt was?
- Was het duidelijk?
- Miste u iets of juist niet?

Wat beviel u niet aan het gebruik van het dagboek?

- Was het eenvoudig?
- Wat vond u van de tijd dat u kwijt was?
- Was het duidelijk?
- Miste u iets of juist niet?

Het nieuwe dagboekje is prettig. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje is efficint in gebruik. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje is een makkelijke manier van werken. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje motiveert mij om het in te vullen. (Oneens 1 2 3 4 5 Eens)

Het gebruik van het nieuwe dagboekje is makkelijk te leren. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje is begrijpelijk. (Oneens 1 2 3 4 5 Eens)

Het nieuwe dagboekje is duidelijk. (Oneens 1 2 3 4 5 Eens)

Vragen over de afbeelding van de agent op het scherm

Wat voor type karakter zou u prettig vinden?

- Waarom of waarom niet?

Welk karakter vind u het prettigst?

- Waarom of waarom niet?

In welk karakter heeft u het meest vertrouwen? Zie figuur E.1.

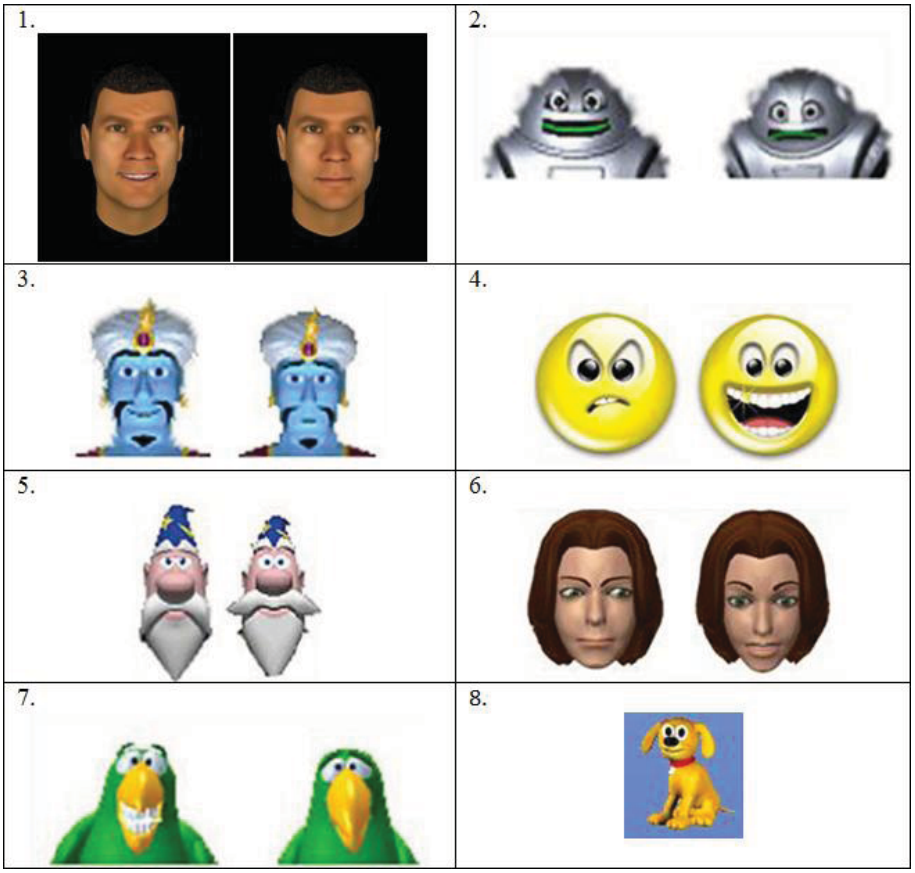

Figure E.1: Karakter waaruit gekozen kon worden door deelnemers van het experiment

Appendix F

Observations

The table below provides an overview of the most remarkable observations per patient during the evaluation of the diaries. Double observations are left out. A is the basic diary, B is the persuasive diary.

Patient	Observation
1	Volgens mij is het hetzelfde. Ik ben wat praktischer, dus deze vind ik iets fijner (A). Hoe sneller hoe beter. Dat andere was niet storend in principe.
	Niet echt een voorkeur, maar hoe korter, hoe duidelijker.
	Doordat het makkelijk is, is het ook sneller gedaan en daardoor motiveerde het mij.
2	Karakter is gezien en was leuk. Ik zou zijn advies wel opvolgen, moet wel het idee hebben dat het van een medicus komt.
	Kiest voor B, lijkt maar zo, iets uitgebreider, prettiger.
3	Kies voor A, moet ook niet teveel poespas zijn.
	Dit was het? Dit is toch niet zo moeilijk!
	Heeft het karakter opgemerkt: Deze lijkt iets vriendelijker. Andere was zakelijk.
4	Dit was het? Dit is toch niet zo moeilijk!
5	Karakter hoeft niet. Is overbodig.
	De vorige was prettiger (B)
6	Kiest duidelijk voor A. Kortere vragen en minder afleiding misschien.
	Het advies over medicatie zou toch nog met de arts besproken worden.
7	Wie is dat? Hahahhahaha Kostelijke!, grappig. Merkte de expressie van het karakter op.
	Advies per computer heb ik helemaal geen vertrouwen in. Dat moet toch echt door een dokter gedaan worden hoor.
	Kan niet echt kiezen, waren haast het zelfde. Beide kon ik mee werken, verder zegt het me niets.

8	Perfect wat betreft duidelijkheid. Mooi om te gebruiken dat ding.
	Valt wel reuze mee. Was kort en duidelijk.
	Vond het niet zo interessant. Karakter was niet prettig, ziet liever de dame. Heeft wel vertrouwen in het advies van het karakter.
9	Vond het wel leuk, was niet moeilijk en de tijd stelt niets voor. Duidelijk. Vrij gemakkelijk. Kan moeilijker.
	Motiveert het om iedere dag met je zelf en je gezondheid bezig te zijn??
	Eigenlijk niet echt op gelet (het karakter) zou vrolijker mogen. Een karakter speelt wel een rol bij het hebben van vertrouwen. Het moet voelbaar zijn. Het moet belangstelling tonen. Je kijkt wel naar het gezicht. Maar het moet ook niet te vrolijk zijn.
10	Heeft wel vertrouwen in het advies van het karakter. Maar dat moet wel een soort van groeien.
	Was het zelfde programma. Maar B was duidelijker. Visueel zit er verschil in. A was minder duidelijk.
	Simpel, een kind kan de was doen. Wel duidelijk.
11	Kiest voor A, maar dit is geheel willekeurig. Misschien iets simpeler.