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Seamlessly access and share data between interactive devices based on natural user interface

- Focus on daily Scrum meetings

Master of Science Thesis in Interaction Design

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Gothenburg, Sweden, January 2012

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Abstract

The purpose of this study was to investigate if interactive devices could be used as an aid during daily Scrum meetings. Another aim was to find out how to seamlessly share data between different interactive devices during daily Scrum meetings, based on the NUI paradigm. The study was conducted at and commissioned by Touchtech, a software company developing multi-touch solutions in Gothenburg. The research methods utilized in this study consisted of a field study, brainstorming, paper prototyping and low-fidelity prototypes with user tests and questionnaires.

The interviews indicated that the biggest concern for the employees was that interactive devices would be too time consuming to be used during daily Scrum meetings. Brainstorming and paper prototyping led to seven low-fidelity prototypes for Microsoft Surface, Microsoft Kinect and Windows Phone. These prototypes were tested during daily Scrum meetings and then followed by questionnaires. The questionnaires indicated that privacy was a big concern for the participants and the most popular prototype was developed for the Microsoft Surface that used tag as identification and only let the owner of the data display the information. Further the participants favored the prototypes where the number of steps required to share data was few and where participants could copy files between each other without having to disturb the one presenting.

The research indicates that interactive devices could be used as an aid during daily Scrum meetings but more research needs to be done. The authors suggest that the prototypes should be tested at more companies during their daily Scrum meetings and also more different prototypes should be done to see if it can be improved even more.

Keywords: Human-computer interaction, interaction design, daily Scrum meetings, Microsoft Surface, Microsoft Kinect, Windows Phone.

Acknowledgement

This Master Thesis is the final work at the Master of Science program in Interaction Design. The thesis consists of 30 credits, which is equivalent to 20 weeks of work. We want to thank our corporate supervisor, Deniz Chaban, for his support and guidance as well as the coworkers involved at Touchtech for being helpful and cooperative. We would also like to thank our examiner Morten Fjeld and the entire research team at TableTop Interaction Lab for their valuable feedback.

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1 Introduction

Scrum is a tool for software companies using the agile development process (see section 2.7). In agile development all members of the team have a short everyday meeting called daily Scrum. This is an important channel to share knowledge in an organization and helps the team understand each other's tasks and problems. In these meetings the participants have a short time explaining what they have done the previous day, what they are going to do today and what problems they have encountered. This thesis is written in the field of interaction design and the focus lies on the daily Scrum meeting in a small organization and how interactive devices and software can be used as an aid. The motivation for this master's thesis is to study and improve daily Scrum meetings.

1.1 Goal and aim

The goal and aim for this thesis is to research the possibilities with today's technologies and how they can be used to improve the way data is shared inside an organization. The research focuses on daily Scrum meetings since this is a situation involving a small group of people where a need to share information already exists. All the research and prototypes are done on existing commercial devices.

1.2 Research questions

- Can interactive devices be used as an aid during a daily Scrum meeting?
- How to seamlessly share data between different users using interactive devices during daily Scrum meetings, based on the NUI paradigm?

1.3 Limitations

To share data and knowledge is a vital component inside any organization. Modern technology has increased the possibilities on how this can be done. Even though the possibilities for this are increasing, many companies have problems implementing this in a way that encourages the employees to use the available techniques and the possibilities. This thesis does not try to handle social dilemmas occurring when sharing data in organizations.

Since Touchtech is a certified Microsoft partner, prototypes are developed for Microsoft products and research is done on commercial products. All prototypes are low-fidelity prototypes and technical shortcuts have been taken since the main focus lies on the interaction and investigating different ideas, not to create a fully working system. The shortcuts are both security related as well as using the simplest way for communicating.

1.4 The company

Touchtech develops software applications for interactive devices such as Microsoft Surface, smartphone and Microsoft Kinect. They also develop technical multi-touch solutions for interactive floors and walls.

"Interactive spaces and surfaces that engage and bring people together. Intelligent applications that adapt to our needs for an exceptional experience. That's our vision!"

Touchtech vision (1)

2 Theoretical background

This section presents the theoretical background such as related work, interactive devices, human computer interaction, natural user interface and Scrum.

2.1 Related work

There is a lot of research done on how different interactive devices can be used to simplify or improve different business meeting scenarios. In this section an overview of some work related to this thesis will be briefly presented.

The first paper is about using a PDA in different meeting scenarios and the software designed for these scenarios (2). The major implication according to the writers was to make electronic meeting systems interoperable, allowing different devices to exchange information in an integrated way. In this article their solutions was to exchange data using XML standard, allowing different devices to communicate with each other, but also to use a standardized meeting information structure to support different meeting scenarios. The technology available today offers other ways to support management of information. This paper helped limit this thesis to only handle a single meeting scenario and to only focus on available interactive devices. This thesis will also focus on the natural user interface paradigm to make the learning process for the users shorter and hopefully interest more people in the benefits of interactive devices as an aid.

The second article describes an application for project planning called “ScrumTable” (3). The software is designed for Microsoft Surface v1.0 (see 2.2.1) and is intended to help organizations during an entire development process, from planning the projects to daily Scrum meetings. While “ScrumTable” tries to be a solution for the entire process, this thesis focuses on how interactive devices can be used as an aid during the daily Scrum meetings. It will also give a better understanding on how sharing of information might best be done on existing interactive devices.

2.2 Interactive devices

Today many interactive devices are available for customers such as Microsoft Surface, Microsoft Kinect and smartphones. These devices use the human body as navigation and are far from standard mouse and keyboard. They need a new way to think on how interfaces should be designed, and how the interaction should be done in a smooth and enjoyable way. The following section will describe the hardware that this thesis covers.

2.2.1 Microsoft Surface Version 2.0

Microsoft Surface Version 1.0 was announced in May 27, 2007 and released the next year (4). It is a multi-touch table where users can interact using both their hands and physical objects. The table is designed for multiple users and has a 360-degree interface to support users on all sides of the table. The touch-screen is capable of object recognition and can respond to over 50 different objects at the same time.

The newest version of the table, which is Microsoft Surface Version 2.0, has a 40-inch LCD display, and a thickness of 10cm allowing for both vertical and horizontal placement. A new technique called PixelSense is used to detect inputs (5) where each pixel on the screen has an infrared light pixel built in that can detect touches. Microsoft Surface Version 2.0 runs on a custom version of Windows 7.

Figure 1: Microsoft Surface 2.0.

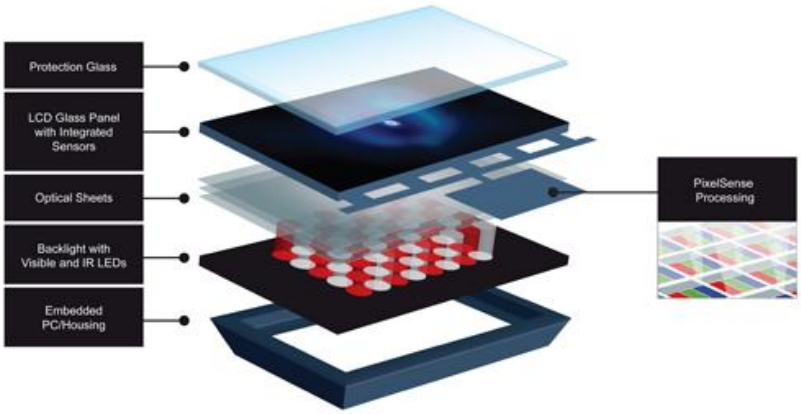

Figure 2: The different components of Microsoft Surface 2.0.

2.2.1.1 ScatterView

To simplify for developers on the Microsoft Surface a control exist which allows for manipulation of User Interface (UI) elements using gestures. All interface objects such as buttons images etc that can be put on an interface can be placed inside a ScatterView allowing the user to move, rotate and scale an object freely (6).

Figure 3: An image placed inside a ScatterView.

2.2.1.2 Tags

The Surface table can respond to specially designed barcodes, which can be placed onto physical objects, giving the table the possibility to distinguish physical objects placed on the table (7). The tags are limited to having 256 unique values between x00 – xFF.

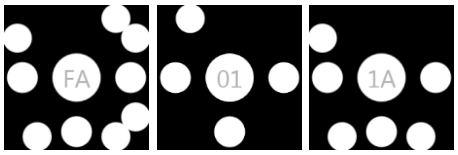

Figure 4: Example of tags used by the surface for object recognition.

2.2.2 Microsoft Kinect

Microsoft Kinect is a gaming device that enables the player to interact with their body without an ordinary game controller. The Kinect uses several different technologies such as depth sensors, RGB camera and multi-array microphone. The depth sensor includes an infrared laser and a CMOS sensor. For every laser dot projected by the laser and processed by the CMOS a comparison is made with neighboring dots to get the depth. This produces a depth image, which is used to distinguish a person (8). The algorithm developed by Microsoft can detect and follow a person independent of their size or position and without any need for a calibration position (9). The infrared laser works under any ambient light condition but since the system has low resolution the Kinect has a hard time to read small objects.

Figure 5: An image of the Microsoft Kinect.

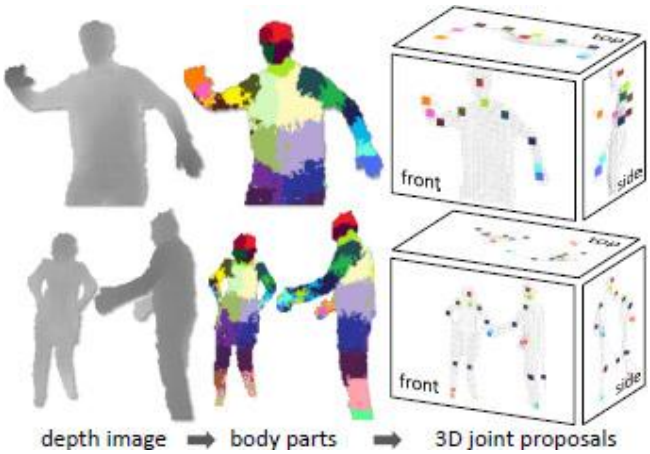

Figure 6: Simple representation on how the algorithm goes from a depth image to a joint proposal.

2.2.3 Microsoft Windows Phone

This report will only handle smart-phones with Windows operating system (10). This is because of the availability, since the company Touchtech is partner with Microsoft and because development environment used in this thesis is the same for all Microsoft products. Windows Phones are available from many different brands such as Nokia, Samsung and LG. The strength of a smartphone is the mobility and that it is multi-functional giving the user the possibility to call, send text messages, access the Internet, and use the phone as a GPS and much more.

Figure 7: Image of the newly released Nokia Lumia 800 using Windows Phone.

2.3 Development environment

All interactive devices presented in the previous section are Microsoft products and they all use the same development environment. The following section explains the two major parts required to start developing for Microsoft products.

2.3.1 Microsoft Visual Studio

Visual Studio is an integrated development environment (IDE) that allows creation and management of Microsoft based projects (11). The included tools are among others code editor and debugger. Microsoft Visual Studio supports several different programming languages but for this thesis the languages C# and Extensible Application Markup Language (XAML) was used (12). C# is an object-oriented programming language and XAML is among others used to define user interface elements and data bindings. They are both designed and maintained by Microsoft.

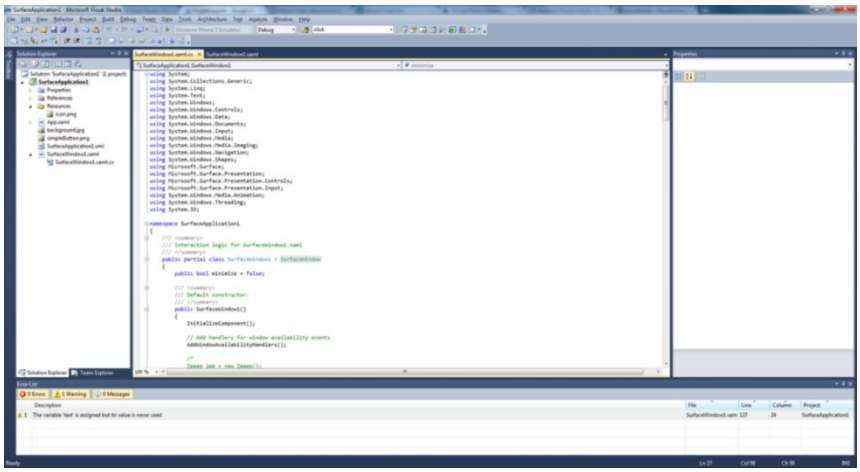

Figure 8: Print screen of Microsoft Visual Studio.

2.3.2 Microsoft Expression Blend

Microsoft Expression Blend is a tool for designing XAML-based graphical interfaces (13). Buttons and other assets are created in a drag and drop fashion. Blend allows for easy customization and animation of all objects. Blend also contains a simple code editor for writing C# code. The program is designed for agile development where a programmer and a designer can work at the same time on the same project.

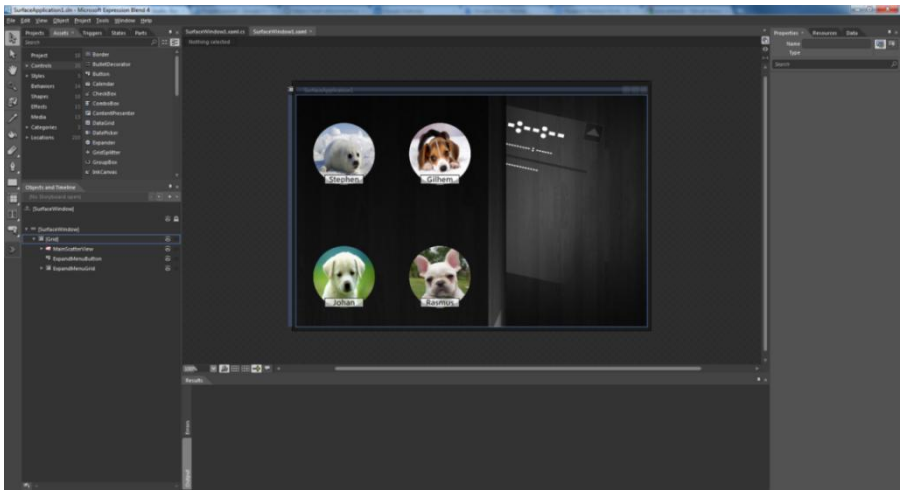

Figure 9: Print screen of Microsoft Expression Blend.

2.4 HCI

In the 80's when personal computing emerged everyone was a potential customer requiring a new way of thinking regarding usability and usefulness. This resulted in a new research area called Human Computer Interaction (HCI) which is the study of interaction between humans and computers (14). HCI goes beyond designing interfaces and studies the effects that computer systems have on users. The designer should take into consideration abilities, limitations and working environment of the users when designing a new system. If the system is developed without consideration of the usability perspective, users will have to spend a lot of time learning the new system. One risk with this is that the users might use other means to complete their task instead of learning the new system. Since computers today are part of daily activities, designers are endlessly looking for ways of making communication between users and computers easier and more efficient. HCI is considered to be a multi-disciplinary subject requiring people with knowledge of users' cognitive psychology and social sciences, as well as hardware limitations and possibilities.

ACM SIGCHI Curricula for Human-Computer Interaction definition for HCI is the following (15): *"Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."*

2.4.1 Interaction design

Interaction design is a fairly new design area using its own set of methods and approaches even if it is related to other disciplines including design and social discipline (16). Interaction design does not only focus on form but also on behavior of interactive products and the needs and desires of users'. This means that an interaction designer has to adapt the technology to users. Interaction design

focuses on “how things might be” opposed to a science or engineering where the focus is “how things are”.

2.5 NUI

According to Brave NUI world the term Natural User Interface can easily be misunderstood, the word Natural does not refer to mimic the real world (17 ss. 9-14). When talking about natural in this context, it is rather about creating a user experience that feels natural to both the normal and expert user. Another important factor is to not try copy already existing user interface paradigms but instead try to explore the new possibilities. This section will cover both the history behind NUI and some guidelines that have been followed in this thesis.

2.5.1 Interface history

Command-Line Interface (CLI) was popular on the early Cathode Ray Tube (CRT) based computers (18). There were predefined commands for different actions and the user was forced to remember them. Each time a command was entered, text was printed out as feedback. It could either be the result of that command or a feedback telling that the command entered is unavailable. Since there were no graphical representations other than text, users had to learn those different commands depending on where you were in the system. With this kind of static interface, new users have to know what those commands do in beforehand.

Graphical User Interface (GUI) was a huge step from Command-Line Interface and it is still used today. In GUI a command is represented by a symbol, it could be an icon or a button from a menu. Commands are executed using the computer mouse and feedback can be clearer state of the interface where you can get additional information by hovering, pressing or releasing the mouse cursor. This type of interface is much more user friendly than CLI and the user can discover those commands while exploring the program.

Today users are introduced to another interface paradigm: Natural User Interface (NUI). This kind of interface relies on intuition and is more common on touch screen systems. This kind of system provides another way to execute commands. It should be more self-explained and appeal to both normal and expert users. This is achieved by using as few commands as possible for each task.

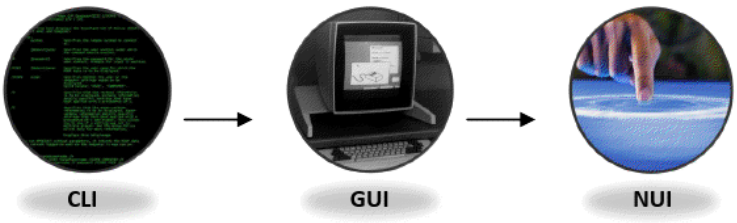

Figure 10: From CLI to NUI.

2.5.2 Social

The well-known Graphical User Interface limits the user with its single input and output system, such as mouse and keyboard (17 ss. 37-42). This tend to eliminate the social aspect of working together and also supports the classical way of working alone, for example in front of the computer. To achieve a more social work environment, the focus must rely on the interaction between the people

around the devices and not the interaction with the device. A device should be a helping tool when socializing with the people around it and not the tool you communicate through. Using such devices that supports multi-user input with the Natural User Interface can emphasize the social experience. This approach also fits perfectly for social gaming where two people have to communicate to complete the same task.

2.5.3 Seamlessness

Seamlessness is one of the more important factors of the Natural User Interface paradigm (17 ss. 43-46). To create a sense of seamlessness increases the users' experience greatly, but at the same time it can also be broken very easily. Therefore this topic is very fragile and should be kept in mind when designing Natural User Interfaces.

To make the user accept this sense of disbelief and keep it that way, a couple of features must be taken into consideration: respond to every contact from the user and give clear feedback of the object that is being manipulated, respond immediately to every contact from the user and smoothly animate and translate the object that is being manipulated without any interruptions.

As soon as one of these features break, the user's sense of connection to that object disappears. The benefit with a seamless Natural User Interface is that the user can easily adapt and the learning curve can decrease, but this must be tested with several users.

2.5.4 Touch versus in-air gestures

Choosing systems with In-Air gestures for certain situations must be done carefully (17 ss. 97-103). It is nothing like touch surfaces, since the actions are recorded at all times. When working with touch surfaces actions will only be recorded and registered when touching the surface. In-Air gestures are a one state system where every little movement is registered.

When designing for In-Air systems, there is no way to simulate a real button press. There are different solutions for this, for example a button press can be done by hovering over a button that is represented on the screen. This can be a good solution at first glance but it has disadvantages. Hovering over a button can be unclear and the user has to aim pretty accurate for a certain amount of time.

Another example of an action is gesture. For example a circle gesture, which can be used to perform a certain action. One major disadvantage of using gestures is that it is unknown to the user the first time the user uses the application. Another disadvantage is while navigating, the user can accidentally create a circle gesture.

2.6 Formations around interactive devices

To understand how to design an interface for an interactive device, knowledge of how people interact with each other has to be acquired. This section focuses on theoretical analysis on how people interact and which pattern they usually follow while interacting with other people and devices. This thesis only explains the parts that are relevant to the interactive devices covered earlier in this chapter.

F-formation is shortened of "facing formation" and it is set of different formations people can achieve when there are two or more participants (19). This was a study done by Adam Kendon and it

is well known in computer-supported cooperative work. Although his main research area was gestures, he was deeply interested in face-to-face interactions.

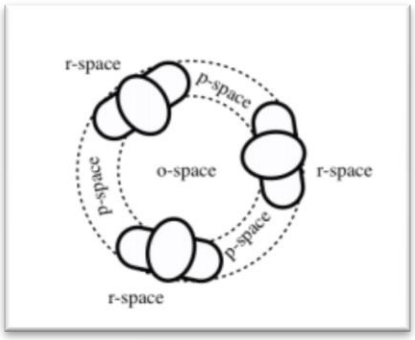

Figure 11: Image shows an “o-space” formation.

Figure 12: A “semi-circular” formation.

The most relevant formation when designing for Microsoft Surface is the “o-space” where three or more people create a circle where they are facing each other. This thesis also looks into “semi-circular” position, which is used when interacting with the Microsoft Kinect.

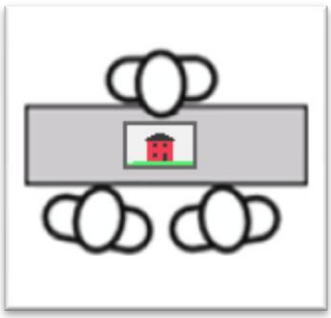

Figure 13: Two people seeking information at the counter with an assistant.

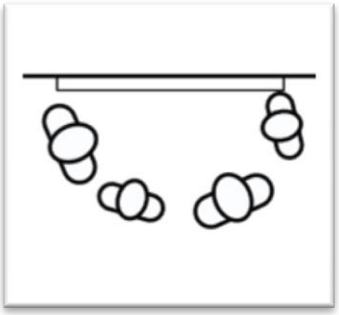

Figure 14: “Semi-circular” F-formation around a display on the wall.

Adam Kendon tested different scenarios where the first relevant one was an interaction between two people seeking information from a third person at an interactive counter, where they formed an “o-space” (see Figure 13). All three participants had access to the information displayed on the counter. The problem arrives when there are more people involved. If there were four people at the counter, the fourth person would participate but not play an active role (if the fourth person stood at the nether side of the counter), the purpose with interactive screens where it should enhance the social aspect breaks. If the counter had more space at the sides where more people could fit around it. Then it could handle up to four to five people before the social aspect broke. To fully experience the interactive screen, there should not be more participants than the screen or the space around it can handle.

When comparing to the Semi-circular F-formation (see Figure 14) the study shows that a screen on the wall fits much better for larger groups. Everyone becomes equally active and there is no dominant role. This is thanks to a “semi-circular” F-formation around the display on the wall. The decision-making and the discussion engage everyone. Even if everyone is not all talking, they all have access to the information. All of them can go up to the display and point at stuff. This kind of display is recommended for larger groups than four to five people but at the same time not too large.

2.7 Scrum

The Scrum is an agile development method mostly used in software development teams, which helps to organize and increase the productivity of the team (20). Since the method involves small iterations, the probability that the product would fail during its development process decreases. The team works in so called “Sprints” that can last from 1 to 4 weeks. During this period, a “daily Scrum” meeting takes place to give the whole team, including the team leader and the product owner, a brief overview of where development team are and what they are going to do.

The Scrum framework has three roles, three ceremonies and three artifacts:

Roles	Ceremonies	Artifacts
Product owner	Sprint planning	Product backlog
Scrum master	Sprint review	Sprint backlog
Team	Daily Scrum meeting	Burndown chart

Table 1: A Scrum consists of different roles, ceremonies and artifacts.

2.7.1 Roles

There are three different roles in the Scrum framework which have a close connection to each other and to the project.

2.7.1.1 Product owner

The product owner could be a customer or a customer representative. It is the product owner who has the vision and the list of features that should be included to the product. He also decides the release date and accepts or rejects the work results. During the development process, he can choose to change features and priorities during each Sprint meeting. It is also his job to make the product profitable.

2.7.1.2 Scrum master

The Scrum master is usually the leader of the development project or the team. His job is to make sure that everyone follows the process of Daily Scrum, Sprint Review and Sprint Planning meetings. It is also his responsibility to solve any internal problems within the team, to provide as high productive and functional environment as possible. His other responsibilities is to keep close relationship with other teams or part of the cooperation

2.7.1.3 Team

It is recommended that the team should consist of around 7 members. The team together decides the goal of each Sprint and each member of the team organizes his work. Each member also gets a lot of freedom as long as it is within the boundaries of the project and the final Sprint goal is reached. They also got direct contact with the Product owner and are present during demonstrations of the product.

2.7.2 The process

The whole process starts with the product owner's plan for the product (see Figure 15). He presents a list of different features that should be included into the product, also called the Product Backlog. This list includes inputs from end-users, customers, team and other stakeholders. The Product Backlog is then reviewed by the Scrum team to estimate the cost of the development. The review is usually done in 10 workdays and involves breaking down the list in even smaller tasks and those are then prioritized.

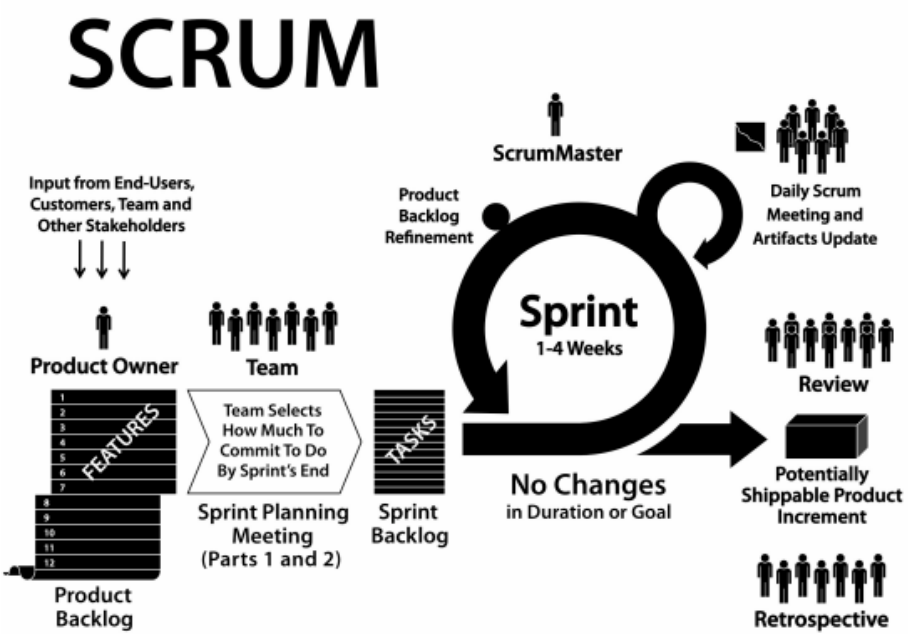

Figure 15: Scrum process (20)

When most of the Product Backlog has been defined, a Sprint Planning Meeting is being held. This meeting is to plan the first Sprint that can be up to four weeks. In this meeting the team decides how much work that can be done during a Sprint depending on the team size, team's productivity level and length of the Sprint period. They select a number of top prioritized features to implement from the Product Backlog during the Sprint and select new ones for the next Sprint. This selection of features is called Sprint Backlog.

When the Sprint has begun, a Daily Scrum Meeting is being held which the Scrum Master leads. This session is very short and can be around 15 minutes. The task of each team member is to answer three questions: What did I do yesterday? What will I do today? And what blocks, problems or impediments are getting in my way?

This kind of information later provides the Scrum Master an indication of how much progress the development team has accomplished which is used in a so called Burndown Chart. A Burndown Chart is a graph, which represents team's progress (see Figure 16).

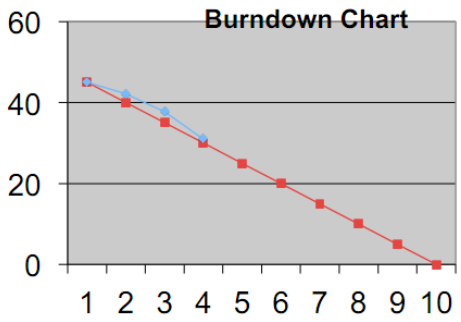

Figure 16: Burndown Chart where the Y-axis represents the person-hour of work remaining in a Sprint and the X-axis represents the number of day left for that Sprint. (20)

This kind of chart can be hung on the wall to show the team when they are making progress. This can give a sense of satisfaction and completeness. Although this chart can change during a sprint if new problems have been detected.

At the end of the Sprint, a Sprint Review Meeting is being held. This is to review the progress of the team or hopefully a potentially shippable product. In the first half of this meeting, the Product Owner presents the progress to all attending stakeholders and the Scrum team. He presents the items from the Product Backlog that have been worked on and completed. During this meeting other elements are also being reviewed such as business, market and technology. At the end of the first half, the discussions involve what items from the Product Backlog to prioritize or if there is other changes that have to be done. The Scrum Master holds the second half of the meeting where he talks to the Scrum team about their progress, about what did go wrong and what could be improved for the next Sprint. After the Scrum Review Meeting the whole process starts all over again.

2.8 Data storage

To be able to access and share data, it has to be stored somewhere. There are a number of ways for accessing data, and the most common way is from the hard drive or a removable media. But in organizations and in other similar situations there is also a need to access data from a mutual server either remote or local.

A technology that is becoming very popular is Cloud (21). Cloud can simplest be described as an off-site data storage system which is maintained by a third party company. This stored data can be accessed from anywhere with any device that has an Internet connection. It can also be shared with other people if wanted. This provides a new way to share data and possibilities of collaborative work. Other than storing data, Cloud services offers processing power, which can be used to run applications on the remote network. There are several companies that offer this solution of accessing and synchronize content. This will enable companies to have the main part of their business logic in the cloud and the part running on the devices will be used for presenting data and connecting to other devices and services. This way the file systems are starting to be represented in a more abstract way. People no longer have to browse windows and folders to find documents. Instead they are all handled and presented by the apps where each has a specific purpose. Those apps can also be designed in a more user-friendly approach.

The benefits or advantages of this kind of technology would be like mentioned before, that the stored data can be accessed from anywhere with any device that has an Internet connection. Another factor would be cost efficiency. This kind of data storage requires a server, which takes up office spaces. By using Cloud services the companies save money from renting physical spaces. This also results in decreased administration and maintenance costs.

3 Methods

This section describes the different methods used during this project. A field study was used to understand the workplace and its employees, brainstorming to generate different scenarios, paper prototyping to illustrate and refine and finally low-fidelity prototypes were build to further test and evaluate.

3.1 Field study

The purpose of the field study is to collect information concerning user behavior at their workplace. Important factors are to understand the users, their environment and tasks (22). A field study usually starts by trying to determine what kind of data is required and where to obtain it. After this the actual data is gathered using for example: direct observation, participant observation and interviews.

3.1.1 Observation

From an interaction design point of view the goal is to understand how people interact with technology, environment and each other. Observations are a great way of identifying the context and helps identifying the needs of the users.

Direct observation may be an initial approach when gathering data and understanding a problem. In direct observation the observer should not be engaged in the situation and the gathering of data is instead done through visual inspection of situations. One disadvantage with this is that the behavior of the participants under observation may be affected by the fact that the observer is studying them. The data collected could be field notes, images or videos.

Another method is participant observations where the researchers participates in everyday activities and tries to be part of the social settings during a longer time. One advantage is that the researchers will be part of the social group and members will act as they normally do, the researcher will also get good understanding of the problem. This is harder to realize and requires more time than direct observation but brings very valuable data.

3.1.2 Interviews

Interviews are used to gather data by asking questions. One way to interview is to ask questions during a direct observation. This informal way allows the researcher to be flexible and capture emerging information, but the data acquired may be unstructured.

A more formal way of interviewing can be made using a set of predefined questions. These questions should be as open ended as possible to give as much data as possible. It is also possible to mix these interviewing techniques so that the interviewer can follow up with new questions as they come up.

3.2 Brainstorming

Brainstorming is a very powerful method when it comes to idea generation (23). A brainstorming session typically involves a group of people, gathered and trying to come up with some ideas for a certain problem or task. It may sound easy to some but very few use its full potential. To maximize the outcome from a brainstorming session there are some certain rules that should be followed. Probably the most important rule is the premature judgment. A silly idea from one person can lead to a new one from another person. That way the group can use each other as a source of inspiration

and generate ideas based on others. That is why any idea is a good idea during a brainstorming session. To increase the silly idea generation, a good rule might be to have the group come up with hundred ideas during an hour. That forces people to say whatever idea that comes in their mind.

The setup for brainstorming session can vary but there are some good pointers for a successful session. For example a group should not consist of more than 8 people and they should be of different background and expertise. Anything that can contribute to an idea generation or inspiration should be brought along. It can be toys to play with, some images to look at or even something totally unexpected to make the people think in other directions. The environment should provide a lot of space to walk, sit and stand. There should also be tons of writing spaces such as whiteboards, papers and post-it pads. As wrap up there can for example be a post-it voting where each participant choose a couple of post-its or ideas to show their direction. This can end with a review and discussion of each other's directions.

3.3 Paper prototyping

Paper prototyping is a well-known method for early usability testing (24). This method helps to give an idea of how the system roughly will look and feel at an early stage of development, before spending hours with writing code and then realizing that this is not working.

The intention is to realize software ideas in paper form and let users test different scenarios. Also to use the acquired knowledge to improve or discards ideas. The method also emphasizes working with several people and merging ideas. The participants do not need to have any technical background. All it takes is some papers, pens, scissors and imagination.

3.4 Low-fidelity prototype

Prototypes can be created to test an idea and compare different designs. They can also help to clarify decisions or find design issues. A low-fidelity prototype has just enough features to perform a usability test, to give valuable feedback of the content, meeting time and workflow (25). A usability test can also end with a questionnaire to receive more personal opinions of the participants.

A low-fidelity prototype should be very simple instead of having advanced animations to impress the testers. A very good looking prototype can make the testers to not be able to provide constructive criticism since they may be afraid of doing so after seeing how much work it has been put into. They can also be so impressed that they forget give relevant feedback of the content and the workflow.

4 Implementation

This section describes the implementation of the different methods that was used during this project such as field study, brainstorming, paper prototype and low-fidelity prototype.

4.1 Field study implementation

The employees at the company Touchtech were observed several times during their Scrum meetings. This was done during a period from October to December in 2011. The field study was divided into three iterations. The first iterations included direct observation. The second iteration included participate observation and in the third iteration interviews were performed. The data from these would be the spinal cord of the brainstorming and the paper prototyping session.

4.1.1 Observation of the Scrum meetings

All observations were done at Touchtech in their office spaces. The purpose was to understand the process of a daily Scrum meeting and how people shared data between each other.

The first phase of the observation included direct observation where notes were taken. Those notes included information such as formations, time, and environment settings and helped to give some confirmation of what a daily Scrum meeting was. The direct observation was helpful but not enough to understand the daily Scrum meetings. To get more insight of what the participants experienced, a closer observation needed to take place. Next phase of the observation involved participate observation. This was done over a couple of weeks and gave the rich insights of where and when technology could be used during such meetings. This was the starting point of the research around Scrum meetings.

4.1.2 Scrum interviews

The interviews was performed to support the data that was collected from the observation and to get additional information from those who almost in a daily basis participate in such meetings. The questions differed from person to person depending on their position at the company (see 8.1). The questions were very focused on interaction and how and which kind of data people wanted to share. The interviews were performed in a closed room at the company Touchtech. Everyone involved in the Scrum meetings were interviewed separately to get each individuals unique opinion. The people interviewed were the Scrum-master, employees and the chief technology officer.

4.2 Brainstorming implementation

The brainstorming session was done in a meeting-room at the company Touchtech (see Figure 17). The room was filled with different devices to give the participants some inspiration. The session included two iterations and all the ideas were written down on post-it notes. The first iteration emphasized to generate as many ideas as possible even if they were silly. The second iteration took place right after the first iteration with a coffee break in between. The best ideas were picked from the first iteration and new ideas were generated from those. In the end the different ideas were reviewed and discussed from each participant's point of view. The brainstorming session was attended by the people working with this thesis.

Figure 17: The environment of the brainstorming session.

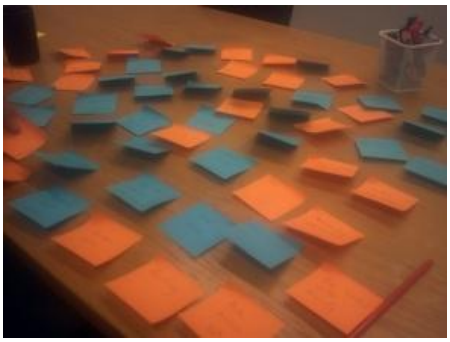

Figure 18: First brainstorming iteration.

Figure 19: Second brainstorming iteration.

4.3 Paper prototype implementation

The paper prototypes were implemented from the ideas of the brainstorming session and the discussions around the field study result. It was done in a meeting-room at the company Touchtech with a lot of paper and different colored pencils (see Figure 20). The prototypes included how the user could access and share his files with other users, since the goal of this thesis is not to create a fully working system but instead to try different solutions. That is why the focus relied on the interface and the interaction. The paper prototypes were done in several iterations. This was done because during some of the first usability tests, new ideas were born after seeing how people used this kind of product. The usability tests involved the people working at the company where two people at the time and tested one of the paper prototypes. Each test involved a scenario where they had to talk about an image and share it with the other person. The aim was to observe where these different products had errors and how they could be improved. These factors were noted by the second person working with this thesis but not actively participating in the usability test. This section describes the different paper prototypes, and the outcome of the usability tests can be read in the result section (see 5.3).

Figure 20: The environment of the paper prototype session where a lot of paper and colored pens were used.

4.3.1 Paper prototype 1: List view

The first paper prototype is intended for Microsoft Surface and was inspired by list views used in graphical user interfaces. The paper prototype was divided into three columns. In the left column the user can select which account to access and the files belonging to that account will be displayed in the middle column. When a file is selected, the right column will display all available accounts the user can choose to share the file with (see Figure 21 image 5).

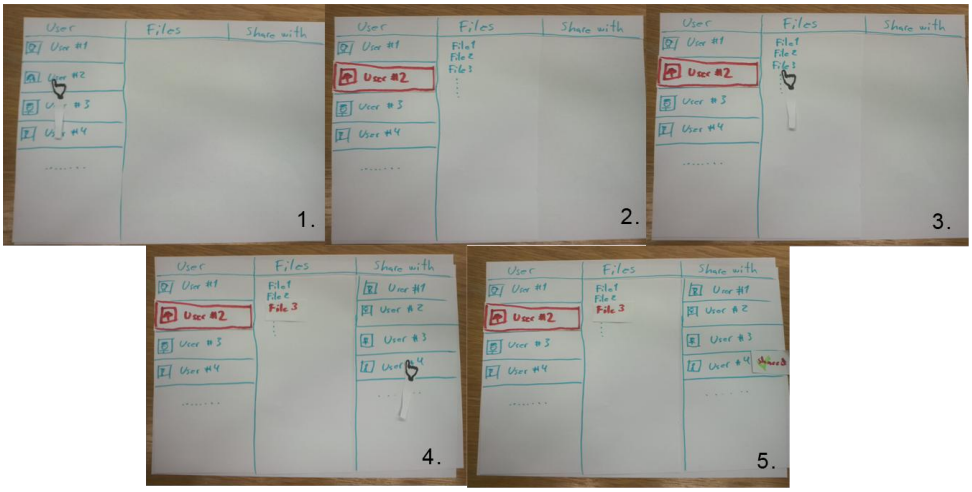

Figure 21: Paper Prototype 1 using a list view.

4.3.2 Paper prototype 2: Touch and hold to open menu

The second paper prototype is also intended for Microsoft Surface where the user accesses the menu by touching and holding a finger on the surface area (see Figure 22 image 1 and 2). The menu will appear at the same position as the finger and all available accounts are represented by a button placed in a circle around the finger. When the user chooses an account from that menu, the files related to that user pop up randomly on the ScatterView (see Figure 22 image 4). To share a file the user touches and holds on a file, which brings up a new menu with the different accounts, the files can be shared with (see Figure 22 image 5).

Figure 22: Paper Prototype 2: Touch and hold to open menu.

4.3.3 Paper prototype 3: Buttons and drag and drop

The third prototype is also intended for Microsoft Surface and has a menu placed on the left side of the screen. Each available account is represented by a button and when one of them is pressed the button is highlighted and all files appear randomly on the table in the ScatterView (see Figure 23 image 3). When a file is dragged and dropped onto a button (see Figure 23 image 5), the file will be copied to that account, and then animate back to the position it had before being dragged (see Figure 23 image 6).

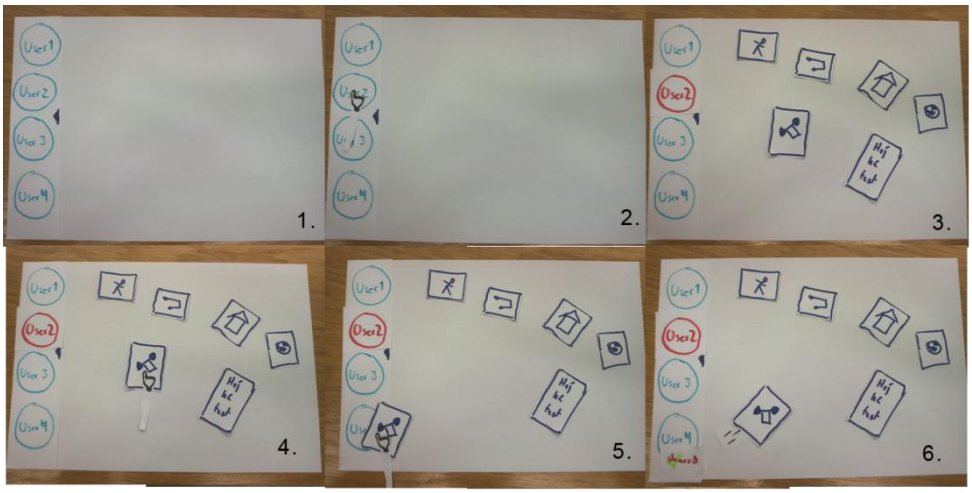

Figure 23: Paper prototype 3: Buttons and drag and drop.

4.3.4 Paper prototype 4: Phone and drag and drop

The fourth prototype is also intended for Microsoft Surface and use a ScatterView. Each user is identified with its own phone and when placed on the surface the files related to that account pop ups in a circle around the phone (see Figure 24 image 2). Several users can put their phone on the surface at the same time (see Figure 24 image 3) and files are copied by dragging a file into the private space represented by a circle (see Figure 24 image 4).

Figure 24: Paper Prototype 4: Phone and drag and drop.

4.3.5 Paper prototype 5: Share files using phone

The fifth paper prototype is an extended version of the previous prototype. The possibility to drag and drop to share files was removed and instead phones are used to copy a file. When a user is showing a file, the rest of the users can copy that file by placing their phone on top of the file (see Figure 25 image 6).

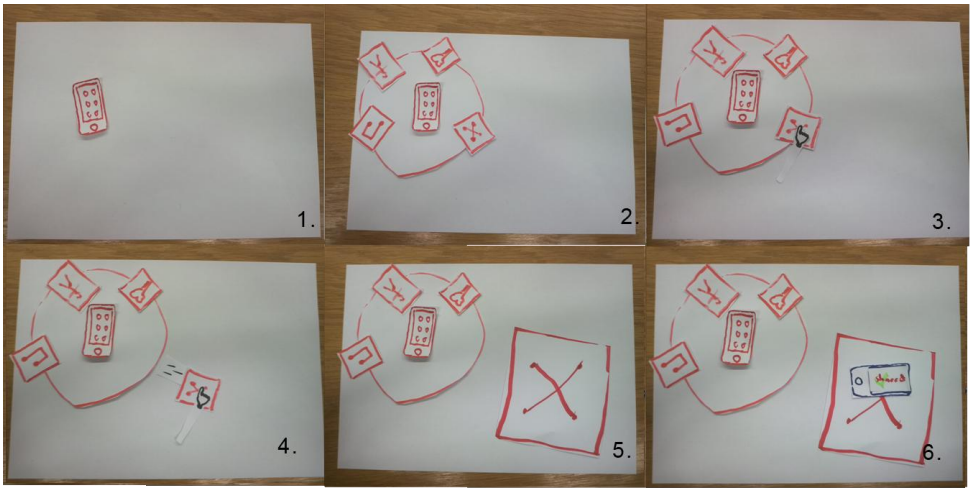

Figure 25: Paper Prototype 5: Share files using phone.

4.3.6 Paper prototype 6: Kinect

The sixth paper prototype involves a Microsoft Kinect instead of a Microsoft Surface table. The user stands in front of the Microsoft Kinect and uses the right hand to navigate and select items on the screen (see Figure 26). The right hand is represented with an icon on the screen.

The steps of this application are the following: Start by holding the right hand over the button in the upper right corner, this switches the state of the button and showing available accounts. When an account is selected the files will be shown at bottom of the screen. The left hand is used to scroll through the files at the bottom of the screen. That is done by sweeping the hand to the right or left.

With the right hand the user can choose to select a file by holding the hand over the file. The file will be shown in the center of the screen just above the list of files but in a larger size. After this step the user can share the file with another user by selecting a person in the upper left corner using a similar button as the one on the right side.

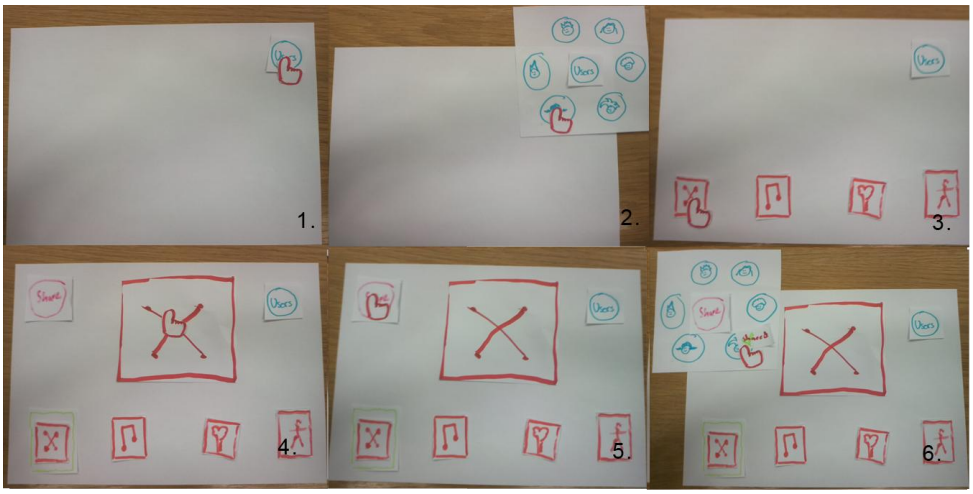

Figure 26: Paper Prototype 6: Kinect.

4.3.7 Paper prototype 7: Kinect and phone

The seventh paper prototype is exactly the same as the sixth paper prototype except that the share button is removed (see Figure 27). Instead of this button a smartphone is used, when the user has selected a file from the file list, the rest of the users can copy that file using a simple application on their smartphone. The interface of the smartphone application is very simple, first the user starts the application which automatically connects to the associated account and after that a simple button is used to copy the file.

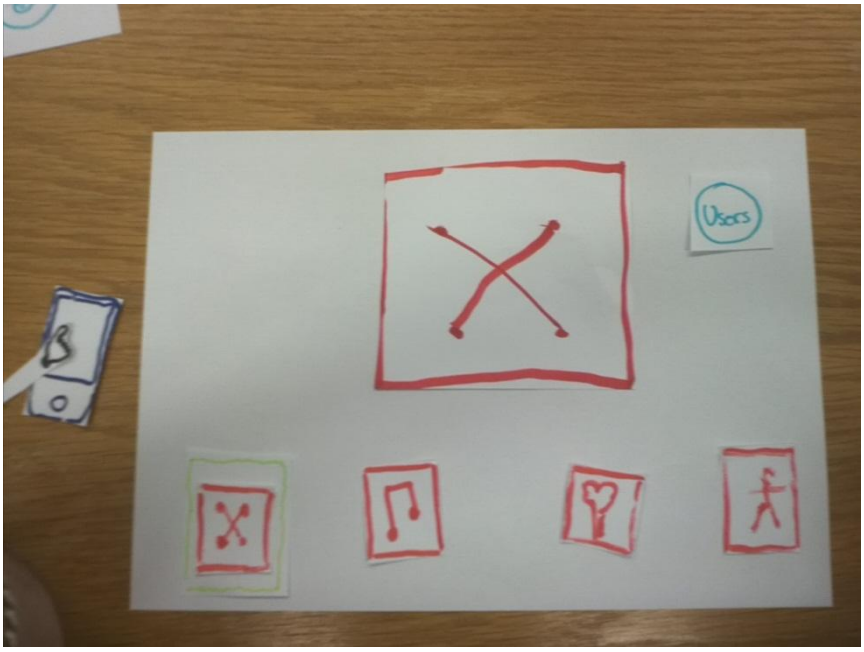

Figure 27: Paper prototype 7: Kinect and phone.

4.4 Low-fidelity prototype implementation

The paper prototypes were realized as low-fidelity prototypes to be able to further test and analyze the interaction. Since all devices used in this thesis are Microsoft products the prototypes here were created in Microsoft Visual Studio and Microsoft Expression Blend. Prototype 2, 3, 4 and 5 uses ScatterViews for easy rotation, movement and scaling of the notes and the images.

4.4.1 Server and preparation for the Scrum meeting

To be able to test the low-fidelity prototypes, a server needed to be configured to be able to access and share the data during daily Scrum meetings. The server was configured in a way that all the devices and computers could access the data (see Figure 28).

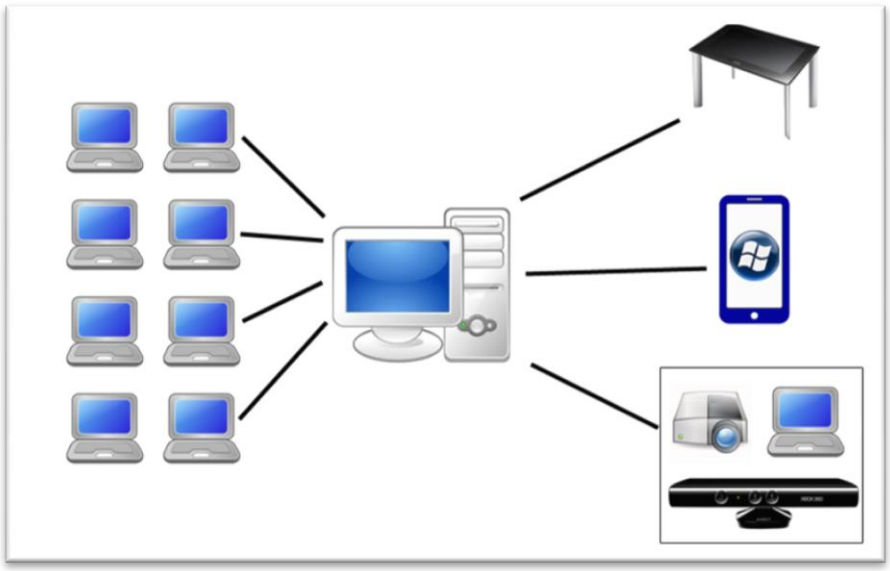

Figure 28: Visualization of how the server was connected with the rest of the devices.

The preparation involved participants accessing their own accounts from their desktops and upload the data to the server that they wanted to share during the daily Scrum meeting. The data could be images or some text notes.

4.4.2 Low-fidelity prototype 1: List view

The first prototype was realization of paper prototype 1 featuring a dynamic list where the user could select an account which accesses the server and displays user's files in the middle column (see Figure 29). The middle column shows the files and in case it is an image, it is represented by a small thumbnail of it and image information. When a file is selected in the list at the middle, the user get options in the right column to either share the file to a specific person or to display it in full screen (see Figure 30). Another feature is a button called "Show downloaded" on top of the list in the middle. When that button is pressed, all the files user has downloaded will be displayed in the second list.

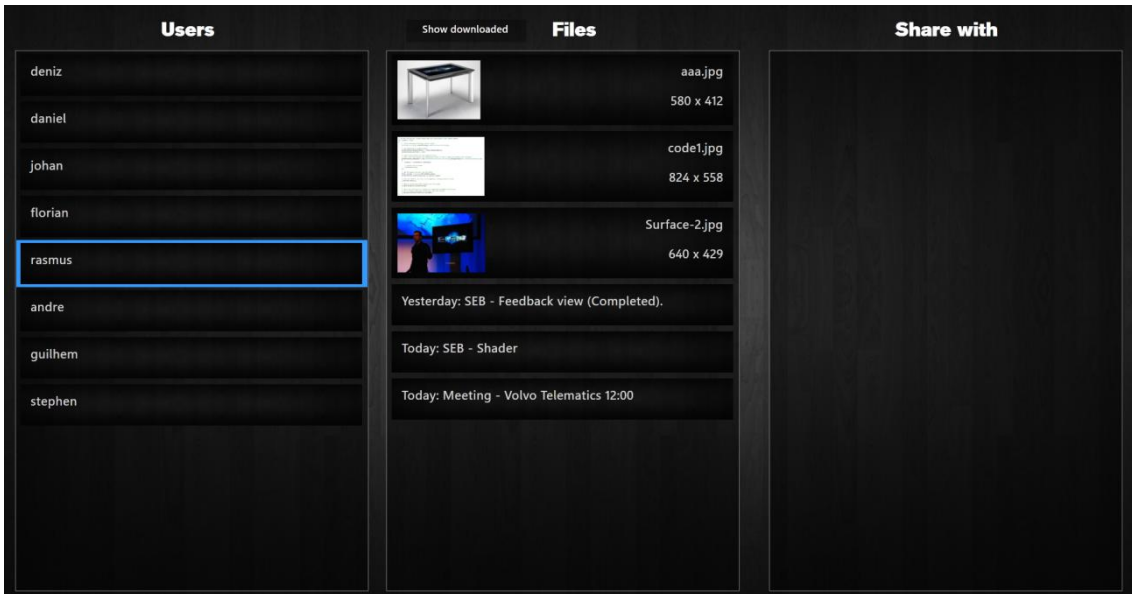

Figure 29: When a user is selected in the left column, files belonging to that user will be displayed in the middle column.

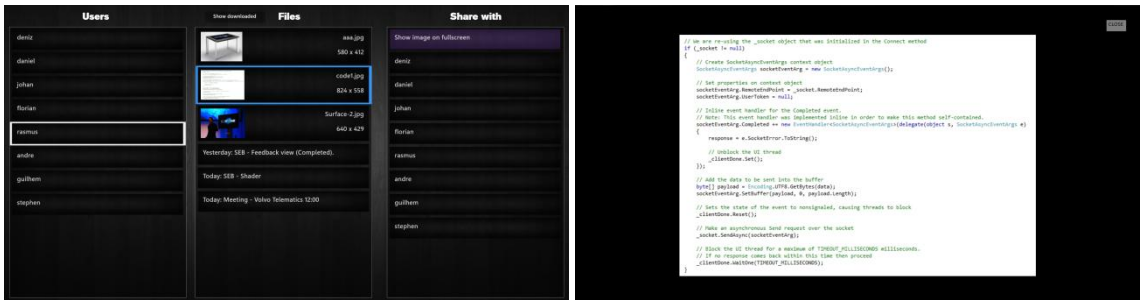

Figure 30: Figure x: By selecting a file (left image) the user can either send it to another user or display it on full screen (right image).

4.4.3 Low-fidelity prototype 2: Touch and hold to open menu

The second prototype is a realization of paper prototype 2, where the users access the menu and their accounts using different input methods (see Figure 31). The idea tested during paper prototyping was that the user would touch and hold to access the menu, but in the low-fidelity prototype the users have the choice to choose between different input methods, this was done with the radio buttons in the top right corner of the application. This option was implemented only for testing purposes; since the changes was too small to each have an own prototype. The different input methods are the following: single touch, double tap, touch and hold, dual tap and pinch. Each input method brings up the same menu supporting up to eight different user accounts. The menu will idle for 8 seconds before closing itself if it is unused. When the user chooses an account, files associated with that account would randomly appear on the table as ScatterView items. To share a file the user has to press the “Share” button placed on each file. That brings up a menu with different accounts and the user can choose who to share with (see Figure 32). To access the downloaded files, the user has to summon the main menu again and press its own account again which this time is represented by a light blue color (see Figure 31).

Figure 31: The user summons the menu with a single tap and can choose to change user or access the downloaded files for this account by pressing the light blue button.

Figure 32: Files are shared by pressing the "Share" button placed on each file and choosing a target account.

4.4.4 Low-fidelity prototype 3: Buttons and drag and drop

The third prototype is a realization of paper prototype 3 and has an expandable menu placed on the left side of the screen (see Figure 34). The users can access their files by pressing one of the eight buttons with their name and image. The button for the user currently displaying files is highlighted with a green color. When a user drag a file it becomes translucent and when a file is dragged above a user button that button changes and gives simple feedback that it is possible to share the file to the user (see Figure 33). If dropped the file gets copied and animates back to the position it had before being dragged. The user can see downloaded files by pressing the button "Show downloaded files" on the top right corner of the screen.

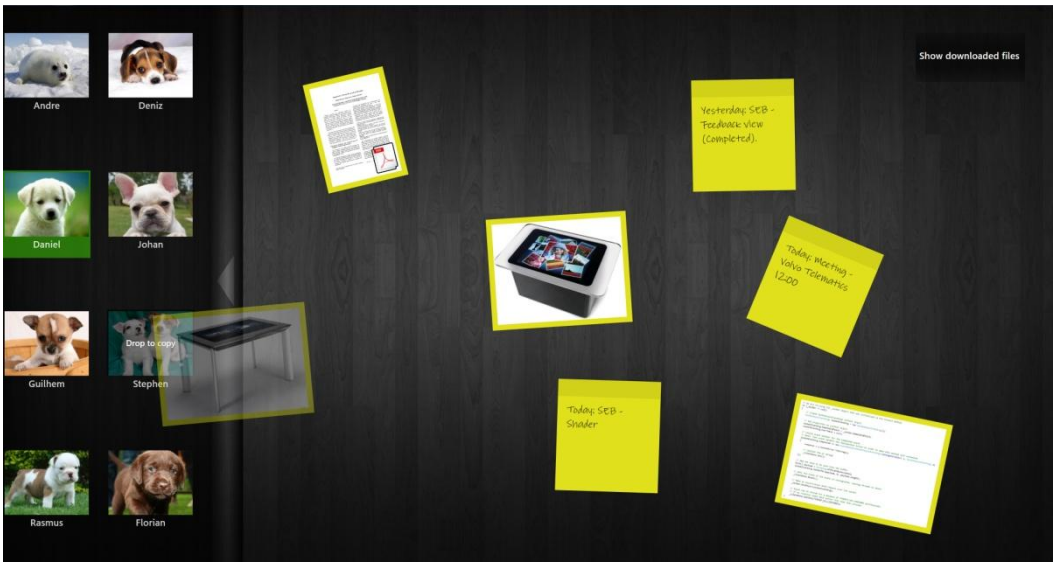

Figure 33: An image is shared with using drag and drop. The image becomes translucent and the button gives feedback.

Figure 34: To free space it is possible to minimize the menu.

4.4.5 Low-fidelity prototype 4: Phone and drag and drop

The fourth prototype is a realization of paper prototype 4. There is no menu; instead the Surface reads tags (see Figure 35). Each user has one unique tag that can be placed on a card or on a phone. The user places the tag on the table and all files are shown in a circle around the tag. Several users can place their tag on the table at the same time and drag files from each other. By dragging a file onto another's user's tag-area, that file will be downloaded to that users account and then animate back to its starting position.

The prototype can support up to 8 users (tags) at the same time. All items located at the circle surrounding the tag will follow the tag if it is moved across the surface. Each tag-area has two buttons: the first one is the "Callback" button, which returns all items belonging to the user to the tag-area. The second one is the "Download" button, which clears all items from the tag-area and instead displays downloaded items.

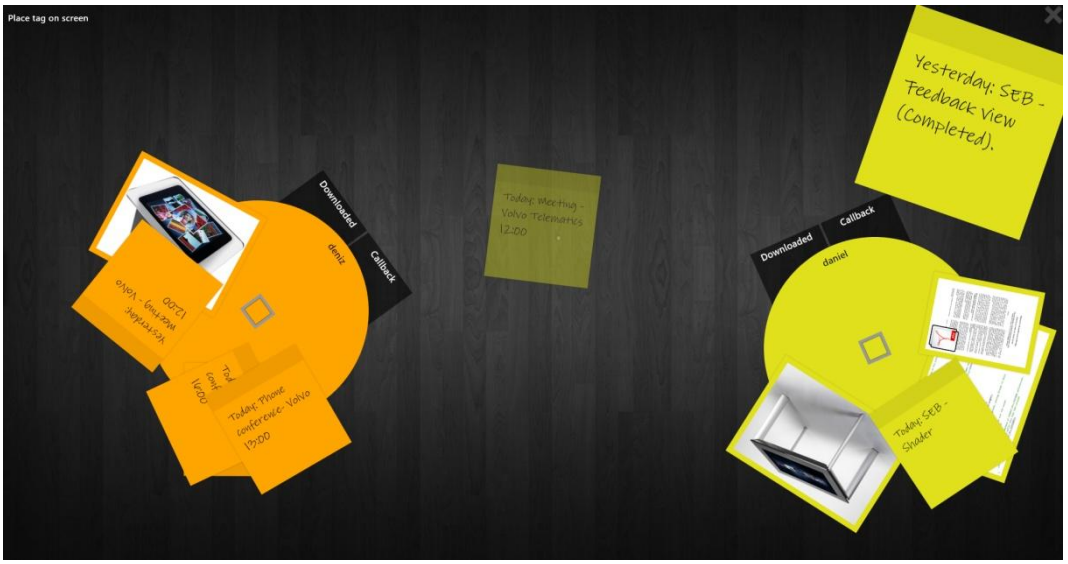

Figure 35: Two different users have placed their tags on the table and they can show and share the files with each other.

4.4.6 Low-fidelity prototype 5: Share files using phone

The fifth prototype is a realization of paper prototype 5 and an extended version of low-fidelity prototype 4. The possibility to drag and drop to share files is removed and instead tags are used to download files. Only one user can display files at a time and the rest of the users can download the files by placing their tag on top of the file they want to download (see Figure 36). The item that is downloaded gives feedback with a green border and a text saying “File copied”.

Figure 36: A user is showing files on the table and another user has placed the tag on the image to download it.

4.4.7 Low-fidelity prototype 6: Kinect

The sixth prototype is a realization of paper prototype 6, which involves a Microsoft Kinect instead of a Microsoft Surface table. This prototype can only track one user at a time and each user have to be calibrated. The calibration includes one person standing still in front of the Microsoft Kinect for a couple of seconds.

The user uses the right hand to navigate and select items on the screen (see Figure 37). The right hand has a pink icon on the screen to represent its position. A button is selected by holding the right hand over the button for about two second and during this time a loading bar is displayed. When two seconds has passed the button enters a new state and the user can select an account (see Figure 38).

The left hand is used to scroll through the files in the bottom of the screen. That is done by sweeping the left hand to the right or left. The left hand is only tracked when held at a height between chest and head area, this allows for relaxing the left hand while not scrolling. The left hand does not have an icon on the screen to represent its position since it is only used for scrolling.

The steps of this application are the same as intended for the paper prototype 6. The user selects account on the “Who are you?” button and then selects a file in the list. A file is copied to another user by selecting the “Share with” button and visual feedback is shown when a file is copied (see Figure 38).

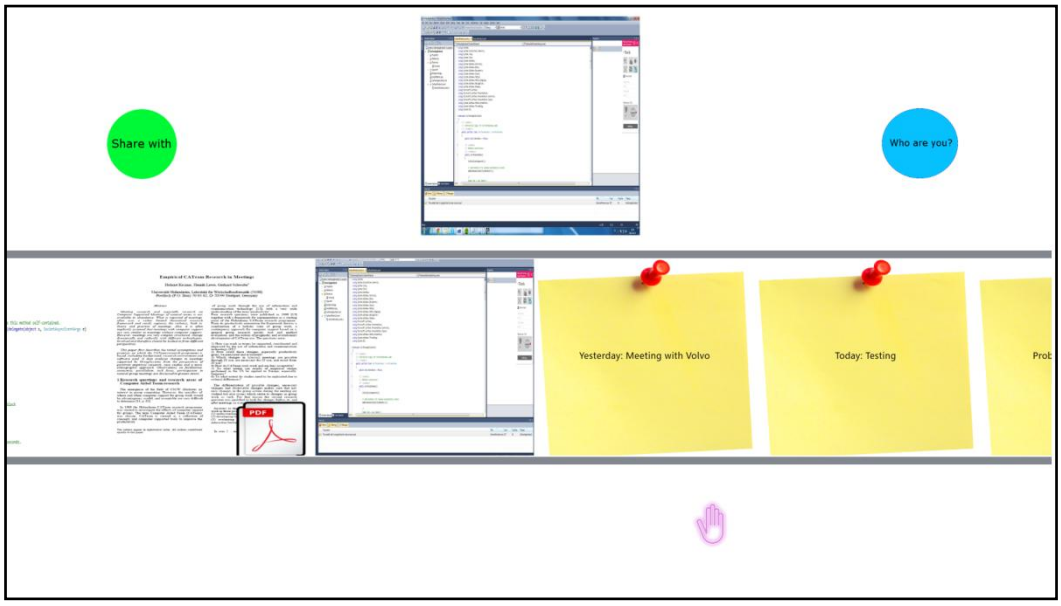

Figure 37: The user has chosen its identity and also selected a file, which in this case is an image.

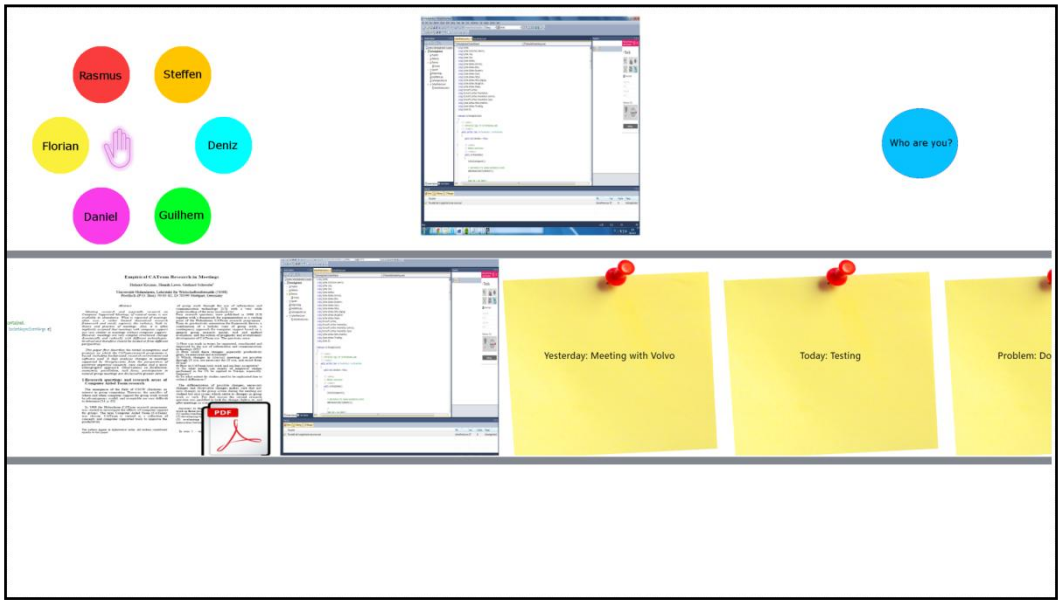

Figure 38: The user has entered the “Share with” state to pick a user to share with.

4.4.8 Low-fidelity prototype 7: Kinect and phone

The seventh prototype is a realization of paper prototype 7 and an extended version of low-fidelity prototype 6. The difference is that the button at the top left corner is removed (see Figure 39). In the previous prototype it was used to select an account to share a file with and in this prototype a smartphone is used instead. When the user selects a file from the file list, another user can choose to copy that file with its smartphone. The interface of the smartphone is very simple (see Figure 40), first the user chooses an account and then presses the “Press to copy file” button. As soon as the button is pressed, the item selected is transferred to the account.

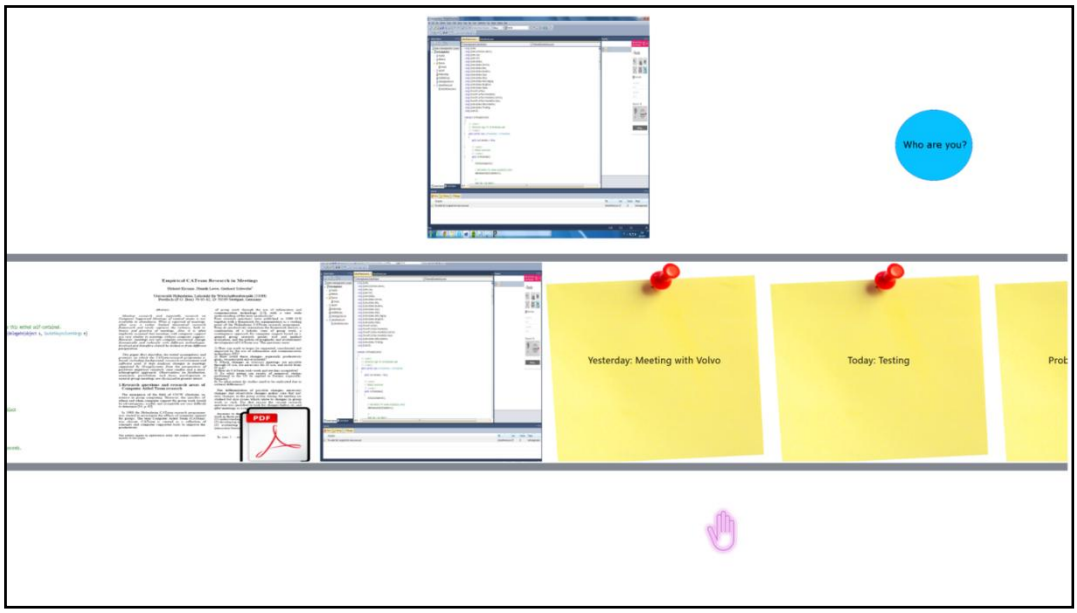

Figure 39: The “Share with”-button is removed from the top left corner. Instead a smartphone is used to download a file.

Figure 40: The user has chosen his account and can press “Press to copy file” to download the file. The right image shows the feedback when a file has been downloaded.

5 Result

This section presents the results from the Field study, Brainstorming, Paper prototyping, and the Low-Fidelity prototypes.

5.1 Field study result

The results from the field study are presented in this section. Both direct observation and participant observation is presented in the observation section. The interview section contains data both formal and informal interviews.

5.1.1 Observation result

The observation showed that the information shared during a daily Scrum is not always relevant to all of participants but led to a basic understanding of the process. Those times when a participant needed help with a problem the team spend no time discussing these during the meetings and instead the people involved would discuss it afterwards. It was noted that during the observation that participants did not use any specific order when gathering before the meeting and was only dependent on when they arrived to the meeting area. The participants were always standing in a circle (see Figure 41). Only the size of the formation changed depending on the size of the group.

A good approximation on how long the meeting usually takes and how long each participant usually speaks was collected (see Table 2). Since not every participant attended to every meeting the total time of the meeting is a bit misleading, but the average for each participant is both relevant and accurate.

Participants:	Average time
Participant 1 (Scrum master)	1min 28sec
Participant 2 (Project leader)	1min 43sec
Participant 3	1min 21sec
Participant 4	1min 30sec
Participant 5	1min 43sec
Participant 6	55sec
Participant 7	40sec
Participant 8	58sec

Table 2: This table displays the average time that each participant spend speaking during daily Scrum meetings.

	Average time
Average meeting time:	8min 6sec

Table 3: This table displays the average time the entire team spend speaking during a Scrum meetings.

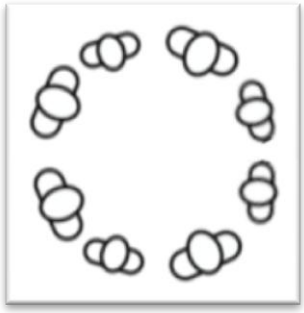

Figure 41: In all meetings that were observed the team stood in a circle.

5.1.2 Interview results

The answers from all the interviews were summarized and the most relevant information is described here. When asking what the participants usually discussed during a daily Scrum, all participants mentioned that they at some extent had problems remembering what they did the day before. Some participants also had problems remembering what todays agenda was. A topic that came up during the interviews was that some of the participants had problems understanding what the other participants were talking about, if they were not involved in the same part of the project.

Another topic discussed was how to motivate the entire team to use the different prototypes during an entire test phase. A general concern was that it might take too much time both in preparation and during a daily Scrum if interactive devices would be used. This led to more technical discussions on how data should be accessed on the prototype. The most discussed idea was a server where the user could upload their files and when needed the table would access that data and show it on the table, without any need for removable media or similar.

During the interview the need for privacy was discussed, who and when someone should be able to access and share the data. All the users wanted a private area or a private way where they could access and save their data. When asked if they would want to use for example a mobile device as identification or maybe as another way to store the data, the general impression was that this might cause for unnecessary preparations. But during this an idea from one of the participants was to use a personal company card instead.

The company has the intention to use some sort of task management software but in the present such software is not being used. Most of the task managements is done on wall at the company, in paper form and never transferred into digital form. This led to a discussion of what kind of data the prototypes should support, this varied a lot since the interviews were conducted with designers, developers and project leader. Designers wanted the possibility to show ideas, developers wanted to discuss what they have achieved and the project leader was mostly interested sharing planning and scheduling.

Another concern from some of the participants was that the prototypes using the Microsoft Surface and the Kinect would not be practical for day-to-day usage, this because the Surface is designed for showcases and the Kinect more for games.

5.2 Brainstorming result

During the brainstorming session the numbers of covered devices were reduced into only focusing on Microsoft Kinect, Microsoft Surface and Windows phone. The session resulted in a few different scenarios and the following areas to be focused on during the thesis:

Microsoft Surface: Research mobile phones placed on a surface, different interaction following the NUI paradigm and Kinect for positioning and recognition of users.

Microsoft Kinect: Research basic and logic ways to control an interface, and also the possibilities with combining the Kinect with a mobile phone.

Windows Phone: Prototypes testing different ways to share data between mobile devices using the NUI paradigm.

5.3 Paper prototyping result

This section contains the results of the usability tests of the paper prototypes. More tests were done but only the seven low-fidelity prototypes, which were realized, are presented. All of these paper prototypes were tested and modified several times during the usability test period.

5.3.1 Paper prototype 1: List view

The usability test resulted in a good understanding on how a fixed angle of an interface on the Microsoft Surface would affect the participants. The participants had to either lend over the paper prototype to read the information or rotate the entire paper prototype. One major concern during the tests were that this version gave no possibility to show for images in bigger versions and therefore an option to show images over the entire screen was added. Even though the paper prototype was not perfectly suited for the Microsoft Surface, the participants liked the simplicity of this prototype.

5.3.2 Paper prototype 2: Touch and hold to open menu

The paper prototype tested the advantages and disadvantages of using 360-degree interface. The participants had no problem accessing and showing information to each other independent on from where they sat around the paper prototype. This paper prototype raised some questions among the testers for examples how much will the button hide of the file, and how the interface should be constructed to make it easy to understand how to open the menu.

5.3.3 Paper prototype 3: Buttons and drag and drop

The usability tests for this paper prototype tested how the user would use the drag and drop to share files. When a file was dropped, an animation returned the object to the position it had before it got moved. This raised the issue with how much room that is needed for data on the surface. To solve this issue the last prototypes had the possibility to collapse the area that contained all available participants.

5.3.4 Paper prototype 4: Phone and drag and drop

The usability tests for this prototype showed that some participants liked the possibility to have more than one active user at the same time. They were also positive to the privacy that this paper prototype gave. There was some skepticism that it might not be necessary to use an actual phone as

identification and also that letting more than one person at a time display might affect the daily Scrum in a bad way.

5.3.5 Paper prototype 5: Share files using phone

This paper prototype was very similar to the previous paper prototype; most interactions were the same except for how data was shared and that it only supported one active user. This was appreciated that no one else than you could choose to send a file to yourself, and the general assumption was that this version would solve some of the privacy problems.

5.3.6 Paper prototype 6: Kinect

The usability test raised many concerns for the participants of how a Kinect would fit to a Scrum meeting. Another concern was that only the person that controlled the Kinect could choose to share files and that in most cases some of the other users are the ones interesting in taking a file.

5.3.7 Paper prototype 7: Kinect and phone

Paper prototype 7 had the same interactions as the previous prototype but the general response was that it was good that the person wanting the file could choose it instead of the participant controlling the application. The participants thought this shortened the total interaction.

5.4 Low-fidelity prototype result

In this section all results for the usability tests of the low-fidelity prototypes is presented. Each prototype is explained with the focus group as the main target but each section also contains results from the rest of the test groups.

5.4.1 Server and preparation for the Scrum meeting

The questionnaire showed that the amount of time preparing for the daily Scrum meeting varied a lot between the different participants, but none spent more than 10 minutes preparing (see Table 4). The overall feedback showed that most of the participants felt okay with the way of preparing, but some mentioned the lack of support for pdf files, videos and some image formats. There was also an idea about an application automatically moving screenshots to the private file folder.

	Average time	Minimum time	Maximum time
Preparation time:	5min 45sec	3min	10min

Table 4: Preparation time for the Daily Scrum.

5.4.2 Low-fidelity prototype 1: List view

Even though the prototype was oriented at a certain direction all of the participants were standing in a circle around the table (see Figure 42). In the image below (see Figure 43) the user to the left is standing 90 degree turned from the table and trying to read upside down. It is not shown in this picture but was observed during this meeting that he almost turned his head about 90 degree as well (total of 180 degree) to fully be able to read his notes. Participants standing in a bad angle rather used a discomfort position than ask another participant to switch place.

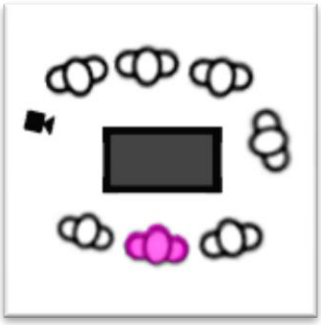

Figure 42: The positions of the focus group during the usability test for prototype 1; the one in pink is the Scrum master.

Some problems occurred when trying to interact with the standard Windows controls using touch inputs instead of the standard mouse clicks. Although the participants had to sometimes click more than once to perform an action, they did not seem to mind that. Both the focus group and the test groups had no problems understanding what to do and how to use the prototype. Both displaying and sharing data was done without any deep explanations of the different features.

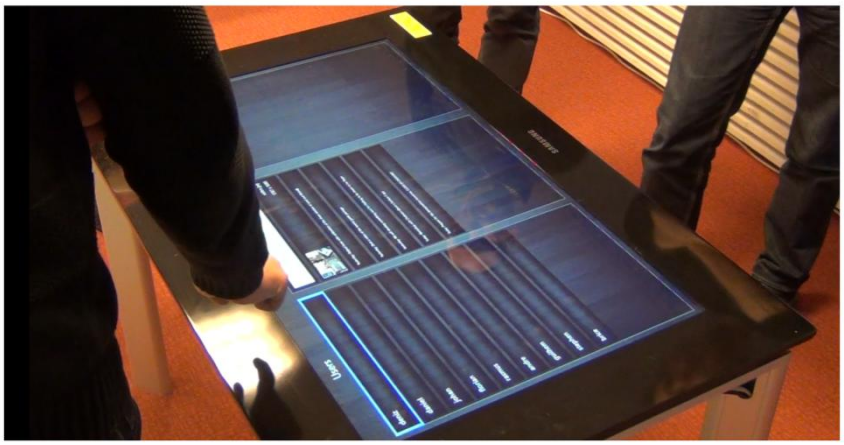

Figure 43: A participants standing in a bad angle presents his tasks.

In almost all situations the one presenting his work was the one interacting with the table. The other participants did not touch anything except when they wanted to copy a file. Several people could not copy different files at the same time since you first had to select an item and then click on the person you wanted to share with. This made the flow stop when a person remembered he wanted a file that was already talked about. He then had to go back to that file and press to download that file.

The time each participant spent speaking during this prototype can be read from the table below (see Table 5). The time depends on where they were at the project at time and how much data each participant had to share with the rest of the group. The total time of the whole meetings is also presented here below (see Table 6).

Participants:	Time
Participant 1 (Scrum master)	3min 10sec
Participant 2 (Project leader)	2min 30sec
Participant 3	-
Participant 4	3min 50sec
Participant 5	3min 40sec
Participant 6	1min 0sec
Participant 7	2min 20sec
Participant 8	1min 50sec

Table 5: This table displays the time each participant spend speaking during prototype 1.

	Time
Meeting time:	18min 20sec

Table 6: Total meeting time for prototype 1.

5.4.3 Low-fidelity prototype 2: Touch and hold to open menu

The usability test for this prototype had seven participants and even if it was crowded no one stood behind someone else, instead they made a bigger circle (see Figure 44). The participants took a step forward if it was their turn to talk or if they wanted to copy a file.

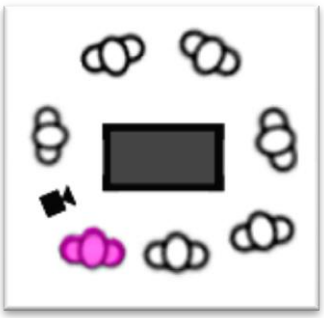

Figure 44: The positions of the focus group during the usability test for prototype 2, the one in pink are the Scrum master.

The participants had no problems understanding how the interface worked, although in some cases some of the users accidently opened several menus which broke the flow of their presentation. Most of the users rotated and scaled the files to make it more visible to all the participants. A problem that occurred was when a person had too many files to show which forced him to arrange them before he could start talking.

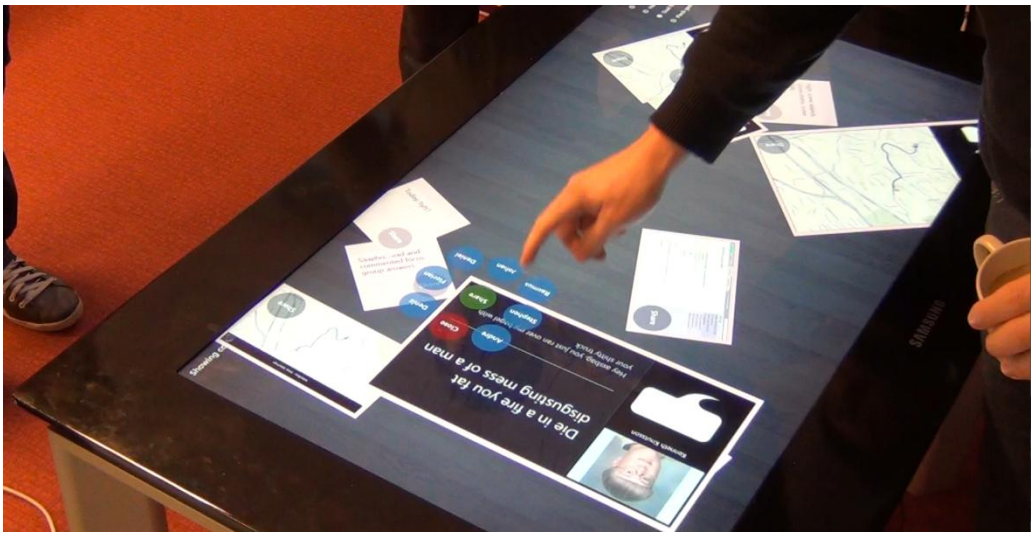

Figure 45: A participant is copying a file.

This prototype made it very easy to copy the file the main user was currently talking about without having to interrupt him. Other users would just press the share button on the current file and choose their own name.

The time each participant spent speaking during this prototype can be read from the table below (see Table 7). The time depends on where they were at the project at time and how much data each participant had to share with the rest of the group. The total time of the whole meetings is also presented here below (see Table 8).

Participants:	Time
Participant 1 (Scrum master)	1min 45sec
Participant 2 (Project leader)	2min 0sec
Participant 3	3min 5sec
Participant 4	3min 10sec
Participant 5	1min 50sec
Participant 6	2min 10sec
Participant 7	1min 0sec
Participant 8	-

Table 7: This table displays the time each participant spent speaking during prototype 2.

	Time
Meeting time:	15min 0sec

Table 8: Total meeting time for prototype 2.

5.4.4 Low-fidelity prototype 3: Buttons and drag and drop

All of the participants were standing in a circle around the table (see Figure 46). Participants standing in a bad angle could rotate the images and notes to a better angle. In the image below (see Figure 47), two users interact with different items at the same time and adjusting the items to fit their position.

Figure 46: The positions of the focus group during the usability test for prototype 3; the one in pink is the Scrum master.

The participants had no problems to understand what to do and how to use the prototype, both displaying files and sharing data was done without any deeper explanations of the different features. A problem that occurred was the amount of content some people had. One of the users had a lot of notes and images. Since the items start location is random, the user had to arrange them before he could start talking, which resulted in a couple of seconds of silence. This interface also had a button to expand and extract the menu but the participants never used it.

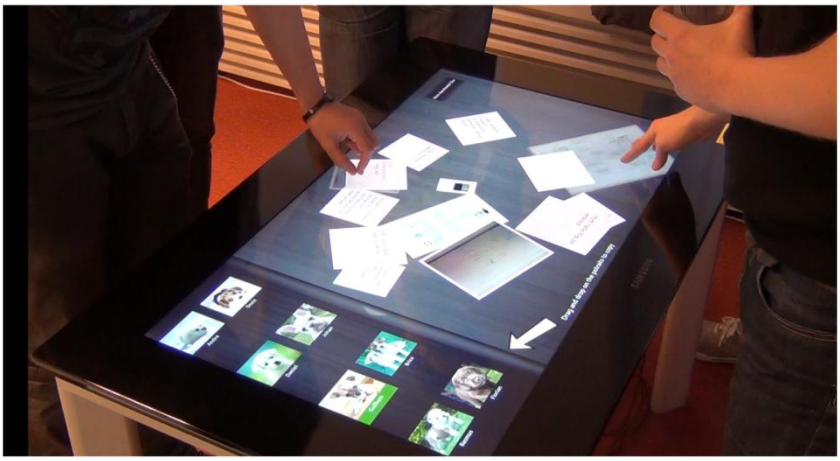

Figure 47: While one user is talking about his image, another user is copying an image.

Several people could copy different files at the same time since this interface allowed multiple interactions. This made the whole process flow and the user who talked could continue doing that without any interruptions, except if another person wanted to copy the image or the note the main user was talking about.

The time each participant spend speaking during this prototype can be read from the table below (see Table 9). The time depends on where they are at the project at time and how much data each participant had to share with the rest of the group. The total time of the whole meetings is also presented here below (see Table 10).

Participants:	Time
Participant 1 (Scrum master)	2min 40sec
Participant 2 (Project leader)	2min 20sec
Participant 3	-
Participant 4	2min 10sec
Participant 5	4min 15sec
Participant 6	-
Participant 7	1min 30sec
Participant 8	1min 30sec

Table 9: This table displays the time each participant spend speaking during prototype 3.

	Time
Meeting time:	14min 25sec

Table 10: Total meeting time for prototype 3.

5.4.5 Low-fidelity prototype 4: Phone and drag and drop

During the usability test with the focus group there were eight participants around the table. The participants had to stand in a wider circle and behind each other since there was not enough space around the table (see Figure 48).

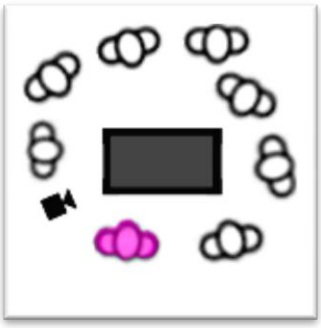

Figure 48: The positions of the focus group during the usability test for prototype 4, the one in pink are the Scrum master.

The borders of all files also had the same color as the circle area that covered the tag. As in previous prototype the participants had no problems understanding how the interface worked. A negative aspect with this prototype was when a user scaled up an image; it covered the rest of users' areas, which forced them to stop interacting. Another negative aspect of the prototype was when images and notes popped up around the user's tag and that user had to drag out the content to arrange them in a suitable way.

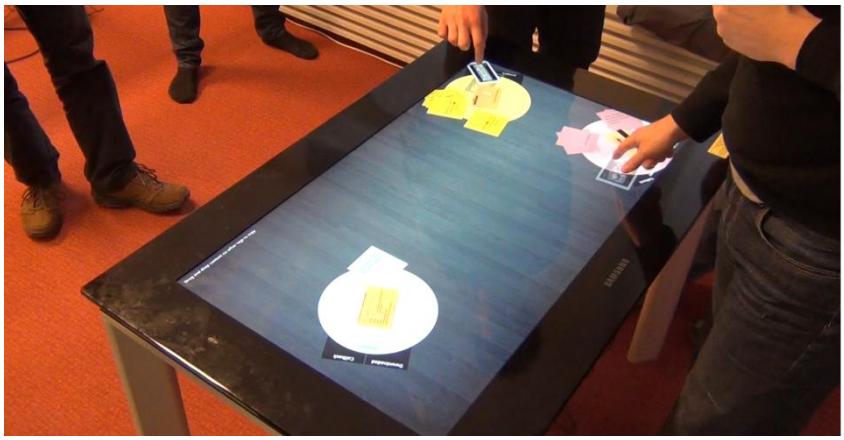

Figure 49: Three participants interacting with different items at the same time.

Several people could copy different files at the same time since this interface allowed interaction with several items at the same time (see Figure 49). This made the whole process flow and the user who talked could continue doing that without any interruptions except for one exception. If another participant wanted to download the main user's current file, he was forced to interrupt him for a short period of time and grab that item. Another drawback that occurred when downloading the file was the scale of the file representations. The main users usually scaled up the file so the rest of the participants could see it easier. When another participant wanted to download that file, he needed to scale down the current file to have space to put his tag on the table and copy it that way. A technical issue that occurred was the cards the participants did put on the table to identify themselves with. If they were slightly bended, the surface table could not identify them.

The time each participant spend speaking during this prototype can be read from the table below (see Table 11). The time depends on where they are at the project at time and how much data each participant had to share with the rest of the group. The total time of the whole meetings is also presented here below (see Table 12).

Participants:	Time
Participant 1 (Scrum master)	2min 20sec
Participant 2 (Project leader)	0min 50sec
Participant 3	3min 0sec
Participant 4	3min 10sec
Participant 5	2min 0sec
Participant 6	2min 10sec
Participant 7	3min 0sec
Participant 8	1min 20sec

Table 11: This table displays the time each participant spend speaking during prototype 4.

	Time
Meeting time:	17min 50sec

Table 12: Total meeting time for prototype 4.

5.4.6 Low-fidelity prototype 5: Share files using phone

The usability test for this prototype had eight participants and even this time the participants had problems standing around the table when it was crowded (see Figure 50).

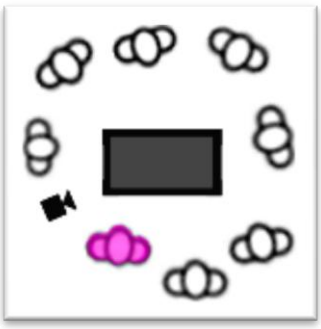

Figure 50: The positions of the focus group during the usability test for prototype 5, the one in pink are the Scrum master.

The participants had no problems understanding the prototype, both displaying files and sharing data was done without any deeper explanations of the different features. Since you could rotate and scale all the files, there would almost be no bad angles for any participant. They all could rotate the files to fit them better, if they were interested. A technical issue that occurred during some of the usability tests was if the cards were even slightly bended, the surface would have problems reading them. During the session with the focus group they used a candle to press down the cards on the surface (see Figure 51).

Figure 51: The one currently describing his tasks has used a candle to press the card up against the surface.

This prototype also made it very easy to copy the file the main user was currently talking about without having to interrupt him. People would just throw their card on the file and pick it up again. Also several people could copy different files at the same time since this interface allowed interaction with several items at the same time. During these tests all participants at some point tested to copy a file.

The time each participant spend speaking during this prototype can be read from the table below (see Table 13). The time depends on where they are at the project at time and how much data each participant had to share with the rest of the group. The total time of the whole meetings is also presented here below (see Table 14).

Participants:	Time
Participant 1 (Scrum master)	2min 45sec
Participant 2 (Project leader)	1min 55sec
Participant 3	1min 40sec
Participant 4	2min 10sec
Participant 5	2min 20sec
Participant 6	1min 10sec
Participant 7	1min 45sec
Participant 8	1min 20sec

Table 13: This table displays the time each participant spend speaking during prototype 5.

	Time
Meeting time:	15min 5sec

Table 14: Total meeting time for prototype 5.

5.4.7 Low-fidelity prototype 6: Kinect

The usability test for this prototype had six participants and the space was not an issue. Everyone had plenty of space and access to all the information from where they stood. The participants' rotated positions depending on whose turn it was to talk. The person presenting his files stood where the pink person stands in the image below (see Figure 52). The rest of the group stood in a half circle around him faced against the projected wall. A technical issue that occurred was when the main user wanted to stretch his legs by moving back or forward a little bit, the Microsoft Kinect would lose him and he needed to be tracked again. That made the flow of the presentation break. Another problem that was noticed was the difficulty of both aiming your hand towards the Microsoft Kinect and talk at the same time. It also seemed difficult to aim at the menu objects that were placed in the corners. People needed to be very patient and accurate but instead they were very hasty.

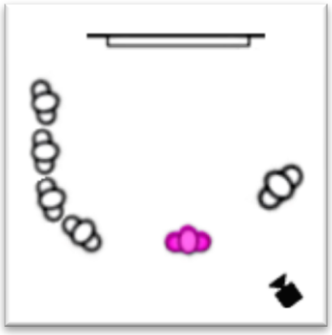

Figure 52: The positions of the focus group during the usability test for prototype 6, the one in pink are the one currently talking. The Scrum master is not marked.

The participants had no problems understanding what to do and how to use the prototype, both displaying files and sharing data was done without any deeper explanations of the different features. A problem that occurred was the green share button on the top left corner. People seemed to have difficulties to aim accurately in that corner but that could also have something to do with the technology. The participants expressed themselves clearly that they did not like that button. Also if another participant wanted a file he needed to ask the main presenter for it which broke the flow of the presentation. Another negative reaction of the interface was the chosen image, which scaled strangely for some resolutions.

Figure 53: The one currently aiming with his hand towards the wall is controlling the content.

The time each participant spend speaking during this prototype can be read from the table below (see Table 15). The time depends on where they are at the project at time and how much data each participant had to share with the rest of the group. The total time of the whole meetings is also presented here below (see Table 16).

Participants:	Time
Participant 1 (Scrum master)	3min 0sec
Participant 2 (Project leader)	-
Participant 3 S	4min 30sec
Participant 4 D	2min 10sec
Participant 5 G	4min 30sec
Participant 6 J	2min 30sec
Participant 7 F	1min 20sec
Participant 8 A	-

Table 15: This table displays the time each participant spend speaking during prototype 6.

	Time
Meeting time:	18min 0sec

Table 16: Total meeting time for prototype 6.

5.4.8 Low-fidelity prototype 7: Kinect and phone

The usability test for this prototype had four participants and the space was not an issue. Everyone had plenty of space and access to all the information from where they stood. The participants rotated positions depending on whose turn it was to talk. The person presenting his files stood where the pink person stands in the image below (see Figure 54). The rest of the group stood in a half circle around him faced against the projected wall. A technical issue that occurred was when the main user wanted to stretch his legs by moving back or forward a little bit, the Microsoft Kinect would lose him and he needed to be tracked again. That made the flow of the presentation break. Another problem that was noticed was the difficulty of both aiming your hand towards the Microsoft Kinect and talk at the same time. It also seemed it was difficult to aim at the menu objects that were placed in the corners. People needed to be very patient and accurate but instead they were very hasty.

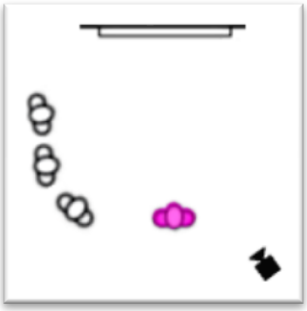

Figure 54: The positions of the focus group during the usability test for prototype 6, the one in pink are the one currently talking. The Scrum master is not marked.

The participants had no problems understanding what to do and how to use the prototype, both displaying files and sharing data was done without any deeper explanations of the different features. Allowing the rest of the participants copy files from their phone without disturbing the current presenter retained the flow of the presentation (see Figure 55, left and right image). Overall people seemed to understand the prototype and the only negative reaction of the interface was the chosen image, which scaled strangely for some resolutions.

Figure 55: The one holding the phone has the possibility to copy files.

The time each participant spend speaking during this prototype can be read from the table below (see Table 17). The time depends on where they are at the project at time and how much data each participant had to share with the rest of the group. The total time of the whole meetings is also presented here below (see Table 18).

Participants:	Time
Participant 1 (Scrum master)	2min 30sec
Participant 2 (Project leader)	-
Participant 3 S	-
Participant 4 D	2min 15sec
Participant 5 G	-
Participant 6 J	2min 20sec
Participant 7 F	1min 35sec
Participant 8 A	-

Table 17: Table x: This table displays the time each participant spend speaking during prototype 7.

	Time
Meeting time:	8min 40sec

Table 18: Total meeting time for prototype 7.

5.4.9 Questionnaire summary

This section presents the most important result from the questionairres (see Appendix 8.2) that each participant from the focus group answered.

This is the summed perception of all of the participants from the focus group regarding the prototypes. The list below present the overall perception where 1 is the most appriciated one for daily Scrum meetings from the question “Which prototype served its purpose best during the daily Scrum meetings?”:

1. Low-fidelity prototype 5: Share files using phone
2. Low-fidelity prototype 3: Buttons and drag and drop
3. Low-fidelity prototype 4: Phone and drag and drop
4. Low-fidelity prototype 2: Touch and hold to open menu
5. Low-fidelity prototype 1: List view
6. Low-fidelity prototype 7: Kinect and phone
7. Low-fidelity prototype 6: Kinect

All the participants from the focus group answered a couple of questions regarding the seven prototypes. The questions for each prototype was answered in a scale from 1 to 10 and the result is presented here below (see Table 19). The result showed that the prototype 3 and 5 was most appreciated when it came to: “easy to understand”, “felt natural to share data” and “the files were presented in a good way”.

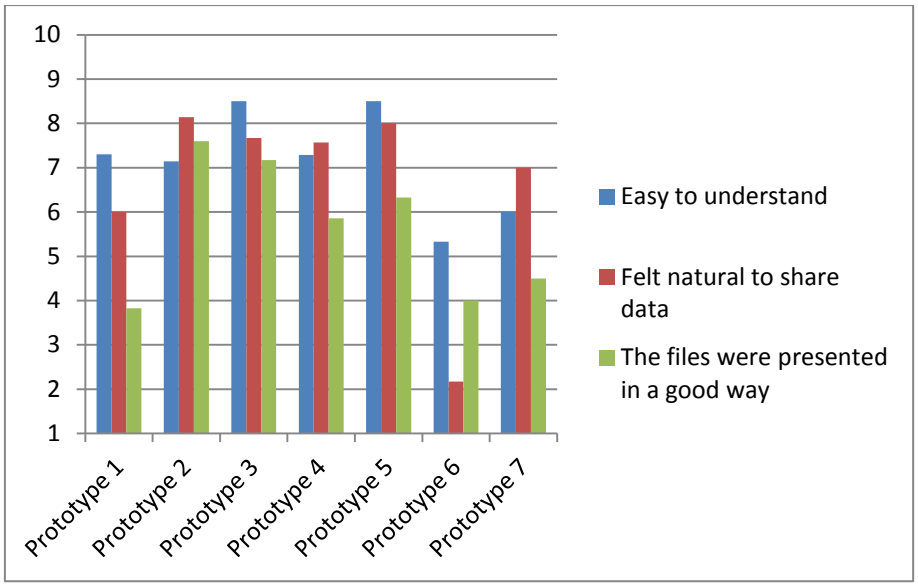

Table 19: The overall feedback from the participants where 10 is agreeing and 1 is disagreeing.

The questionnaires also showed that everyone who participated in the user tests would consider using a tabletop during daily Scrum meetings. They were also positive for the possibility to be able to share data.

6 Analysis and Discussion

In this section the result is discussed and connected to theoretical background and methods. It is important to notice that all the studies were performed at the company Touchtech, other companies can have a different setting and environment for their daily Scrum meetings and then our outcome could have been different.

6.1 Field study

The field study gave us a good understanding of the whole process of the daily Scrum meetings at Touchtech and gave ideas on which interactive devices that could be used and how they could be combined. The interviews conducted on all the participants gave even more insight of the whole process and we were able to locate the main concerns the participants had about using interactive devices at daily Scrum meetings. The biggest issue to the participants was that the use of interactive devices might prolong the Scrum meeting and complicate the preparations. The formation of the group was always an F-formation of an “o-space” as described by Adam Keldon (see 2.6). Only the size of the formation changed depending on the size of the group.

6.2 Brainstorming

During the brainstorming, only the participants writing this thesis attended and there were several reasons why we did not use more participants. Both that we did not want to take time from the employees at the company and that it was hard to find other participants. The result from the field study gave us a good starting point for the brainstorming and we could easily distinguish which devices and combinations we wanted to investigate further.

6.3 Prototypes

The prototypes were designed for up to eight participants both because the recommended amount of people for a Scrum team is five to nine and that the amount of participants during the daily Scrum meeting at Touchtech was at most eight participants. The questionnaires showed that the participants did not mind the preparation as much as the interviews indicated that they would do. The preparations could be shortened and possible removed entirely if our prototypes would be connected to a computer system that was used for time reporting and task planning. We did not spend any time implementing and researching this since Touchtech in the present situation does not use this kind of system.

All the Microsoft Surface prototypes used the F-formation of an “o-space” as described by Adam Keldon (see 2.6). During the user test it was noticed that when it was more than six participants around the Surface the participants stood in a bigger circle and took a step forward when it was their turn to talk. The Surface table is a bit too small to support that many participants at the same time but if a bigger table were used instead we would not have this problem. The fact that we had a camera placed on one of the sides of the table might also affect the way people were standing. The Surface table is also slightly to low and people might stand better if it would be a bit higher.

Prototype 2, 3, 4 and 5 for the Surface using ScatterView items had both pros and cons. The pros were that the user could modify them and several people could interact with different objects at the same time. The cons were that if a user had too many files to show, that user had to organize them before he could start talking. A function that organized them in a more sorted way would make a

huge improvement, which was never implemented during this thesis. The only time they were organized was during prototype 4 and 5 where the participants put down their phone to access their files, but they were not sorted. A technical problem that occurred with prototype 4 and 5 was with the tags. Since the tags were printed out on paper and glued to cards made of thin cardboard, the surface table had hard time to identify them if they were slightly bended. That forced the participants to take up the card and put it down again.

6.3.1 Prototype 1: List view

The fact that the prototype was not designed for a 360 degrees experience resulted in that the participants disliked this prototype the most of all Surface prototypes (see 5.4.9). This gave a clear indication that the prototypes must support all directions to not interfere with a daily Scrum meeting.

As mentioned in the result people would rather stand in strange positions than switch places. We could see this behavior both in the focus group and the other test groups. Why they did not ask each other to switch places could depend on several factors. Many of the employees are new at company or it could be some cultural differences. It can also be as simple as they maybe did not want to break the Scrum order. We did not spend any time speculating around this since this thesis is not focusing on social dilemmas.

We could also see the drawbacks with using ordinary GUI elements not customized for the Surface. The fact that the participants had to touch a button multiple times for it to respond broke the flow of the Scrum meeting and the users' sense of disbelief, which is an important factor when it comes to NUI and seamlessness.

6.3.2 Prototype 2: Touch and hold to open menu

Prototype 2 supported all directions of the table and from the questionnaires we could see that the participants thought it removed some of the bad spots that occurred in prototype 1. This prototype could read the angle of the finger and summoned a menu after its direction, which never put the user in a discomfort position. This created an experience that both appeals to the expert and normal users which is an essential factor of the NUI paradigm.

In some cases some of the users accidently opened several menus while leaning on the table, since to open a menu was for example only a single touch on the surface. This broke the flow of their presentation and forced them to take some time to close them all again. This was solved by testing different input methods and the most appreciated one was the "double tap" since it was simple to produce but not that simple that the user would accidently do it.

In this prototype each Scatterview item had a button that summoned a menu with all the participants' names. Each participant could choose to copy a file to his or her own folder. This button was both liked and disliked. It was easy to understand and copy the file but sometime people accidently pressed on it when they tried to manipulate the Scatterview items. It was easier to avoid the "Share" button when the images was scaled up but this often occurred when the images just spawned and they were smaller. A smaller button would maybe be better but at the same time that would make it harder to aim and hit.

6.3.3 Prototype 3: Buttons and drag and drop

In Prototype 3 we tried a mix of both prototype 1 and 2, combining a static menu with a ScatterView. Instead of the "Share" button a new approach was used to share files: drag and drop. This way of sharing a file was appreciated in the user tests since it was a clear and natural way to share files.

The menu only supported one direction which made it hard for the participants standing in the wrong direction, this could be solved by having a rotatable menu but then each participant would have to rotate the menu every time they wanted a clearer view for copying files. This interface also had a button to expand and minimize the menu but during the user tests not a single user used it, since there was enough space for the items with the menu expanded.

6.3.4 Prototype 4: Phone and drag and drop

In prototype 4 a more private way of accessing the files was tested. Only the user that had the tag could access the files associated with that tag. In the paper prototypes our idea was to use phones with tags but in the low-fidelity test simple cards with a tag were used instead of smartphones. This was because we saw no advantage using phones during the daily Scrum meeting. To increase security the phone could be used for authentication, running authentication software to increase privacy even more. But since we only did low-fidelity prototypes we did not focus on any technical or security issues, this solution was enough for us.

One aspect of this prototype, which the participants did not like, was that the items easily overlapped others private area, which prevented them from copying, items from each other. Some of the participants also disliked that they had to remove some items to open space for their card if they wanted to copy a file. The users also needed to wait for their turn if several people wanted to copy the same file. All this feedback made us understand that the files need to be structured in a better way and to copy a file needs to take fewer steps.

6.3.5 Prototype 5: Share files using phone

Prototype 5 works exactly as prototype 4 but the way file is shared was changed. All the steps where the users had to clear out space for their tags and to drag and drop items to it were removed. Instead the user only had to put the card on one of the items to copy it. This was much appreciated since it allows several people to copy the same item at the same time and also it does not interrupt the user who is presenting.

6.3.6 Prototype 6: Kinect

In prototype 6 a Microsoft Kinect was used to control the content. This was done to investigate how people would behave in a Scrum meeting with a display on the wall and if a Kinect could benefit them in such meetings. Already from the first test of the low-fidelity prototype we saw that a Kinect would be more an obstacle than benefit for the Scrum participants. People needed to calibrate which took some extra time from their meetings. If the main presenter moved around a little bit, the Kinect would request for a recalibration. The main presenter also needed to aim with his hands and talk at the same time, which seemed to be a difficulty for the majority of the participants. The presenter seemed to sometimes forget what to say when trying to aim and talk at the same time.

Another drawback was that the other participants who was not presenting needed to ask the main presenter for a file if they needed one. All this added some extra time to the overall Scrum meeting,

which is a problem since a daily Scrum meeting should be short. The user tests showed how much each participant talked during the Scrum meeting (see Table 16). That meeting took about 18 minutes for only six participants and most of that time was used to try to calibrate or share files with the rest of the participants. One positive aspect with this prototype was the space. It was never too crowded which happened with the Surface prototypes. The formation of the group was always an F-formation of a "semi-circular" as described by Adam Keldon (see 2.6).

6.3.7 Prototype 7: Kinect and phone

Prototype 7 has the exactly same pros and cons, except for one exception. How to share files were changed which improved the meetings with a Kinect and a display on a wall enormously. The flow of the meeting did not break when people wanted to copy a file from the main presented. Instead of asking the main presenter, they used a smartphone to download the files. One drawback with this was that during the low-fidelity prototype testing, we did not have a phone for each participant so they had to pass it around.

6.4 Conclusion

The aim for this thesis was to investigate if interactive devices could be used as an aid for daily Scrum meetings and what contributions they would give. It is important to notice that this thesis only focused on the daily Scrum meetings and not the entire Scrum process. During the observation we saw that many people struggled remembering what they had done the day before and the interviews showed that the participants sometimes had problems understanding each other's works and problems. That is why we focused on the content and how people shared information with each other. We wanted to help people to more easily explain their daily work and also share important information between each other.

The first research question of this thesis was: can interactive devices be used as an aid during the daily Scrum meetings? This research tested different prototypes with different devices and all the prototypes showed that each participant talked more than they used to. This does not have to be a bad thing. It can be seen as an indication that people remembered more stuff about their work than they used to. All the notes and images displayed on the tabletop or on the wall seemed to help the main presenter to not forget what to bring up during these meetings. All the content shown on the tabletop or on the wall also helped other participants to easier follow others work. All the low-fidelity tests showed that a meeting never exceeded more than 18 minutes and 20 seconds and a daily Scrum is usually time boxed to 15 minutes. A daily Scrum meeting with an interactive device included exceeds a couple of minutes of the time frame, but we believe that it contributes to much more valuable information. It is a comparison the company have to do; a meeting, which takes more time with rich visual information against a shorter meeting with no visual information. We believe that interactive devices can be used as an aid during the daily Scrum meetings and those extra minutes that the meeting exceeds is worth the more valuable information.

The second research question was: how to seamlessly share data between different users using interactive devices during daily Scrum meetings, based on the NUI paradigm. To be able to answer this question, several different prototypes needed to be done on the same device. From all the different low-fidelity prototypes that were tested, Prototype 5 gave the best result and was most appreciated (see 5.4.6). We believe that this prototype gave best result for the following reasons: It

supported privacy, it only took 2 steps to copy a file and it used ScatterViews, which supports free-form manipulation. This shows an indication that to access and share files should have as few steps as possible. The interface should have support for all directions and privacy is very important. The low-fidelity test took 15 minutes with 8 participants, which is perfect for a Scrum meeting. It is important to notice that this prototype gave the best result from only those seven low-fidelity prototypes that were tested. It does not mean that it is the best solution; it was the best from those, which were tested in this research.

6.5 Future work

During this thesis we tried to test as many prototypes as possible. We had more paper prototypes that were ready but we only had time to tests those, which are presented in this thesis. Concerning the future, more tests have to be performed on the current low-fidelity prototypes and those prototypes also need to be tested on several different companies. This has to be done to get more accurate results. In this research we got the result that Prototype 5 suited best for the daily Scrum meeting but it does not have to mean that it is the best solution. It was only the best from those prototypes we tested. That is why more different prototypes have to be done to see if it can be improved even more.

All the low-fidelity tests used a local server, which represented a Cloud server (see 4.4.1). During this thesis we excluded all the issues concerning security and off-location servers such as Cloud. In the future these technologies can be implemented to investigate how these affect the daily Scrum meetings. Since these can add more time to the meeting while trying to access the content from a Cloud server and to enter the login information. How these issues affect a Scrum meeting can be further investigated.

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8 Appendix

8.1 Interview

The section presents the interview questions used at the field study.

8.1.1 Questions to Scrum-master

- Hi! Would you like to describe yourself in 2-3 sentences? What is your position here at the company?
- What kind of information is important to you in a Scrum-meeting? Which is the most valuable?
- Do you want to be able to save and access information from a Scrum meeting later?
- Would you like to have a Microsoft Surface as an aid during a Scrum meeting? To be able to show screenshots and small notes? Meetings, deadlines and time plan?
- What kind of data would you than want to see as a Scrum master?
- Is there an already existing software like a scheduler or similar to integrate into a Microsoft Surface application?
- Would you like to see all the data presented during a Scrum meeting, to be saved in a timeline fashion? To easier be able to review after the end of each sprint
- Which of the following devices do you think would be a good or bad aid to share data during a Scrum meeting? Why and why not? Surface, Mobile phone and Kinect.
- How would you like to transfer data to the table? With a handheld device, through your desktop (copying files to a network folder) or any other way?
- Should others be able to share information during a Scrum meeting without participating?
- Thank you for your time. Is there any other knowledge you might want to share with us that came to mind?

8.1.2 Questions to Scrum participants

8.1.2.1 Scrum meeting

- Hi! Would you like to describe yourself in 2-3 sentences? What is your position here at the company?
- During a Scrum meeting do you have problems remembering what you did yesterday?
- Do you think it is hard to follow other peoples' project during a Scrum meeting? Do you understand what they do or did?
- What do you think about having a Microsoft Surface as an aid during a Scrum meeting? To be able to show screenshots, small notes or time plan from previous day?
- Is there any other kind of data that would help you describing your work during a Scrum meeting?
- What do you think about using TFS information during a Scrum meeting? What's the biggest concern regarding TFS? Why are you or are you not using it?

8.1.2.2 Data sharing

- How would you like to transfer data to a surface table?

- How would you like to transfer your data to another person on a surface table?
- Are there any thoughts of why you would **not** like to have a Microsoft Surface as an aid?
- Can you see any point in using a Microsoft Kinect for data handling or user identification rather than using a Microsoft surface? Why and why not?

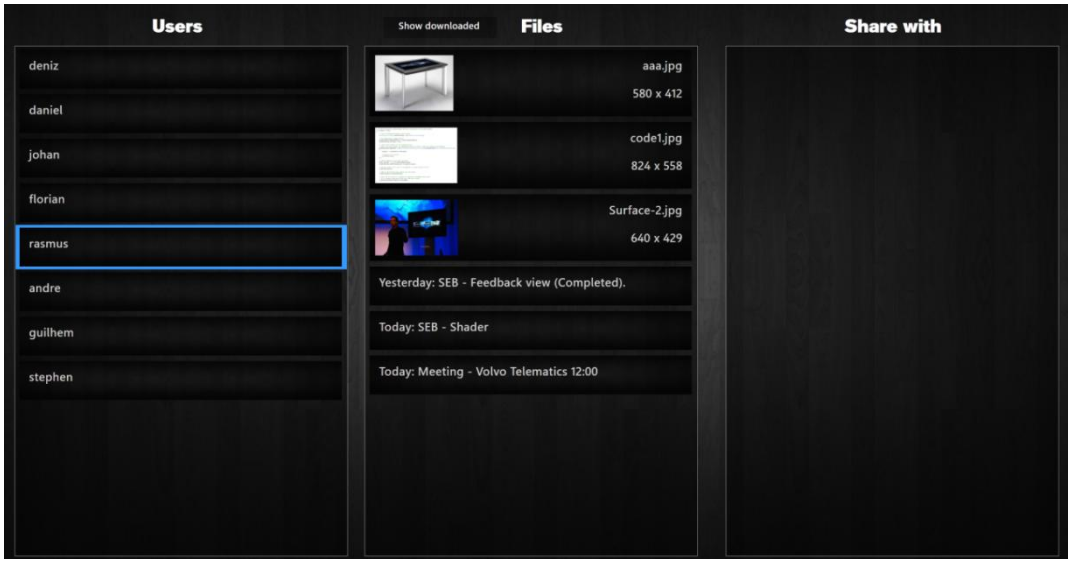
8.1.2.3 Interaction

- How high should a table be? Sit or stand?
- What do you think about Metro style?
- Connecting a projector to a surface table. What would you expect of the interaction?
- Thank you for your time. Is there any other knowledge you might want to share with us that came to mind?

8.2 Questionnaire

Each prototype had a short questionnaire with the following questions. A questionnaire summarizing all prototypes was also held.

8.2.1 Questionnaire: Daily Scrum



It was easy to understand the interface of this prototype? 1 – Hard | 10 - Easy

1	2	3	4	5	6	7	8	9	10

It felt natural to share data this way? 1 – Not at all | 10 – Very natural

1	2	3	4	5	6	7	8	9	10

The way my images and notes were presented to me was good? 1 – Bad | 10 – Very Good

1	2	3	4	5	6	7	8	9	10

What particular aspect(s) of this prototype did you like?

What particular aspect(s) of this prototype did you <u>not</u> like?

Did this prototype ease your presentation during the Scrum meeting? Why and why not?

Any final feedback of this prototype? What would you add or remove?

8.2.2 Open questionnaire for all prototypes

In a scale 1 to 10 how important is it to be able to copy data from each other during a daily Scrum meeting? 1 – Not important | 10 – Very important.

1	2	3	4	5	6	7	8	9	10

How many minutes did you spend preparing for each Scrum meeting (in average)?

Would you want to prepare in another way for a Scrum meeting? If yes, how?

Did the prototypes move the focus away from the Scrum meetings? Why and why not?

How did you feel about the height of the Surface table? Did the height affect the meetings in any way? Would you want a higher/lower table or maybe mounted on the wall?

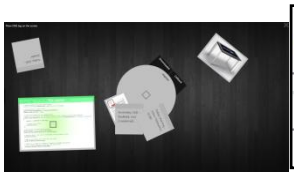
Which prototype served its purpose best during the Scrum meetings? Put the following numbers below the prototype: 1, 2, 3, 4, 5, 6, 7 (1 being the best). You can only use each number once.

Prototype 1

Prototype 2

Prototype 3

Prototype 4



Prototype 5

Prototype 6

Prototype 7

Would you prefer to use this kind of a product in the future to share information during a Scrum meeting? If yes, which of the prototypes would you prefer and why?