User interface for AI-Rehabilitation

Research and Development Project

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Contents

1 Introduction

Many elderly citizens have a need for training in order to maintain function and be independent of home help [1]. Not all elders train regularly, and this can lead to an increase in time and money spent by the municipality, because of the assignment of assistive tools and the need of home help. Using assistive tools can be a downside, since the elder can get a decrease in strength and a need for additional assistive tools in the future. This report is part of a project between Aarhus University and Aalborg Kommune, called AIR or AI Rehabilitering. Aarhus University have created an AI capable of determine if an elderly citizen is able to complete a training course. Purpose of this project is to visualize the results from the AI. This is to assist the case workers in determining whether or not a citizen should receive a training course, or assistive tools. This report covers some of the methodologies used in User Driven Development, and how these methods were used in creating a low fidelity prototype. The prototype was made in collaboration with a group of five people at a meeting held at Aalborg the 01-10-2020.

1.1 AIR

AIR or AI-Rehabilitering is a project between 7 municipalities in Denmark, using AI as a support tool for case workers [2]. The AI can bring an indication on whether or not a citizen is able to complete a training course, by calculating an estimated probability, based on various factors. The reason behind the AI is twofold with the first being quality of life. If the citizen is able to train, it becomes possible to prolong the citizens life and the need of fewer assistive tools in the future. The second reason is that the municipalities is able to save both money and personal time on citizens who might not complete the training course, and thereby reap the benefits. A rich picture of the AIR project is illustrated on figure 1.1.

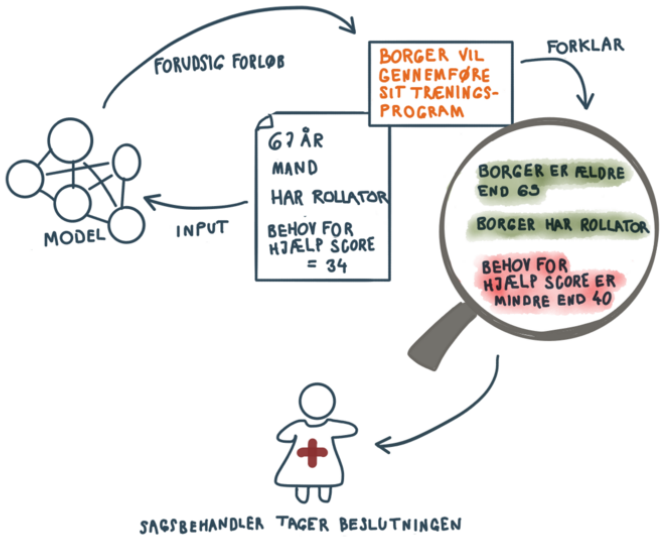

Figure 1.1: Rich picture of AIR [2]

1.2 Problem formulation

The focus of the RD project is to design a web application for the research project AI Rehabilitation (AIR). The web application should reach a "proof of concept prototype" level of maturity. The functionality of the web application should support the rehabilitative efforts done by case workers, when evaluating a citizens need for a training course. The interaction design and user experience should be established through participatory design efforts with a pilot group of potential end-users. Therefore, this RD project also includes the formation of a pilot group and running a participatory design process with the group where the web application prototype is incrementally refined. The pilot group should be established in cooperation with the RD project's external partners. Finally, the web application prototype must be be proven functional via concrete experiments including the pilot group.

2 Methods

Multiple methods have been used throughout this project, and was used as part of a meeting held at Aalborg the 01-10-2020 with five people attending. The results presented in chapter 4 are based on the results gathered by using these following methods.

2.1 User Driven Development

The first and most important method used in this project is the User Driven Development (UDD) methodology. This core premise is to include the users in the development process by talking to them regarding their needs, but also by measuring how they interact with the product under development. This puts the user at the center of attention, and makes sure that the product caters to the users needs. In 1985 John Gould and Clayton Lewis [3, p. 48] came up with three principles for which this methodology is based on.

The first principle is *Early focus on users and tasks*. This principle put emphasis on getting to know the end user, including their behavioral and cognitive patterns [3, p. 48]. By observing the user executing their normal daily tasks, it is possible to attain knowledge of how the user is going to interact with a new product. The first principle also states that the user should be involved in the design process. This is a very important point as in the end, it is the observed user the product is developed for.

The second principle is *Empirical measurement*. This principle revolves around gathering reactionary and performance data of how the user interacts with a prototype, simulations, prepared scenarios and even manuals [3, p. 48]. Every time the user interacts with the system, it is observed and analyzed to find flaws. These flaws could be a non intuitive design, missing information or even too much information and thus confusing the user rather than informing.

The third and last principle is *Iterative design*. This principle is perhaps the simplest of the three, but the most important. The idea is to improve the product by using the previous principles and look at the results. This process is repeated, to improve the product through iterations. As the product reaches a more mature state, it becomes increasingly difficult to improve at the same rate. After a certain number of cycles, the effort put into the first two principles becomes so huge compared to the value gained, that the iterations either slow down or stop altogether.

These three principles have been realized by using the methods mentioned below.

2.2 Low-Fidelity Prototyping

Low fidelity prototyping has been used extensively in this project, and is a cheap and easy way to translate complex and huge systems into something more tangible [4]. A low fidelity prototype can be a quickly programmed user interface, wireframe or even a paper prototype. Using it in the early stage of product development can eliminate problems, both in terms of design, content and interactivity [4]. A low fidelity prototype can achieve important feedback before too many resources is spent on the product. This gives the designers the ability to change the design early on, without the expense of changing it programmatically.

2.3 Focus group interview

A focus group interview is a qualitative data collection method [5]. This method was chosen since it allow the participants to answer questions, express preferences, and discuss with the other participants. One of the advantages of using a focus group interview instead of e.g. a semi-structured interview, is that the participants can talk among each other, and change the other participants opinions. By comparison, the only people present in a one-on-one style interview is a single interviewee and one or two interviewers. This can seem intimidating for some, and the focus group interview approach can help reduce the tension by having the interviewees be surrounded by peers. Another advantage is that the participants talking among themselves, can bring up important points. Some of which the interviewer might not have thought to ask about, due to missing domain knowledge.

Picking the participants is also important. The ideal size is between three to ten people [3, p. 271], and it should be mentioned that a larger group size is dangerous since some people might not get a chance to say anything. It is also important to get a diverse group of people, since this allows for more perspective.

As mentioned, five people were attending and chosen based on the following set of criteria:

- 1x case worker with few technical skills
- 1x case worker who is preferably over the age of 55

- 1x case worker who is preferably under 30
- 1x case worker with limited experience as a case worker

A case worker with few technical skills could be more inclined to speak up about the design to make it more intuitive. This could be to minimize the number of menus necessary to find a requested feature, or the number of mouse clicks.

Limited experience could be suited for rethinking certain work processes and how they could be improved.

The remaining two criteria were set up, since this could lead to a greater diversity in how a person would interact with the system.

Looking at the three UDD principles, the focus group primarily focused on the first principle *Early focus on users and tasks*. The purpose of the focus group interview was first and foremost to gain a better insight, due to the lack of domain knowledge.

2.4 Brainstorming

Brainstorm is a method used to generate ideas about any given topic. The ideas does not have to be well thought out, as it is the number of ideas that count. Any idea could lead to an even better idea by combining or reflecting on previously mentioned ideas. A brainstorming sessions was included in the focus group interview, as this would combine the benefits of both methods. The brainstorming session was used to create the first low fidelity prototype in collaboration with the participants. Having a brainstorming session without a prepared prototype gives the user complete control, both in terms of design and functionality. The result made sure, both the first and second principle of UDD was used.

2.5 Wizard of Oz Test

The Wizard of Oz test is a form of low fidelity prototyping on a software system that does not yet exist [3, p. 428]. The principle behind this idea is that the user interacts with the system as if it was complete, but in reality the developer, or wizard, determines what the user sees. When using this test form, the user interacts with the prototype, made either as a sketch or a simple software prototype, and then tell the wizard what he/she wants to press or to interact with. The wizard performs quick changes to the prototype in order to match the action performed.

The prototype from the brainstorming session was used as a starting point for the Wizard of Oz test. It was digitalized and printed to be interactable, which added a benefit of the user being able to write feedback on the printed design. This equates to writing feedback directly into the system, and thus giving important feedback to the low fidelity prototype's design and functionality.

Using this prototyping method made it possible to fulfill the second principle from UDD, *Empirical measurement*. This early gathering of data adds valuable informa-

tion to the system, how it should be designed and function to suit a variety of user needs.

2.6 Think-Aloud Technique

The last method used was the Think-Aloud technique. This method, as the name implies, makes the user speak their thoughts out loud. A benefit of this technique, is that the user can express any thoughts, which gives the interviewer an insight into what the user is thinking. The technique can be summed up into two rules. The first rule is that no wrong thought can be said aloud. Every thought is valid whether it is positive, negative or just commentary. The second rule is the most important rule which is *silences is one of the biggest problems* [3, p. 297]. If the user does not speak out loud, it is not possible to know what he/she thinks, are looking at or whether or not the prototype has a positive or negative impact.

It is difficult to use the Think-Aloud technique by itself. Therefore the technique was combined with the Wizard of Oz test, such that it was possible for the interviewers to follow the users thoughts. Combing these two methods made it easier to follow the second principle of UDD, and it was possible to collect even more information. The technique also allowed for a better use of the first UDD principle, since the interviewers got to know their users thought process, and therefore understand them better on a cognitive level.

3 Initial design

The very first design was a small sketch, made before attending the meeting at Aalborg. This sketch was based on the following key elements:

1. An explanation about the citizen's result
2. A simple user interface
3. No confusing numbers

These were captured during a meeting with Michael Harbo from DigiRehab [6]. The essential idea was to find out how a design could look. The sketch can be seen on figure 3.1 and was made using a sketchpad in OneNote [7] to illustrate. The main element is a scale using a gradient color and a number, indicating the citizens probability for completing the training course. Combing both a visual scale and a number, helps convey a feeling through the colored scale, but also a fact through the number. The idea is for the user to be able to quickly get an impression of the result from the AI. To give the user a further explanation, a simple scrollable text field was added along with a graph.

Last element added was a textbox, and can be seen at the top left corner. This was made as a way of feeding the AI with e.g. the citizens CPR number as an input, and thus be able to get a result presented as output.

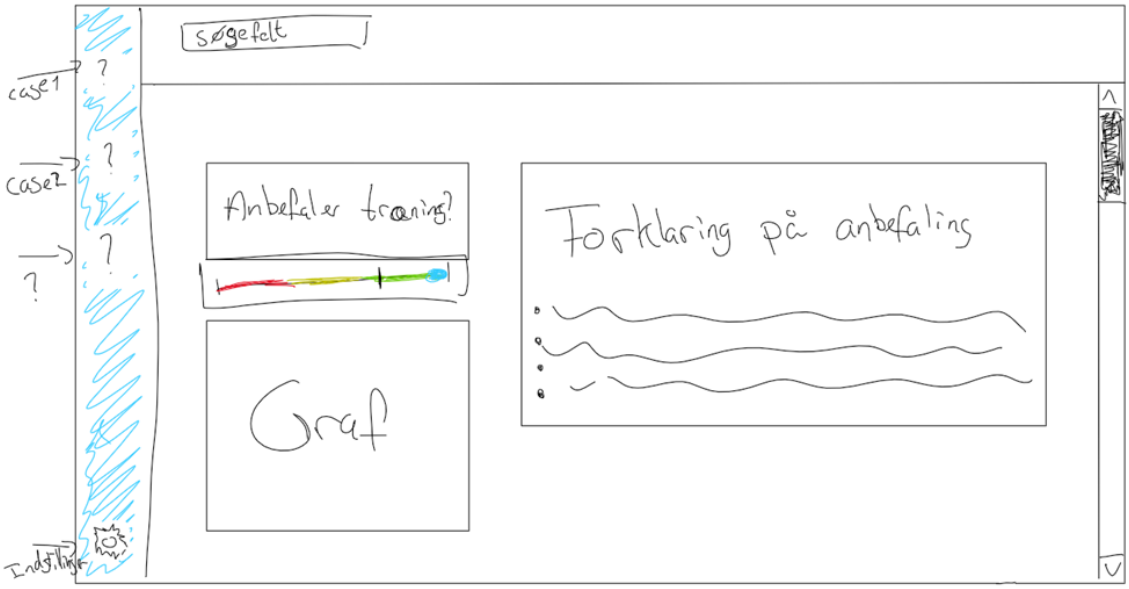

Figure 3.1: Initial sketch

4 Results

In this chapter, the results is presented. As mentioned, these results were acquired during the meeting with Aalborg Kommune the 01-10-2020, and the low fidelity prototype for the Wizard of Oz test originated from the brainstorming session.

4.1 User Requirements

Several requirements were defined by the participants. Both during the focus group interview and the Wizard of Oz test. These requirements are listed in table 4.1. The requirements have not been transformed into concrete requirements, but act as a guideline as to how the system should behave.

Table 4.1: User requirements

Req. Id	Description
UR1	There should be as few mouse clicks as possible.
UR2	The user should have to scroll as little as possible.
UR3	There should be a number that indicates the probability of completing the training course.

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Table 4.1 – continued from previous page

Req. Id	Description
UR4	There should be a visual representation, that indicates the probability of competing the training course.
UR5	The reason behind the probability should be explained.
UR6	The AI reasoning should express the positives that increases the probability.
UR7	The AI reasoning should express the negatives that decreases the probability.
UR8	The number of reasoning windows should not be static.
UR9	The number of reasoning windows should be dynamically generated.
UR10	There should not be shown too much information by default.
UR11	The reasoning windows should be collapsed by default.
UR12	There should be a list of all the assistive tools the citizen posses.
UR13	The list in UR12 should state under which paragraph the citizen got the assistive tool.
UR14	The list in UR12 should state when the citizen first acquired a certain assistive tools.
UR15	There should be a graph representing when in time the citizen got which assistive tool.

4.2 Design

The following section introduces the design of the first low fidelity prototype in digitalized form, along with a wireframe. It should be noted, that not all of the above requirements are fulfilled in these designs.

4.2.1 Low Fidelity Prototype Design

The following design is the first low fidelity prototype created in collaboration with the participants, during the brainstorming session. It can be seen on figure 4.1.

Throughout the brainstorming session it was made clear that some sort of result should be displayed. A number was at the beginning good enough for most of the participants, until it was asked if an additional way of visualizing the result could add value. Different designs were drawn, but the gradient scale came as a design element all participants could agree on. Since a number and a gradient color does not tell much by itself, some additional reasoning windows were added, to give a more in depth explanation from the AI. These reasoning windows should be priority based, as to which explanation is the most important to read. As seen on figure 4.1 one of the windows are collapsed. By default all windows should be collapsed, until a case worker clicks on one of the of them. This was to ensure a simpler user interface by default.

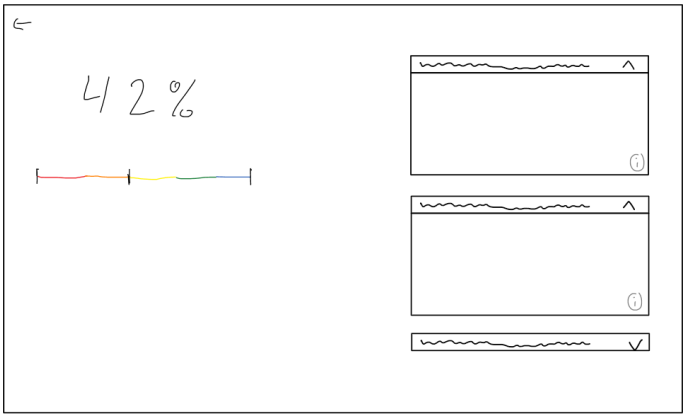

Figure 4.1: First draft of design

During the Wizard of Oz test, a design idea was brought to light by one of the participants. The idea is symbolized on figure 4.2 by the box on the right. It illustrates a table and a graph of the assistive tools the citizen posses. By providing this information it became possible to get a condition overview of the citizen. Additional information could be whether the assistive tools had been requested by the citizen, or if the tool was provided because the home helper requested it. In fact it was clear that all participants would like to have some sort of table with the raw data concerning assistive tools presented. Some of the participants liked the idea of the graph while others just wanted the raw data presented. Since the project is about visualization, it was decided to include both the graph and the raw data into the next stage of the design. Another idea was a small *information icon* as can be seen on figure 4.1 in the lower right corner on each window. The idea behind this was to show which variables or factors that had an influence in the explanation.

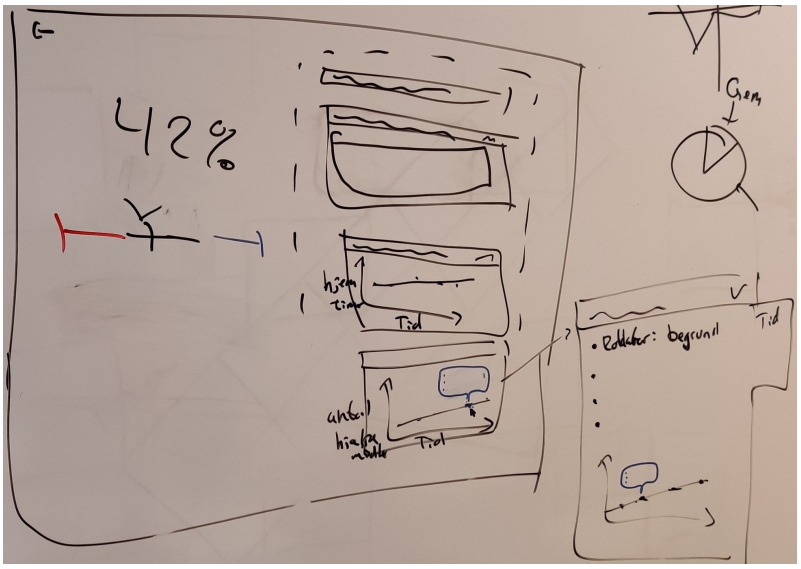

Figure 4.2: Design idea during the Wizard of Oz test

4.2.2 Wireframes

To get a more accurate design representation, a wireframe was made [8]. The wireframe was based on the gathered user requirements, the low fidelity prototype design and the overall insight knowledge gained during the meeting. The gradient scale from the previous design seen on figure 4.1 have been changed to a circular progression bar. This was to give a modern feel while keeping the idea behind the gradient scale and color. As mentioned above a new addition to the low fidelity prototype was added as a table combined with a graph, showing what assistive tools the citizen have, and when these assistive tools were visited. As for the four reasoning windows, a sentence is provided as a paragraph to give a short explanation behind the result. This can be expanded as seen on figure 4.1 with a more detailed explanation. The *information icon* is also included in the wireframe when the windows is not collapsed. The search bar at the top right corner serves as an illustration as to how the AI could be feed with an input.

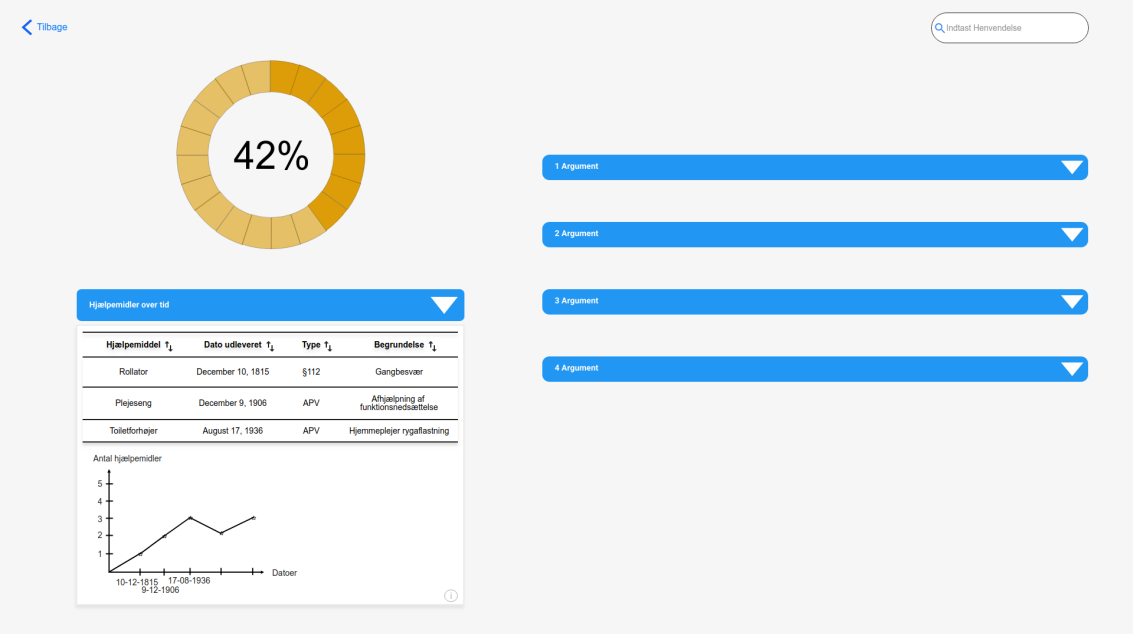

Figure 4.3: Wireframe design

5 Conclusion

The initial designs for the AIR project took some time to get started as the group members first had to do some research with regards to different approaches for doing user driven development. This procedure also made it clear how much work it takes to prepare, plan and execute different meetings such as a focus group interview and a Wizard of Oz test. The group members previously had some minor experience with focus group interviews, but had not conducted one on a more professional level. Trying different methodologies for how to best interact with the end user, proved how different the results can be. Looking at the results from the focus group interview

the big gain was the general look and feel of the design. This changed completely during the Wizard of Oz test where the results contained minor improvements to the design, but gave a better insight into some of the information the end user would expect to find in the final product. The contrast between these methods made it clear that depending on what the goal is, a different approach to the problem should be used.

Looking at the designs attained during this project creates a good foundation for future work, and using these designs could lead to an acceptable end product. There is however a significant chance that a portion of the design and functionality would have to be reworked, due to the lack of user involvement in the later parts of the development cycle. This conjecture is based on how the users interacted with the system during the Wizard of Oz tests as this varied in spite of a few similar patterns. Because of this, it is safe to conclude that further user involvement during the development can save time in the long run, because of fewer reiterations. It is also a way to get more concrete and well defined requirements for the product as time progress, and the prototype gets more defined.

6 Future work

This project creates a strong foundation for future work. The next step would be to plan a new meeting with a strong focus on the wireframes to verify its design. It would also be a great opportunity to verify some basic functionality to let the users know, how the system is going to be to interact with. After the meeting it should be possible to start developing an actual application. Some of the main goals for the application is to have the design to work and feel as the user intended it. By doing so, more time will be spent on developing an application the user wants. This requires a continuous dialog with the users to maintain a proper direction. Another main goal for the development of the application should be the architecture. Having a great architecture will result in features being easily implementable without modifying already working features. This is an important goal since UR9 in the user requirements table 4.1 states that the number of windows present on UI of a citizen is not always the same.

7 References

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