Bachelor's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Information Technology and Electrical Engineering
Department of ICT and Natural Sciences

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Interaction Design for Remote Operations

Bachelor's thesis in Automation and Intelligent Systems
Supervisor: Ottar Osen
Co-supervisor: Øystein Bjelland

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Kunnskap for en bedre verden

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Summary

This bachelor thesis was ordered by Seaonics, and conducted by two students from Automation and Intelligent Systems at NTNU in Ålesund during the spring semester of 2024. The purpose for this project was to provide better knowledge on interaction design for remote operations. The problem statement for this thesis asks about the difference between operations done on-site and remote, what information can be lost when moving an operation from on-site to remote location and how the loss of information can affect the operator. One of the biggest differences is the loss of physical factors. Additionally, the operators contact with the crew on-site is a significant difference. When the operator works remotely, they could be in charge of various operations and vessels. This is also a significant difference when moving an operation to remote. All of these are factors that can affect the operators ability to preform a successful operation. Therefore, these factors need to be compensated for when moving the operation from on-site to remote. During the work, a literature study was preformed in order to gain necessary theoretical understanding regarding the topic. A focus experiment was conducted in order to test the theory found. Interviews of employees at Seaonics were executed in order to provide better technological knowledge regarding remote operations and what information could be important to include when preforming operations remote. These processes lead to the design of four prototypes which were tested. Based on both the feedback from this testing and the previous processes, a final prototype was designed. This is a visual prototype displaying a potential screen setup for a remote operation. The screen setup for the prototype consists of four camera views for the operation, a technical information screen and a screen regarding vessel information. In the prototype, which is based on a LARS operation, the operation is preformed in an operation chair using a joystick.

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Chapter 1

Introduction

This bachelor thesis was made by two students from Automation and Intelligent Systems at NTNU in Ålesund. The work on the thesis took place during the spring semester of 2024, from January to May. The task for this thesis was provided by Seaonics.

Throughout history there have been people from all corners of the world making their living from work done at sea, such as fishing, transportation of both humans and cargo, oil rigs, and construction of wind farms and bridges. All these fields of marine work utilize some kind of vessel to perform their work tasks. Aboard these vessels there are different numbers of crews, which can take up a lot of space on the vessels for cabins and common areas. In order to free some of this space, some of the operations could be performed from a remote location [25]. These operations could be launch and recovery operations and operations done with the use of cranes and gangways [36]. Other motivations to perform marine operations from a remote location could be based on environmental concerns and increasing profit through less people in the crew and smaller costs in connection to travel [25]. If a company were to change the operation for some of their work tasks from on-site to remote locations, there would be several factors to take into consideration.

In Sunnmøre, a region on the western coast of Norway, there is a cluster of companies working within the marine industry. One of these companies is Seaonics. Seaonics specialize in developing handling and lifting solutions that are not only intelligent and efficient but also profitable. Seaonics commitment to innovation drives them to continuously advance their technology of high standards, safety and sustainability. The goal for Seaonics is to lead the transition towards more sustainable and electrified maritime operations, enhancing the capabilities of sustainable ocean exploration, development, and harvesting [34]. One of these handling solutions Seaonics offer is launch and recovery systems, LARS, which is a handling solution used during the launch and recovery for different operations, such as operations using ROVs [35]. During this thesis, LARS operations were the main focus. Therefore, the conducted work was centered around these operations.

If Seaonics were to move the LARS operations from on-site to remote locations, there would be important aspects to take into consideration. One of these aspects could be the potential loss of information the operator could experience, and what measures that could be made in order to prevent the operator from being negatively affected by this loss. The information that faces a potential loss, how this information could be presented and compensated for, and how all this could affect the operator is explored throughout this thesis.

1.1 Problem Formulation

For this thesis, a problem statement was formed.

- What is the difference between operations done on-site and remote, what information can be lost when moving an operation from on-site to remote and how can this loss of information affect the operator?

1.2 Design Thinking Method

The design thinking method, which is a solution orientated methodology and a human centered design process [14], were used throughout the entirety of the bachelor thesis, and was a central method for all processes involved. This method consists of the five following steps: Empathize, where one should strive to understand the users, their needs and problems. Define, where the main focus is to analyze the information gathered through the empathize step. Ideate, where ideas and solutions are formed. Prototype, where the ideas from the ideate step are formed. And test, where the prototypes are evaluated and tested.

1.3 The Process

The work for the bachelor thesis was divided into four main steps, literature study, focus experiment, interviews and prototypes. These four steps all provided their own results, and these results were then used to form the end result of a final prototype.

1.4 Structure of the Report

The rest of the report is structured as follows.

Chapter 2 - Theory: Chapter two gives an introduction to the theoretical sources found in the literature study as well as information describing the design thinking method.

Chapter 3 - The Process: Contains a description of the method and a presentation of the results for each of the four steps of the process, in addition to a discussion for each of the results.

Chapter 4 - The Final Prototype: Contains a description of the method and a presentation of the results for the final prototype.

Chapter 5 - Discussion: In this chapter, the results of the final prototype and the problem statement are discussed.

Chapter 6 - Conclusions: This chapter presents an overall conclusion and suggestions for potential future work in regards to the problem statement and thesis.

Chapter 2

Theory

In this chapter, the theory used throughout the thesis is presented. The theory presented in this chapter is actively used in the thesis, and contributed to creating a foundation for the work.

2.1 Design Thinking Method

Design thinking is a solution orientated methodology and a human centered design process, which is effective when addressing complex problems that are undefined or unknown. The method stands out as it focuses on understanding the human needs, redefine the problem to be centered around the human needs, develop several ideas during brainstorming and encouraging to prototyping and testing [14]. The method consists of five steps, empathize, define, ideate, prototype and test, which are done in chronological order throughout the thesis. These steps are displayed in figure 2.1 below [12].

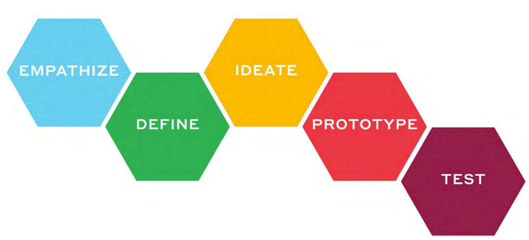


Figure 2.1: Design Thinking Method [12].

2.1.1 Empathize

Empathize is the first step of design thinking method and the basis of a human centered design process. Observe, engage and immerse are the three principal points in empathy. In the observing principal the users and their actions in everyday life are monitored. While engaging, time is spent with the users and interviews, where both scheduled and shorter, more unplanned interviews are conducted. In the final principle, immerse, one "experience what the user experiences" [12].

When preforming a human centered design process it is crucial to acknowledge the people being designed for, building a deeper understanding of who they are and develop empathy for them. Observing individuals within their environment provides insights about their feelings and needs, which will contribute to innovative solutions. Ideal solutions are carried out from the optimal insights to human behavior. However, recognizing these insights can be challenging because minds instinctively ignore information without human awareness. It is crucial to master how to see things from a different angle. Interacting with individuals directly provides a substantial insight to their way of thinking and personal values, which in many cases are not evident to them. A profound engagement can in many instances lead to unexpected findings for both the designer and end user. The stories people share and their descriptions of their actions provide a good indicator of their perception of the world, even if what shared differ from their real behavior. These beliefs and values are foundations to building good design. Personal experience in the design space, in addition to engaging with the users, is important for a good design [12].

2.1.2 Define

Define is the second step of design thinking method. In this step the designer analyze and implement the findings from empathize into essential needs and insights, and develop a precise and significant challenge. Define concentrates on narrowing focus over expanding ideas. The main purpose of define is to cultivate an understanding of the users and the design context, and based on this define a problem statement. The problem statement is advised to serve as a guiding statement which concentrates on particular users, together with the insights and needs discovered in empathize. The define mode clearly states the problems the user is aiming to solve, and this makes it critical in the design process. Frequently, it is crucial to reconsider the problem using new insights and fresh perspectives in order to foster creativity [12].

2.1.3 Ideate

In the ideate step of the design thinking method the purpose is to create various design options and expand the users thinking to research different concepts. Unlike in the define process, the ideate process concentrates on expanding ideas over narrowing focus. The ideate step is preformed in order to shift from detecting problems to discovering solutions. Different techniques of ideation are listed below [12]:

- Overlook the apparent solutions in order to create innovative solutions.
- Benefit from the team members strengths and perspectives.
- Discover new and unexpected exploration fields.
- Produce a number of options and a variety of them in the innovation process.
- Develop obvious solutions and work with the team to think beyond them.

2.1.4 Prototype

The focus in prototype is to get ideas worked with during the previous steps of the design thinking method out into the physical world. A prototype can vary in size, ranging from large to small, and can contain solutions of different levels of complexity. Prototypes are efficient in the design process in order to improve the solution further. Seeing the idea in a physical form makes this easier for the designer. In this process several other prototypes can be made through testing with the user, design team or others. Prototyping is also important for understanding the design space and the user. Some of the reasons for prototyping are [12]:

- To learn.
- Solve disagreements. This can be disagreements within the designing team or between the designing team and the user. A physical model contributes to making this process easier and more effective.
- Start a conversation. A prototype can contribute to having a different form of conversation with the user, which can contribute to a better relation between the designing team and the user and acquire different point of views.
- To encourage breaking large problems into smaller testable ones in order to focus on solving one problem at a time.

2.1.5 Test

In the testing step the designer is able to receive constructive criticism from the user or other test persons, and learn more about the users requirements and desires. This step is carried out in order for the design team to be able to improve the prototype and develop new designs. Testing is crucial in order for the design team being able to create the best possible solution [12].

2.2 Interaction Design

Interaction design focuses on creating user experiences that enrich and expand peoples ability to work, communicate and engage with one another. It involves shaping environments that are used for human interaction and dialogue. Interaction design not only addresses the practical aspects of our daily engagements with digital tools but also explores and looks into the underlying reasons for these interactions. Interaction design is regarded as an important factor in relation to all disciplines, fields and approaches that are related to researching and designing computer-based systems [24].

A main objective of interaction design is to minimize the unfavorable elements of user experience and amplify the favorable ones. Essentially, it revolves around creating interactive products that are straightforward, efficient and enjoyable [24].

There are four basic activities to keep in mind in the process of interaction design. These are establishing requirements, designing alternatives, prototyping and evaluating. In addition, it can be of great importance to account for the end users opinions and experiences and evaluate these while in the process of interaction design. This can lead to an end product better suited for the end user, a product that feels good to use and which gives a good impression of user experience. The understanding of the wants and needs of the end users, what they actually do and what they are going to use the product for is also of great importance in the process of interaction design. This should be taken into consideration in order to make a product that fits all the needs of the end user [24].

A term quite central in interaction design is the user experience, which regards how people use a product and how that product behaves. The user experience consists of how the end user experiences the use of the product, how satisfactory and pleasurable the product is to use and what impression the product leaves on the end user. This impression can be affected by for example how switches turn and rotate, and how the touch and sound of clicking a button feels and sounds. There are different components of the user experience that can be evaluated when designing interaction design. Some of these are usability, functionality, aesthetics and content. These are all of central importance for the user experience of the end product [24].

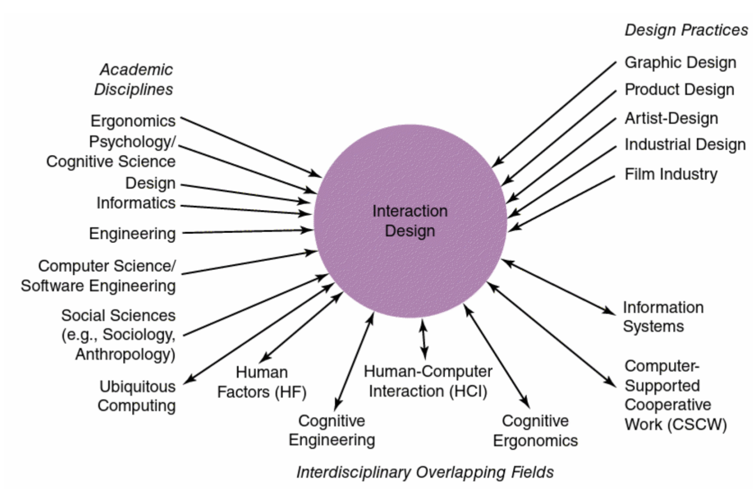


Figure 2.2: Design Practises [24].

Figure 2.2 above shows the academic disciplines, interdisciplinary fields and design practises that affects interaction design [24].

2.3 Color Theory

Color theory and light are important elements in the practice of interaction design. Luminance is measured as the intensity of light emitted from a surface and is displayed as lightness in figure 2.3 further below. Luminance plays a key role in visually conveying information since the eyes notice changes in light levels to a higher degree than changes in color. This makes luminance important for displaying information effectively and is important for clear visualization. Luminance is particularly crucial for small, detailed and moving symbols. Despite its significance, luminance should not be the sole method for encoding information. It is advised against the use of gray-scale for representing extensive numerical data, therefore strategic use of color can be used instead [44].

Chroma refers to the intensity of color and is a technical significant term for perceived vividness. In addition to luminance, chrominance plays an important role in visualizing information. A lower chroma is suggested for lager areas, as colors are more noticeable over wider spaces, while smaller symbols benefit from higher chroma to stand out [44]. Regarding black and white, the endpoints for luminance, these colors both have a low level of chroma. When talking about the benefit of a lower chroma for backgrounds, when using black and white, the luminance is therefore the main factor. Figure 2.3 below shows the concept of hue, lightness and chroma in regards to each other.

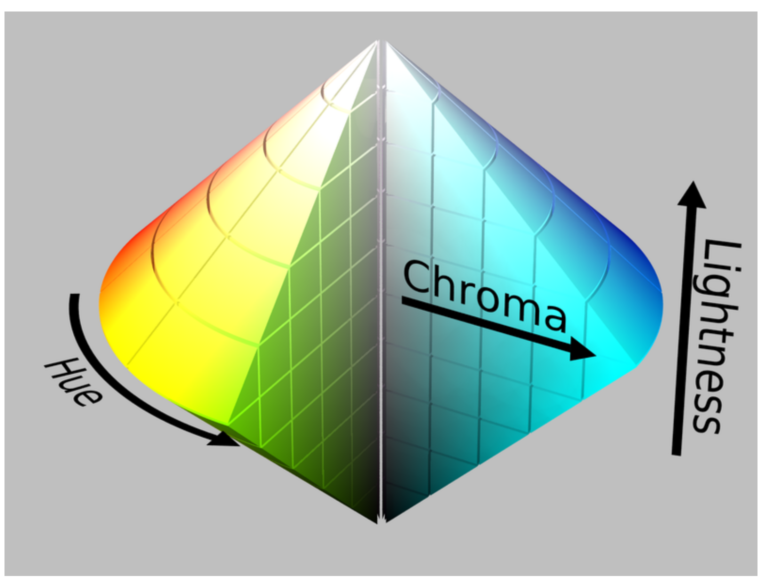


Figure 2.3: The concept of hue, lightness and chroma [44].

Color semantics is the association of colors with specific concepts and emotions, and it varies by culture. For instance, in Western cultures, green often represent safety and vegetation, red indicates heat, danger and financial loss, and blue symbolizes coldness, sadness and tranquility. On the other hand, in Eastern cultures, for example in China, red represents life and prosperity, while green may signify death. The strategic combination of colors into palettes can evoke specific emotions, influencing the perceived importance of interface elements. Color choices can therefore impact the interface effectiveness and user experience [44].

2.4 Physical Senses

There are several physical senses to take into consideration when designing interaction design for remote operations. These physical senses will affect the operators while conduction operations on vessels, both on-site and remotely. However, the most important ones are the visual and aural senses, while the haptic and vestibular senses also play a role and affect the operators [16].

Visual senses are connected to the eyes and regards out sight. Sight is the ability to receive and register light and to process visual impressions. It is used to form an image of the surroundings, including shape, color, contrast and extent [28]. Light, also known as visible light, is electromagnetic radiation that can be detected by the human eye. Light can also be defined as the sensory experience perceived by sight [38].

Aural senses are connected to the ears, and in short regards our hearing. Hearing is the ability to perceive sound. In humans, the sense of hearing is linked to the ear and includes the perception of sound, sensing sound waves and pressure waves [45].

Haptic senses regard touching. The sense of touch provides the information about touch in the form of mechanical pressure and movement on the surface of the skin. The ability to detect touch on the skin is due to various types of specialized nerve cells. These usually have branches that collectively spread across the entire surface of the skin [10].

Vestibular senses are connected to the balance. The sense of balance is the inner ears ability to perceive the position and movements of the head. Based on the position and movement of the head, rapid muscle responses and reflexes are triggered. This can prevent falling and will help with stabilizing the eyes, enabling clear vision even while the head is moving. The sense of balance primarily operates unconsciously, but disturbances can lead to dizziness, nausea, unsteadiness, and involuntary eye movements [17].

2.5 Concentration and Focus

According to [23], past studies indicate that exposure to bright light can immediately boost attention, concentration, focus and cognitive abilities. Additionally, exposure to light enriched with blue wavelengths has been found to amplify attention and increase feelings of alertness, which can result in quicker reaction time. Correlated color temperature is a one-dimensional characterization of the hue from light sources that are close to white. Differences in the portions of the wavelengths from the light source result in various kinds of white light, ranging from warm tones, which are rich in red and yellow wavelengths, to cool tones, which primarily are blue wavelengths [11]. It can be assumed that there is a positive link between correlated color temperature and alertness, with blue-enriched light of higher correlated color temperature leading to greater alertness and the opposite being true for lower correlated color temperature. The relation between correlated color temperature and alertness can also be observed with luminance, where increased levels of light lead to enhanced alertness and reduced luminance has the opposite effect [23].

Cognitive workload refers to the amount of mental energy needed to carry out a task [26]. The cognitive workload essentially grows as a person undertakes a task. However, the intensity of the cognitive workload is not only decided by the task itself, it can also be affected by surrounding environmental conditions and factors [23].

In order to enhance cognitive efficiency, insights from cognitive neuroscience have been used in order to create and design ways to present data that correspond to human visual capabilities. It emphasizes the development of interaction designs that assist our cognitive tasks by presenting data in understandable ways. Moreover, the complex interaction between the brains reception of visual information and its predicted responses plays an important role. The brain not only processes incoming data but also projects anticipatory cues to the visual system, improving focus and guiding further visual explorations. This dynamic process, central to the visual and cognitive systems, highlights the significance of guiding attention through deliberate eye movement and focus reallocation [44].

Furthermore, humans tend to overlook the unexpected, which in turn shows the importance of anticipatory design in information visualization and interaction design. Humans often miss or overlook short and unexpected events due to a lack of preconceived expectations. Therefore, it is of high importance to introduce critical elements before they actually are needed. This is especially crucial in interaction design and in the design of user interfaces where it can be important to recognize warnings or errors as soon as possible after they occur. By understanding these perceptual and cognitive limitations, more effective and intuitive visualizations made with focus on human processing capabilities can be created [44].

The concept of the useful field of view, is defined as the area from which an individual can efficiently gather information. A related phenomenon, known as tunnel vision, is when ones useful field of view decreases under stress, typically narrowing to an angle between 1-15 degrees [44]. This suggests that important information should be positioned within this narrowed field, close to the users primary focus area. Furthermore, an increased visual load can further reduce the useful field of view, emphasizing the importance of ensuring that only essential details are noticeable and within the users direct field of view [44].

Chapter 3

The Process

In this chapter the process for the work leading to the final prototype is presented. Throughout the process, all steps used a LARS operation for a ROV work task as a foundation. Figure 3 below shows a visualisation of the process. The process consisted of four steps, literature study, focus experiment, interviews and prototypes. For each step, the method, result and discussion are presented. Prototypes is divided into three smaller sections. These are screen setup, technical information and testing the prototypes. The method, result and discussion for each is presented in the belonging section. In addition to these four steps, initial work was preformed. The initial work consist of the three first steps of design thinking method, empathize, define and ideate. The use of these are described. A description of the project organisation and the work process is also presented.

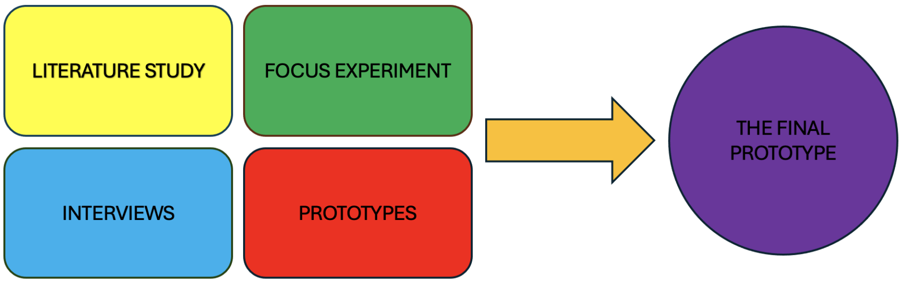


Figure 3.1: The Process

3.1 Project Organisation

During the first period of the bachelor, before Easter, the group had another subject with intensive workload. This occupied a significant amount of time and therefore less time was dedicated to the thesis. However, after Easter, the group was able to concentrate fully on the thesis. The groups work mainly took place at the University where it was arranged for brainstorming, discussion and teamwork. It occurred that tasks were preformed remotely from home. Seaonics also arranged for the group to work at their office, which was utilized.

Throughout the project period for this bachelors thesis, three methods have been used to track and document the progress. These are progress plans and reports, meetings with the supervisors and time sheets updated each week.

To track the progress both a progress plan and bi-weekly progress reports were made. In addition, bullet points for work tasks were made in supplement to the progress plan. The plan itself was made during the early stages of the project period, and the bullet points were made bi-weekly in relation to the progress reports. The progress plan was made with the design thinking method in mind, and by following the steps of the method, each step was given a sufficient amount of time. The thought process behind the development of this progress plan was to mark each week with either a light or dark purple color, where the light purple represented a lighter focus for each step and the dark purple represented a heavier focus for each step. The bullet points for work tasks were made in an effort to get a clear overview of the work at hand, and to ensure that each step of the design thinking method was done thoroughly. The progress reports for each week are available in B in Appendices. The progress plan is shown in figure 3.2 below.

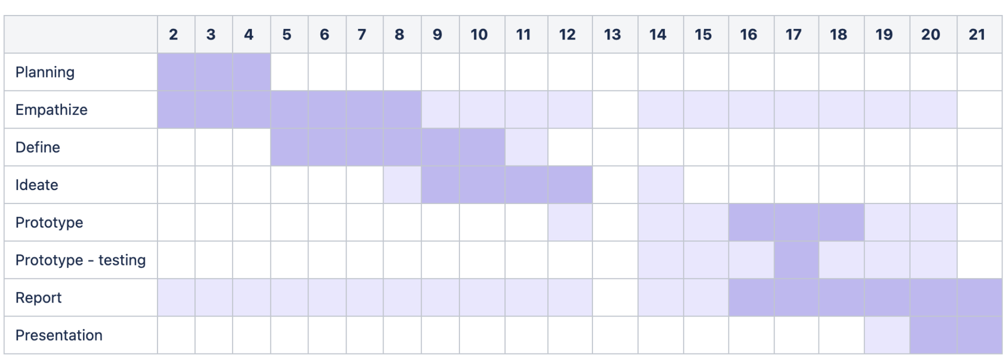


Figure 3.2: Progress Plan

Meetings with the supervisors took place evenly throughout the project period. Before each meeting, a meeting agenda was made and sent along with the invitation to the supervisors. After the meetings, reports were written. The meeting reports are available in C in Appendices. In order to track hours spent on the bachelor thesis, a time sheet was made. All hours for each day were tracked, in addition to a description of the activities done and comments on the specifics regarding the work. The time sheet is available in D in Appendices.

3.2 The Initial Work

During the initial work, design thinking method was actively employed, and created the foundational approach for the thesis. The method consists of five steps and in the initial process, empathize, define and ideate were actively used.

3.2.1 Empathize

Observe, engaging and immerse are the three principle points in the empathize step [12]. Through the process and particularly in the initial phase there were meetings and conversations with employees at Seaonics in order to get a deeper understanding of the problem. The purpose of the meetings was also to understand the motivation to preform operations remote. Seaonics is actively working with remote operations and offers the possibility for their clients to implement this on their vessels. Getting insight on previous work was important in order to immerse in the problem. Different data regarding ROV operations, description of the operations on the vessel and technical specifications were presented and made available by Seaonics. Operation simulators at Seaonics were examined, mainly to get an understanding of operations, what information is presented to the operators and to get a perception on how the work station appears. Getting in contact with operators proved to be challenging and Seaonics was not able to get in touch with any active or previously active operators. Additionally, other companies and their operators were contacted, to provide insight into remote operations. However, these requests were never answered and therefore no direct contact with operators were made.

In order to achieve some kind of compensation for this, YouTube videos made by ABB Group [3] [4] [5] [6], "Remote Crane Operator Stories" were studied. A screenshot from one of the videos is showed in figure 3.3. ABB is a company that works with electrification and automation for production and transportation, in the marine industry, amongst other [7]. The videos shared stories from crane operators who previously have been working on vessels and were re-positioned to operating remote, and the operators shared their stories about how they experienced the transition.

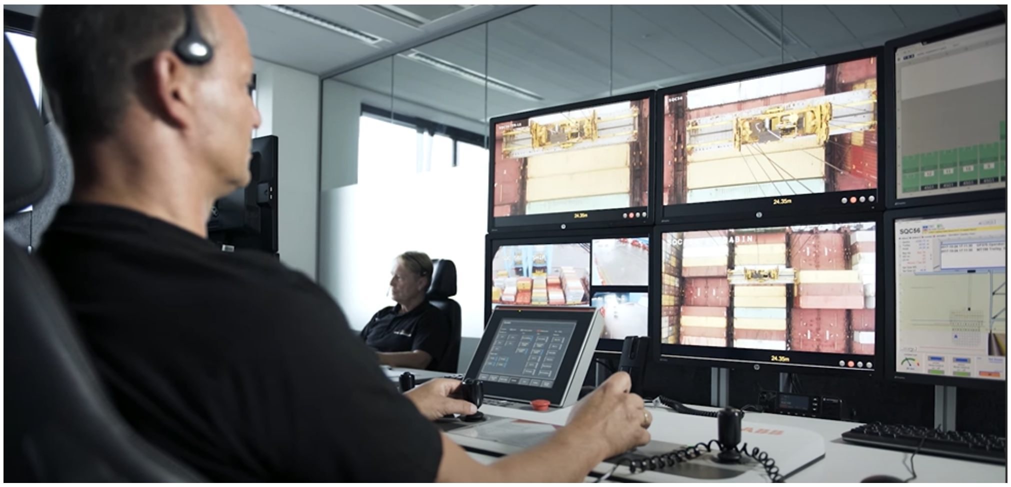


Figure 3.3: Remote Crane Operator Story, [4]

3.2.2 Define

In the second step of the design thinking method, time was dedicated to defining a problem statement based on the findings in the empathize step. Through the process, different problem statements were made and presented to supervisors at the University and Seaonics before the final problem statement for further work was specified. The three problem statements are listed below, where the last one is the final problem statement:

1. What are the motivations to perform remote operations and how should the GUI be designed?
2. How can interaction design improve the user experience and efficiency in remote operations to minimize the differences between on-site and remote operations?
3. What is the difference between operations done on-site and remote, what information can be lost when moving an operation from on-site to remote and how can this loss of information affect the operator?

Problem statement 1 was the first problem statement defined, and this statement was too wide and not precise enough to provide a sufficient result for the thesis. It was necessary to concretize the problem statement in order to achieve a satisfactory result. The supervisors noted that problem statement 2 still was too wide, in addition to interaction design being a large and complex topic. Based on the feedback from the supervisors, problem statement 3 was defined. This problem statement has three concrete questions which can be answered extensively, making the statement suitable for the thesis.

3.2.3 Ideate

Ideate, the third step of the design thinking method was divided into two parts. The first part was expanding ideas and the second part was working with identifying various solutions. In the process of expanding ideas, brainstorming served as a fundamental technique. Brainstorming is a creative technique where people in a group freely share their ideas to solve problems [8]. During brainstorming, several different ideas were shared and the creativity within the team expanded. Different interaction designs found online were also examined in order to expand the ideas within the team. Through these investigations, it was revealed that there are numerous types of interaction design in existence today. Two of the remote operation stations found online are shown in figure 3.4 and 3.5 below.

Figure 3.4: CAT Remote Control Operation, [22]

Figure 3.5: cmLabs Remote Operation Station, [13]

Simulators accessed at Seaonics also demonstrated a solution for interaction design. By examining these existing solutions, designs for further development were identified. Through ideating, several different designs were sketched. The initial designs were sketched out using Goodnotes, which is a note-taking app used on iPad, where it was easy to make adjustments and gain an overview to determine whether the solution warranted further development or not.

Interviews with employees at Seaonics were carried out, as described later on in 3.5 Interviews. The interviews were some of several factors that influenced the final design of the solutions. Through the interviews, the design team got more information about what kind of technical information that could be important to maintain when moving an operation from on-site to remote. Additionally, the interviews presented information regarding physical factors that could be crucial to pass on from on-site to remote operations. This, along with other findings from the interviews, helped influence the interaction design and contributed to the creation of various designs.

Technical and operational data was made available by Seaonics. This data was examined and has contributed to a detailed understanding of the operations. Through brainstorming the technical data, relevant data that could be included in the designs were gathered. For example, the idea to include information about load cases in the design, shown in the technical information screens 3.25, 3.26, 3.27, 3.28 and 3.29 later on, was found through brainstorming after reading a NORSOK Standard on ROV services provided by Seaonics. Load cases are the steps of an operation. On guidance meetings with both supervisors at NTNU and contacts at Seaonics, constructive feedback on the designs were given, which provided a solid foundation for further improvements. In addition, one of the supervisors possesses personal experiences of the marine industry after years of working at sea. This has provided beneficial feedback during the guidance meetings.

3.3 Literature Study

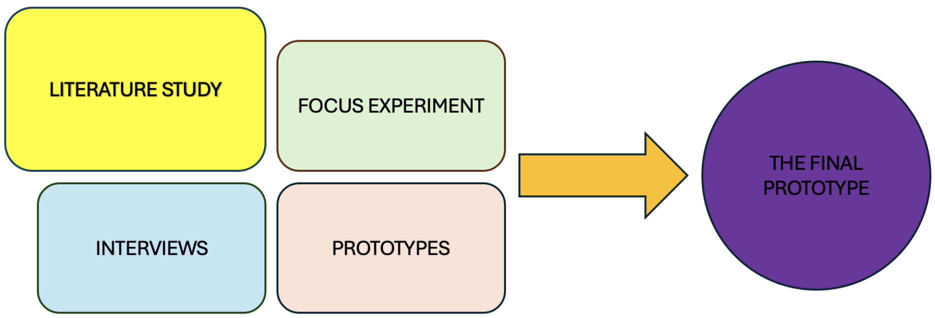


Figure 3.6: The Process, Literature Study

Method

This bachelor thesis started out as a literature study. When conducting a literature study there are several steps to take into consideration to optimize the time spent. These steps are to select a topic, choose an approach, find keywords, review all the source material, read the selected material, find more sources through citations, and organise the source materials in order to best prepare for the writing of the report for the task [40].

The first period of the literature study was used to select a specific topic and area to look further into, to determine an approach for the search, and to select keywords for the gathering of source material. Using an initial search to pinpoint a topic can be advantageous, as it confirms the availability of recent and relevant research. One struggle that often occurs is narrowing down the topic to a more focused area [40].

Then followed reviewing and reading of the source material and finding of more sources through citations. During this stage of the process, it was decided to widen the approach of the bachelor thesis from a literature study. This was achieved by incorporating prototypes as examples on how the different theories and techniques found in the literature search could be used.

For the literature search, Google Scholar was used, which is a search engine for academic literature from every discipline. It was important to organize references in a clear, systematic and easily accessible manner, which can prevent an overwhelming amount of information [40]. Therefore, Zotero was used to sort and save the source material, which is a digital tool used to collect, organize, cite, and share research.

Choosing the right keywords can be essential to an effective literature study. Selecting and developing appropriate keywords is a detailed, time-consuming process that can play a critical role for success [40]. The problem of choosing the right keywords was encountered a few times during the beginning of the search. It proved to be difficult to find keywords and search phrases that was narrow enough to provide satisfactory results. Over time and with more experience, this problem grew smaller.

A method that helped narrowing down the focus area was the technique of snowballing, which is a method where one can find more references by checking the references in a paper or the citations to that paper. To enhance this method, it can be helpful to systematically track where papers are mentioned and cited [46]. By utilizing this technique, the literature study went more seamlessly.

Another problem that occurred was to find sources that were directly related to the technical field of the thesis and the technologies delivered by Seaonics. This was solved by regular conversations and conducted interviews at Seaonics, in addition to the four videos from ABB [3], [4], [5] and [6].

Result

In order for the keywords to provide satisfactory results, time was dedicated to analyze and dissect the problem statement. Through this effort, the key elements were found to be interaction design, design thinking, color theory, focus and concentration, cognitive workload, remote operations, the marine industry and LARS. As stated above, it proved to be difficult to find sources directly related to the technical field of the thesis. Therefore, the key elements for these aspects of the thesis were overlooked in the search for keywords, while the other elements remained as important keywords for the literature study.

The main sources found through the literature study are presented and described in 2 Theory. One of the sources was a book about interaction design [24]. This book talks about all aspects of interaction design, and provided great help in the understanding of this field. The next source talks about remote operations [16]. This source gave an understanding of the central physical senses used during operations in vessels and how these senses could affect operators. In turn, this source gave an understanding on how these senses could be affected when operations were to be performed remotely, which again gave an impression of the importance to make compensations for these senses.

Another source that was found through the literature study was a source that focuses on color theory [44], such as chroma, luminance and color semantics, in addition to the brains reception of visual information and its predicted responses to visual cues, the importance of anticipatory design, the useful field of view and tunnel vision. The next main source talks about concentration, attention, focus and cognitive abilities [23] and how different light can affect attention and the feeling of alertness. Lastly, [12] and [14] were used to describe the design thinking method, all its steps and different techniques. In addition to these main sources, several other sources were found in order to describe terms, words, methods and techniques that could benefit from a further and more thorough explanation.

The result of the literature study provided sources and knowledge of theory, terms, methods and techniques that could provide a big contributing factor, together with the other steps of the process, for a satisfactory final result.

Discussion

When conducting a literature study, it is important to evaluate the quality of the chosen keywords. The search outcomes are influenced by these keywords, thereby impacting which sources one can find. To obtain a higher quantity of qualified sources, the number of keywords could be increased, which could result in even more sources that could be used during this thesis. This could provide a contributing factor for a even better end result. On the other hand, too many sources can be too much to handle, diminishing the final product by increasing the number of sources to an unnecessary height. Therefore, the number of keywords were actively kept as low as possible, to ensure a clear coherence throughout the thesis and in order to only utilize sources that were thoroughly used and explained.

Another factor from the literature study that could have affected the end result were the decision to end the search for keywords before any sources directly related to the technical field of the thesis were found. This decision would impact the final product even more if there were no other processes than the literature study. Since the final prototype was going to be formed based on four processes, the though was that sources and information regarding the technical aspects of the thesis would be found through the other processes, such as the interviews.

3.4 Focus Experiment

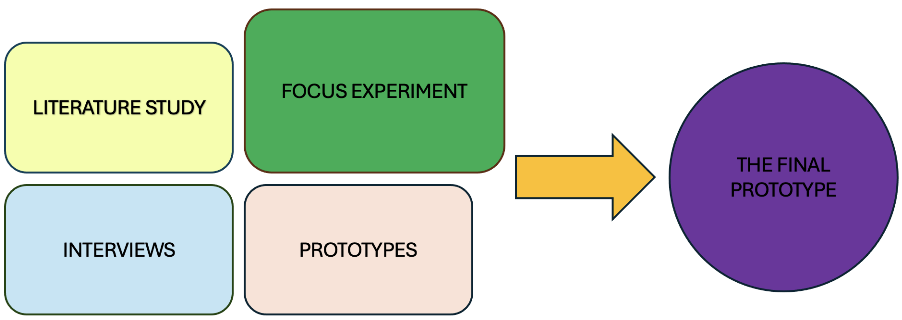


Figure 3.7: The Process, Focus Experiments

Method

In order to observe, experience and test some of the theory in practise, a focus experiment was conducted. This experiment was done in order to test theory from both 2.3 Color Theory and 2.5 Concentration and Focus. The theory that was to be tested related to the use of luminance and chroma, how bright light with a high level of correlated color temperature can boost attention, concentration, focus and cognitive abilities, how the cognitive workload could be affected by using both stationary and moving camera views. During a remote operation, several camera views are displayed, both stationary such as surveillance and moving such as the main operation. Additional theory to be tested regarded the brains reception of visual information and its predicted responses to visual cues, the importance of anticipatory design, the useful field of view and tunnel vision.

During the experiment, a total of seven students participated. Students were used to obtain an unbiased and as honest as possible result. The goal for this experiment was, in addition to what is stated above, to obtain guidelines on how to best develop and present the interaction design for possible prototypes that can be used to answer the problem statement. In the execution of the experiment, a total of six different YouTube videos displaying a variation of animals and natural scenery were used. The experiment was conducted in four parts. In the first part only one video was shown. In the second part, two videos were on the display. Four videos were shown in the third part, while the fourth part had a total of six videos in its constellation. In addition, the experiment was performed in two different groups, where the constellation of the videos in the fourth experiment was changed between each. For the first group, the stationary camera views were placed in the upper right corner and the moving camera views were placed in the lower left corner in the fourth experiment, as shown in figure 3.11. For the second group the constellation was randomized. This was preformed in order to observe if any difficulties with concentration and focus could arise when stationary and moving camera views were mixed up and not displayed in a sorted manner.

The camera views from these videos were both stationary and moving, in order to portray both expected and unexpected happenings. In the first video, a stationary low view of a grass field where both a bowl of water and a bowl of seeds and nuts were placed, was displayed [41]. The second video showed a similar scenery with a little pond in the front [39]. The last stationary camera view was shown in the fourth video, again with a similar scenery with a piece of a log in the center [42]. The first of the videos with a moving camera view was the third video. In this video a wide range of scenery, from Arctic scenery with polar bears and penguins to African scenery with giraffes and flamingos were on display [30]. The fifth video showed different scenery during winter, and displayed all kinds of animals typical for the winter regions [31]. Lastly, the sixth and final video with a moving camera view was a video showing ocean and marine life, from all around the world [32].

The set up for the first experiment, where one stationary camera view was used, is shown in figure 3.8 below.

Figure 3.8: Focus Experiment 1 screen, [41]

The thought process in selecting these videos was to find videos that had similarities in both color and light. This was done in order to be able to make constellations of camera views with resemblances to the actual camera views of remote marine operations in regards to both color and light, as the camera views from these operations can share likeness in both aspects. The differences between the stationary camera views were minimal, with the movements of the different animals being the biggest change. These were chosen to mimic surveillance camera views or camera views with little to no movement. The differences between the moving camera views were bigger, and was chosen to see how the participants of the experiment were affected by abrupt changes in color and how this might influence them. All moving camera views had similarities with both themselves and the stationary camera views, in order to keep a level of surprise and the unexpected. These were chosen not necessarily to mimic the moving camera views from an actual remote operation, rather to show different movements and how the participants managed concentration and focus while observing multiple screens.

Colors and light are important elements in the practice of interaction design [24]. One aspect of importance is luminance, which was a key factor when choosing the videos used for the experiment. Luminance talks about the intensity from light, and luminance plays a key role in showing information visually because the eyes notice changes in light levels more than changes in color [44]. Therefore, it was deiced to include videos with camera views with both a stable luminance and a luminance that was changing throughout the experiment. This was accomplished through the use of stationary and moving camera views, where the luminance for the stationary camera views remained on the same level and the luminance for the moving camera views were influenced both with movement, but also when the video changed from scene to scene.

The set up for the second experiment, where one stationary and one moving camera view were displayed, is shown in figure 3.9 below.

Figure 3.9: Focus Experiment 2 screens, left [39], right [30]

Another key factor regarding the use of color is chroma, which can be described as the intensity and brightness of a color. It is suggested to use a lower level of chroma for larger areas, because colors are more noticeable over a wider space [44]. With the videos chosen for the experiment, these statements were put to the test. In the stationary camera views, the backgrounds were vibrant green colors, where the moving parts were animals, like birds and squirrels, in for the most part grey, brown, beige and black tones. This goes against the recommendations above, with a higher level of chroma in the larger areas and a lower level of chroma in the smaller parts. This was done both in order to see if the recommendations played a big role in interaction design, but also to see if this could affect the concentration and focus for stationary camera views. In addition, the moving camera views showed frames with all combinations of chroma, ranging from a higher level of chroma in both background and smaller objects and a lower level of chroma in both areas. Moreover, a higher level of chroma in the background and a lower lever of chroma for smaller parts is used in the videos. Additionally, the recommendations of a lower level of chroma for the larger areas and a higher level of chroma for the smaller objects are represented. These camera views, as previously mentioned, showed all kinds of natural scenery and animals in motion. And again to test the recommendations, these videos were chosen by the same motivation as the stationary camera views, but to a lager degree as they displayed all types of combinations for chroma.

Concentration and Focus talks about the indication that exposure to bright light can immediately boost attention, concentration, focus and cognitive abilities, where low light can have the opposite effect [23]. Due to this, it was of high importance to find videos for the experiment that fulfilled these criteria. The choice of videos displaying natural scenery, such as under water scenery, was also affected by the suggestion that attention, alertness and faster reaction time also can be amplified by brighter light, especially light of higher correlated color temperature and enriched with blue wavelengths [11]. By following these criteria, the aim was to achieve an experiment that could put concentration and focus to the test in an effective way.

The set up for the third experiment, where two stationary and two moving camera views were displayed, is shown in figure 3.10 below. The stationary camera views were located on the upper left and lower right, while the moving camera views were located in the opposite locations. This was done in order to not place the same type of view next to each other.

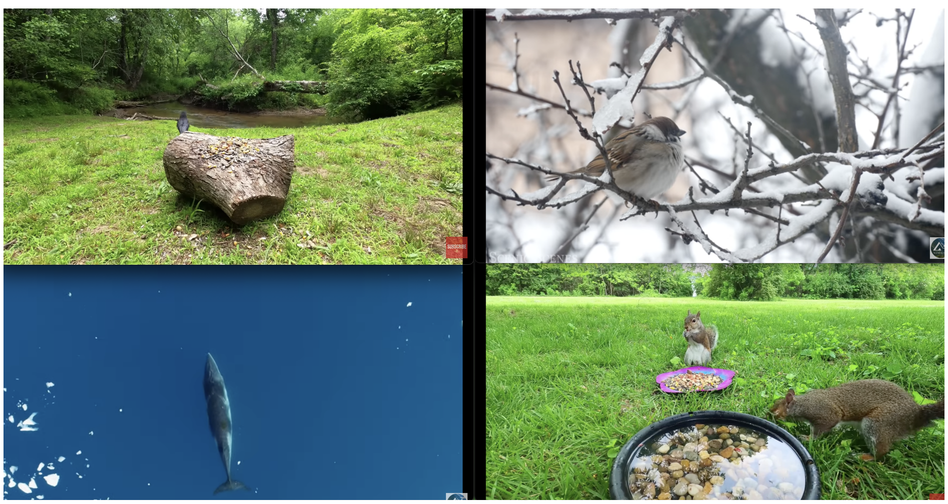


Figure 3.10: Focus Experiment 4 screens, top left [42], top right [31], bottom left [32], bottom right [41]

Another aspect for concentration and focus that could prove beneficial to test was cognitive workload. One of the motivations to increase the number of screens during the experiment was in fact with this in mind. Additionally, during some of the experiments, there were done attempts to start conversations with the participants during the experiment, in order to increase the cognitive workload even further, and also to simulate a real work environment where one can be affected by more than solely the work at hand. And, as mentioned previously, the constellation of the screens where rearranged between some of the experiments, in order to observe how different layouts could affect the cognitive workload, concentration and focus.

Regarding the cognitive efficiency, one of the motivations to use both stationary and moving camera views was to see if the efficiency was affected by the combination of both easily and more difficultly predicted videos [23]. The importance of presenting data in understandable ways and in ways where predictions on behaviour and movement can easily be made, supported the assumption for this to be a well suited method. With the stationary camera views, it was assumed that it would be fairly fast and easy to make assumptions and predictions on upcoming events after a short period of time. Additionally, it could quickly be understood that the videos were going to show the same camera views throughout their duration, and the only changes were going to be the animals running and flying in and out of the frame. On the other hand, regarding the videos with moving camera views, the aim was for the participants to make assumptions early in the experiment that the camera views were going to change scenery and objects. Assumptions like these could in turn prove to improve concentration and focus, since high alertness is a result of assumed surprises [44]. Therefore, the ambition regarding the selection of these videos were that the participants would show signs of different levels of cognitive efficiency throughout the experiment. And with a higher level of cognitive efficiency during the early parts of the experiment with few screens and more screens with stationary views, to potentially a lower level of cognitive efficiency during the later parts of the experiment with more screens and a higher struggle to predict the different outcomes.

The set up for the fourth experiment, where three stationary and three moving camera views were displayed, is shown in figure 3.11 below.

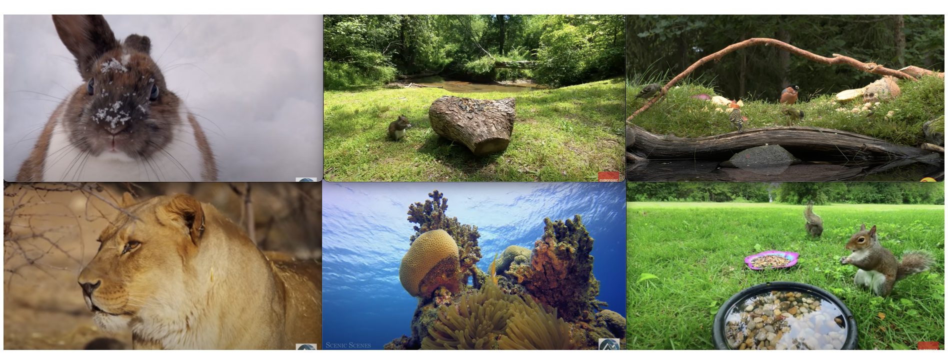


Figure 3.11: Focus Experiment 6 screens, top left [31], top middle [42], top right [39], bottom left [30], bottom middle [32], bottom right [41]

Concentration and Focus also mentions that humans tend to miss or overlook short and unexpected events mostly due to the lack of assumptions and preconceived expectations [44]. Therefore, the use of both more easily predicted stationary and more difficultly predicted moving camera views could provide insight on how high the level of unexpectedness could be before the participants started to miss out on short and unexpected events.

The last factor regarding concentration and focus that was taken into consideration when choosing the videos for the experiments were the useful field of view, which is defined as the area from which an individual can efficiently gather information [44]. Another factor to consider was tunnel vision, which occurs when under stress and the useful field of view typically decreases to a angle between 1 and 15 degrees [44]. All the stationary camera views had the focus area in the center of the frame, while the moving camera views had the focus area spread all over the frame. By using these videos, the statement of the importance to keep only essential details noticeable and to hold visual load under control could be put to the test.

Result

In order to document the focus experiment, the participants were asked to fill out a form with questions regarding how in control and focused they felt during each experiment. These questions were formed with a Likert scale, where the questions were accompanied by statements ranging from 1 to 5, where 1 indicated a low degree of control and focus and 5 indicated a high degree of control and focus [43]. Additionally, the participants were asked to elaborate each of their answers, which in turn lead to conversations and discussions regarding the experiment. The results of the questions are shown in figure 3.12 below.

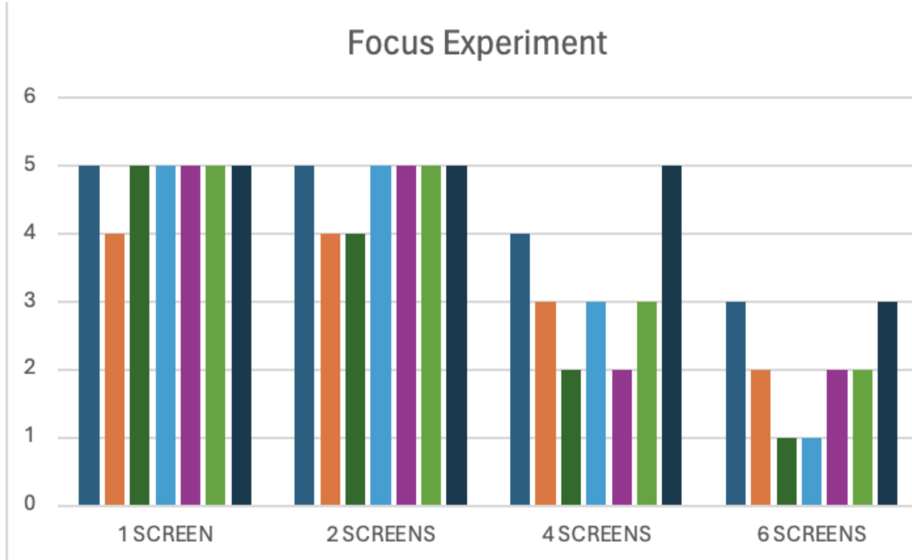


Figure 3.12: Focus Experiment, Results

This figure shows that the participants felt a high level of control and focus during the experiments with one and two screens. This result is amplified by the elaborations from the participants. No one felt the need to further explain their score for the first experiment. For the second experiment, the general feedback was that it felt natural to give more attention to the screen displaying the moving image because this was where the activity happened. The participants felt in control during these experiments, and only felt the need to pay attention to the stationary screen during unexpected activity.

However, the results clearly state that the level of focus and control drastically decreased with four and six screens, where two of the participants rated the control for the set up with six screens as low as possible. The feedback for the experiment with four screen was that the focus was easily directed to screens with a lot of movement, and that it was difficult to have full control over what was happening on each screen at all times. Some of the participants felt that the use of many different colors made it challenging to focus, and that the problem could be solved if the screens all used the same or similar colors. Some participants still felt comfortable and in control in regards to the two stationary videos, since the same was happening and there was not much movement in the pictures and a low degree of surprise.

For the last experiment, the general feedback was similar to the previous feedback, only to a higher degree. They felt it was difficult to observe everything during high activity. The gaze was drawn to the screens with similar color shades, and the screens with a higher level of activity.

This result can provide useful information for the upcoming processes for this bachelor thesis. The importance of color theory, luminance and chroma in regards to interaction design were highlighted, where the participants felt less in control and a bigger cognitive workload in relation to focus when the screens displayed many different colors. The results also emphasize that it can be beneficial to place similar camera views close together, both regarding color and movements. The fact that most of the participants felt the need to give more focus to the screens with moving images can point to the importance to make anticipatory design and keep the level of surprise at a minimum when making interaction design. Regarding the useful field of view, none of the participants felt any form of tunnel vision during the experiment.

Discussion

An element for discussion for processes that utilize questions will always be whether the questions asked were good enough and formed in a way where the answers provide an insight of as high usefulness as possible. During the focus experiment, the only question asked regarded the level of control and focus the participants felt. One question during an experiment can be regarded as a too low quantity. However, the participants got the chance to elaborate their answers, which in turn lead to conversations and discussions about the experience. The decision to conduct the experiments in this manner was done in order to get the most honest feedback from the participants as possible. Prepared questions could lead the answers one way or the other, even if not intentional, a scenario that was tried to be avoided.

The number of participants could also be increased. The results for the experiment could be affected by a higher number of participants. However, the experiment were ended after seven participants, a decision that was made based on two factors. Firstly, the participants gave feedback that related to the different sources used when forming the experiments, which confirmed these sources. Secondly, the participants gave feedback similar to each other, even unknowingly and without influence. This could be a sign that even more participants could end with the same or similar result. The types of participants could also benefit from diversity. In the focus experiment, other students from different fields of study participated. The result could benefit from participants with more relevant knowledge and abilities. On the other side, the experiment was conducted to test focus, which is an ability used by all kinds of persons. Therefore, the choice to conduct the test on students was considered to be sufficient.

Yet another element for discussion regarding the focus experiment is the selected videos used. All these videos displayed scenery from different locations in nature, none were related to actual remote marine operations. The thought behind this selection were to test focus and concentration in general, and not in connection to the problem statement or the thesis. However, if the videos displayed different aspects of marine operations, such as a LARS operation, the result could be more closely related to the problem statement. On the other hand, focus and concentration are central in a high number of situations, where a general approach and result can be representative for these situations and significant in any research.

Additionally, one can argue that the advantage of using colors with a high level of correlated color temperature when talking about focus, concentration and alertness was pointed out, since the moving videos for the most part consisted of scenery with brighter light than the stationary videos, consisting of greens, browns and grays.

3.5 Interviews

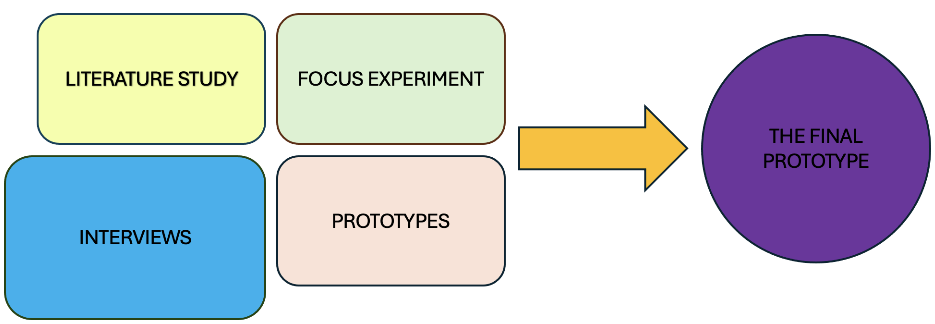


Figure 3.13: The Process, Interviews

Method

In order to obtain information regarding the problem statement, in-depth personal interviews were performed with employees at Seaonics. When conducting a research process, where for example interviews or surveys are suitable methods, there are six major steps to consider. These steps are similar to the steps of the design thinking method.

In the first step the researchers are to define the objectives of the research. For the second step, the researchers are to collect and evaluate necessary secondary data. During the third step, the researchers design the primary research with either quantitative or qualitative methodology. This design process is based on the purpose of the study. The fourth step is to conduct the research and collect the primary data. The fifth step is to analyse this data. And finally, the sixth and last step is to report the findings from the research [33].

There are two main methodologies for conducting research in order to study a subject or field of interest. These are quantitative research and qualitative research. The research process and its six major steps contains one path for each of these techniques. Usually, when conducting a research process, one of the two methodologies are used. However, in some cases, both methodologies are used in combination. The two paths are shown in figure 3.14 below.

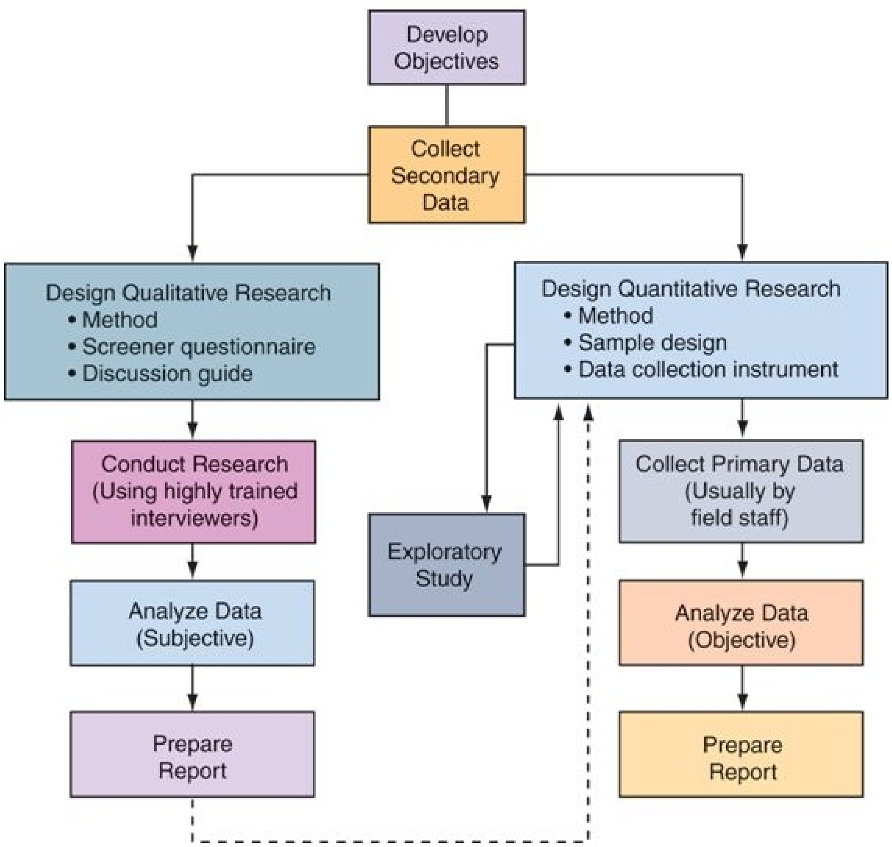


Figure 3.14: The research process [33].

Qualitative research aim to build an understanding of the personal details of peoples experiences and focuses more on quality than bigger scales. Therefore, the insights obtained are often unique and exploratory, rather than universally suitable. In-depth interviews, a qualitative approach, are extensive, informal dialogues that allow subjects to speak at length about their personal experiences and views [33].

Quantitative research is characterized by its explanatory nature and is widely used to conjure more descriptive information. The sample size for quantitative research is usually large. Surveys, a quantitative research approach, can be carried out through various modes such as face-to-face interactions, telephone calls, mail or online platforms. [33].

For this specific problem formulation a combination of qualitative and quantitative research was considered to be the most suitable approach for conducting interviews and collecting data. While in-depth personal interviews were regarded to be the most optimal solution, time was a factor that potentially could make it difficult to execute. Therefore, a combined process of both techniques was considered, where interviewees that had limited time could get the opportunity to contribute in both surveys and shorter personal interviews. However, time was a factor that made this approach difficult as well, especially in regards to the high number of replies quantitative research requires. In the end, it was decided to proceed with a qualitative approach of in-depth personal interviews, with the supplement of regular "over the table" conversations with the employees at Seaonics.

The questions were formed in a rather open-ended manner where the questions asked for the interviewees personal and honest opinions. The use of basic yes/no questions were avoided, since the answers these questions tend to receive were not of big interest. The interviews took place at Seaonics own locations, and are available in F in Appendices.

Result

A total of two in-depth personal interviews were conducted. These interviews provided great and important information around and insight into the services and technologies Seaonics offer, and what they perceive as the main difficulties and important factors in regards to moving an operation from on-site to remote [1] [2].

One of the factors regarded as important is troubleshooting. Some of the aspects of troubleshooting are significantly easier on-site than remote. It can be simpler to identify problems with physical access on-site. Therefore, it can be possible to use the process of elimination for error correction when troubleshooting by ruling out issues with the sensor by means such as disconnection. When operations are done remote, troubleshooting is mainly possible through logs and read-out values from the control system. This handles a portion of the cases, but to determine where the error originated, one might need to have access to the physical components. In addition to sensors, cameras showing many different angels from the vessel are regarded as an important factor in order to keep an overview of the operations when done remote.

However, the interviewees do not regard this as a reason to continue performing operations locally and not switch to remote operations. When doing operations remotely, one can get assistance from a local crew. It is typical for marine vessels to have a skeleton crew, which is a minimal crew with many roles where the job is to keep the vessel operating. People on land give commands to this skeleton crew, whom act on their initiatives. It takes longer to find faults without direct access remotely. Therefore, an "extended arm", such as this skeleton crew, can be of high importance in making remote operations operational.

The importance of a clear chain of command was also brought up during the interviews. This is important in order to maintain a high level of safety. With a clear chain of command, it will become easier to get a predictable result for the operations. When doing operations remote, it is important that the crew on land receives a clearance from the crew on the vessel regarding whether the operation is safe to perform. This could be secured with a clear chain of command.

Another of the factors the interviewees regards as important is the visuals. When performing an operation remotely, the operators are cut off from both situational and operational understanding of the vessel, both in regards to the ship as a whole and all its equipment. It is therefore important that the visuals of the remote station gives a high level of total understanding. Operational understanding is the understanding of all aspects tied to all parts of the operation, such as what the vessel is doing, whether it is following a set route at sea to perform an inspection or if it is stationary and observing. Situational understanding is the understanding of weather, wind and waves. Regarding equipment, it is of high importance to know if everything is working, if there are any faults in or alarms from the system. It is important to have enough cameras in order to obtain a good understanding. Sound is also important, for example in order to hear what is happening and that machines are running as intended. This comes naturally when operating on-site, but can be difficult to transmit to remote operations. It is therefore of high importance that the information about the vessel, equipment and weather will provide a similar understanding during remote operations as it would during on-site operations.

Regarding the compensation for the physical factors that disappears when moving an operation from on-site to remote, the interviewees stated that there were divided opinions on this. In order to maintain a high level of situational understanding and awareness, it is important to find mechanisms that provide this. Visual feedback on weather is important, where an audio-visual transmission could be solved through the use of a microphone that picks up sound. In order to feel the movements of the vessel and the operation remotely, tactile information could be utilized, where sounds are captured and recreated in the remote work stations, like surround sound and vibrations. If it is not available through audio, it must come through control systems or procedures. The important thing is to effectively communicate an understanding that the situations are safe and that there is no risk.

The information gathered through the interviews can be regarded as of high importance for the other steps of the process, and will be actively used during the rest of the thesis and when working with the final prototype.

Discussion

The number of interviews was decided to two, mainly because the interviews resulted in highly satisfactory result. The results gave information and insight regarding the technical aspects of the problem statement and thesis that the literature study did not. However, both participants provided the same or closely related answers, which could be anticipated and explained by bias and based on similar personal and professional opinions. Furthermore, the information gathered through "over the table" conversations with employees at Seaonics provided great insight in supplement to the interviews. Based on this, it was therefore decided to end this process after two interviews. The interviews could end up with a different result had there been more participants, but since they only represented employees at Seaonics, there was a possibility that new answers could also be fairly similar. On the other hand, had there been conducted more interviews, new insights and information could have been achieved since Seaonics is a workplace with a diverse set of knowledge and experiences.

One factor that could have lead to a more varied and different result, could be the inclusion of both active and formerly active operators. There was made an effort to get in touch with operators, both through Seaonics and by other means. Unfortunately, this endeavour proved to be fruitless. The perception of an actual operator could potentially give new insight and a different view on remote operations. The lack of this type of interviewees was tried covered through the Crane Operator Stories [3], [4], [5] and [6]. However, personal contact with an operator could provide even further and deeper insight into remote operations that could benefit the end result and the final product.

Regarding the choice of method for the research process, where interviews and a qualitative approach was chosen, one could argue that the result could be affected if a quantitative approach was chosen instead. As stated above, a combination of both approaches was considered, and this as well could affect the outcome of the results for this process. The quantitative method that was going to be conducted was surveys. This approach could have lead to a more diverse result, since the sample size is that much larger than interviews and qualitative approach. However, the results could have become less detailed, where the personal in-depth interviews provided a highly detailed and deeply explained result. On the other hand, if the surveys were to be conducted, it could be argued to be wise to include participants outside of Seaonics as well, in order to avoid biased opinions and a homogeneous result, which could have been the case if all participants represented the same company.

3.6 Prototypes

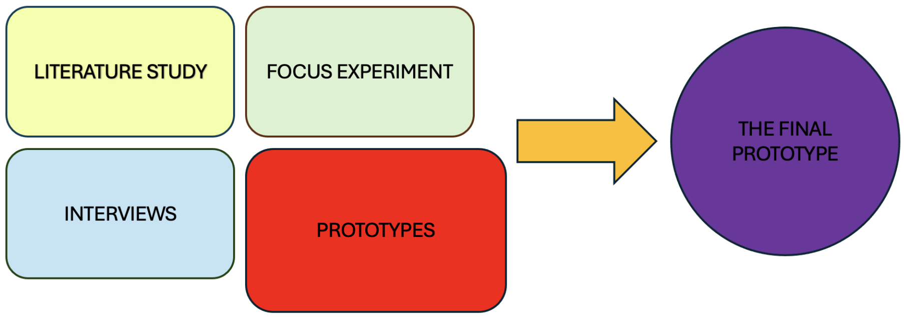


Figure 3.15: The Process, Prototypes

For this thesis, several prototypes were designed. These prototypes were visual representations for interaction design and screen setups for remote operation, and they consisted of displays of essential technical information as well as various configurations of camera views. Four prototypes were tested in order to evaluate them. Based on the feedback from this test, the final prototype was designed. One of the prototypes tested was based on a potential prototype from Seaonics, while the three other were made for the thesis. This section is divided into three parts. The first is about the screen setup, the second is about the technical information screens, and the third is about the testing of the prototypes. Each of these three parts consists of method, result and discussion. Prototyping is the fourth step of the design thinking method, and is an important step in order to form a physical representation of all information and knowledge obtained in the previous steps [12].

3.6.1 Prototype 1-4, Screen Setup

Method

The first four prototypes were designed with different outcomes in mind. An effort to obtain different camera views from Seaonics that displayed actual camera views from any of their operations was made. Unfortunately, this proved to be difficult. Therefore, a selection of images found on Google were used. The first picture, [19], showed an underwater view of two pipelines running along the seabed. This picture was included in order to show a possible camera view of a ROV used in a LARS operation, and was regarded as the main operation when designing the prototypes. The second picture, [27], showed an underwater vehicle being submerged. This picture was included to give a camera view that showed the ROV being submerged directly under the vessel. The third picture, [20], displayed a downwards looking view of a moon pool, and was included to show a surveillance type of view over the moon pool area of the vessel. A moon pool is an opening in the bottom of a vessel used to submerge and ascend different equipment into the sea, a ROV in this case. The fourth picture, [37], showed a winch. During LARS operations, the winch is used to compensate the motions of the vessel in situations where the object being submerged needs to stay still under water, in addition to hoist the ROV up and down. Therefore, a camera view showing a winch was regarded as important for the operation. Additionally, some of the prototypes displayed a mirrored version of the first picture showing the pipelines. This was done to mimic a backwards looking view from the ROV. Figure 3.16 below shows the four different pictures found on Google used in the prototypes.

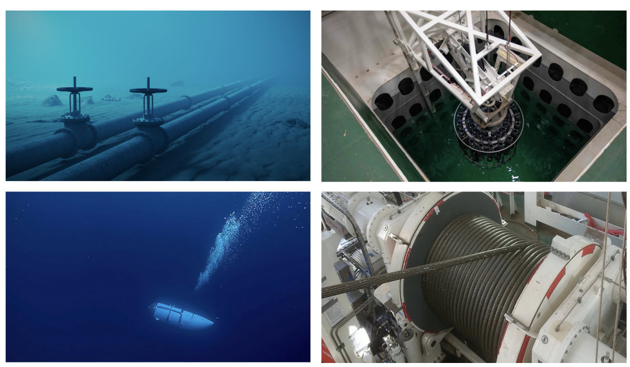


Figure 3.16: Prototype 1-4, Pictures used in Screen Setup. Upper left corner [19], upper right corner [20], lower left corner [27], lower right corner [37]

The first prototype was constructed based on a design provided by Seaonics. This prototype consisted of two screens stacked on top of each other. The upper screen, placed in the same height as direct eye sight, displayed the main operation, while the lower screen showed four different camera views. The lower screen was divided into four equally big parts, displaying the four other camera views. In addition to the two screens, two smaller screens where placed on the armrests on the operator chair, one on each side in close placement to the joysticks used during operations. One of these screens were to display the technical information for the operations, while the other screen were to be a touch screen where the operator could navigate through important information regarding weather, system alarms and load cases. The design process for both these screens are described more in 3.6.2 Prototype 1-4, Technical Information later on. A sketch of the setup for the first prototype is displayed in figure 3.17 below.

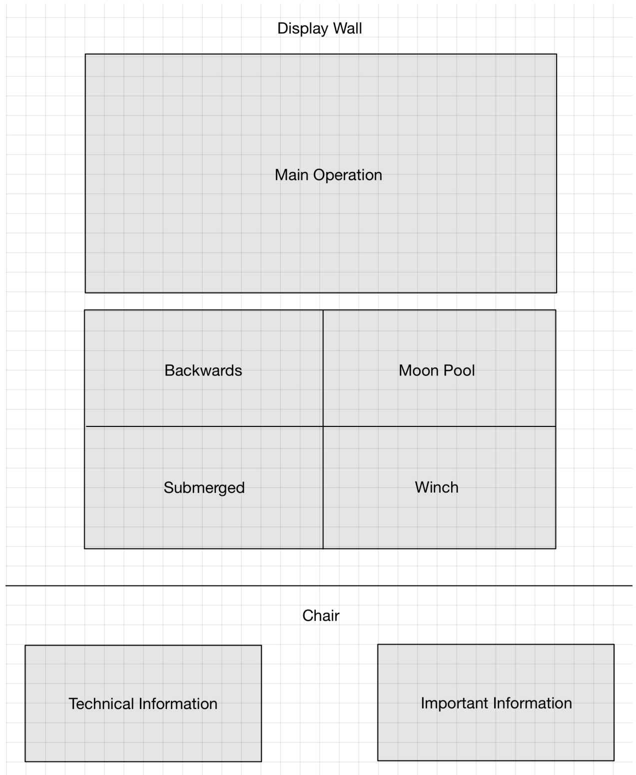


Figure 3.17: Prototype 1, Setup Sketch

The second and third prototypes were the first prototypes designed from scratch for this thesis. Both of these prototypes utilized only one main screen, which was split up into smaller parts displaying different aspects of an operation. Additionally, the screen displaying the technical information placed on the armrest of the chair in the first prototype was relocated to one of the sections of the main screen. The other armrest screen, displaying the important information, stayed at the same place. For the second prototype, the main screen was divided into six parts of different sizes. The upper part of the screen was divided equally into two side-by-side parts, where one displayed the main operation and the other displayed the backwards view of the ROV. On the left side of the lower part of the screen, the technical information were to be presented in a part of equal size to the two upper camera views. The lower part to the right were again divided into three parts, one on the left showing the submerging ROV, and two on the right showing the moon pool and the winch. A sketch of the setup for the second prototype is displayed in figure 3.18 below.

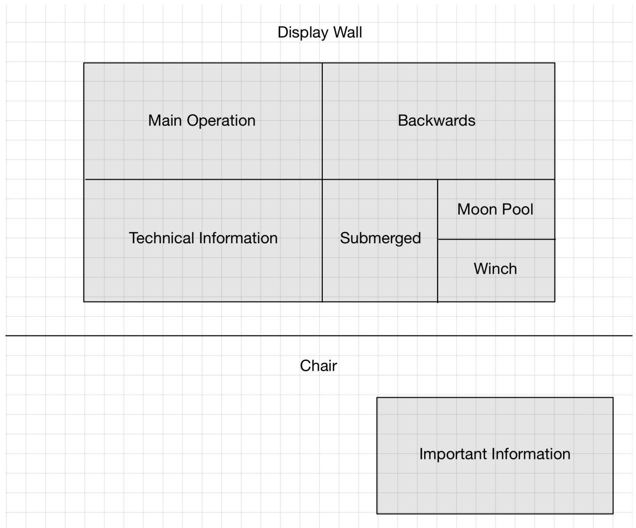


Figure 3.18: Prototype 2, Setup Sketch

The only difference between the second and third prototype was that the upper part of the main screen only displayed the main operation for the third prototype. This was done in order to increase the size of the main operation and to test whether the backwards view of the ROV was going to be noticeable missing. A sketch of the setup for the third prototype is displayed in figure 3.19 below.

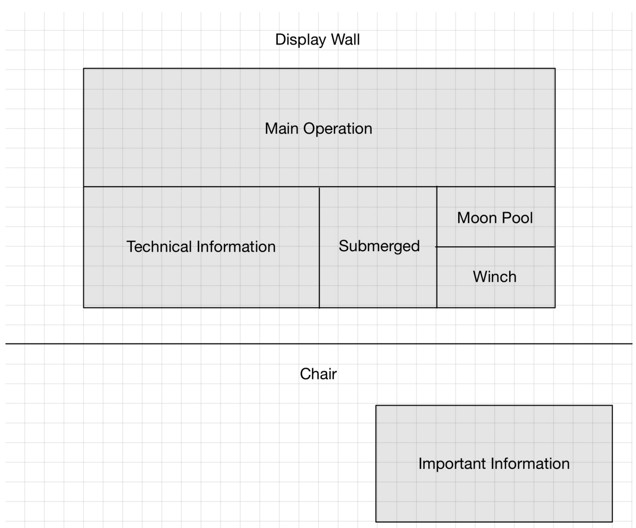


Figure 3.19: Prototype 3, Setup Sketch

The fourth prototype was inspired by different display setups found when doing the literature study and when watching the Crane Operator Stories videos [3] [4] [5] [6]. With this prototype, both screens on the armrests of the operator chair were moved to the display wall. The setup consisted of four screens stacked on top of each other, with two bigger screens on the top and two smaller screens placed next to each other on the bottom. The screen showing the main operation, placed as the middle screen for this prototype, were to be placed in the same height as direct eye sight. The screen above were to display the same constellation as the lower rightmost part from the second and third prototypes, displaying the submerging ROV, moon pool and winch. While the two side by side screens at the bottom were to display a combined technical screen, showing both technical information and the important information, such as weather, system alarms and load cases, and a screen showing the backwards view from the ROV. How the operator navigates through the combined technical information screen is described later on. The though behind this setup was to mimic design setups already being used for remote operations, and to see if possible improvements could be made and revealed through testing. A sketch of the setup for the fourth prototype is displayed in figure 3.20 below.

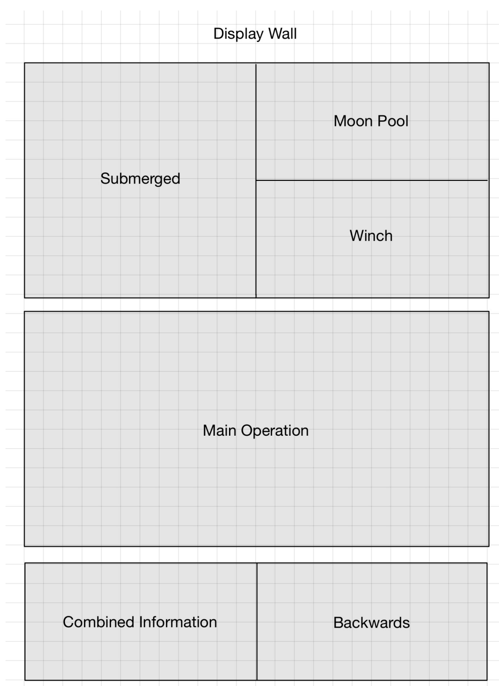


Figure 3.20: Prototype 4, Setup Sketch

Result

Figure 3.21, 3.22, 3.23 and 3.24 below show the screen setup for the first four prototypes. These setups were made in Microsoft PowerPoint based on the sketches, and were used in the testing of these prototypes. A thick border was placed in between the screens in order to visually display that the first and fourth prototypes consist of more than one screen.

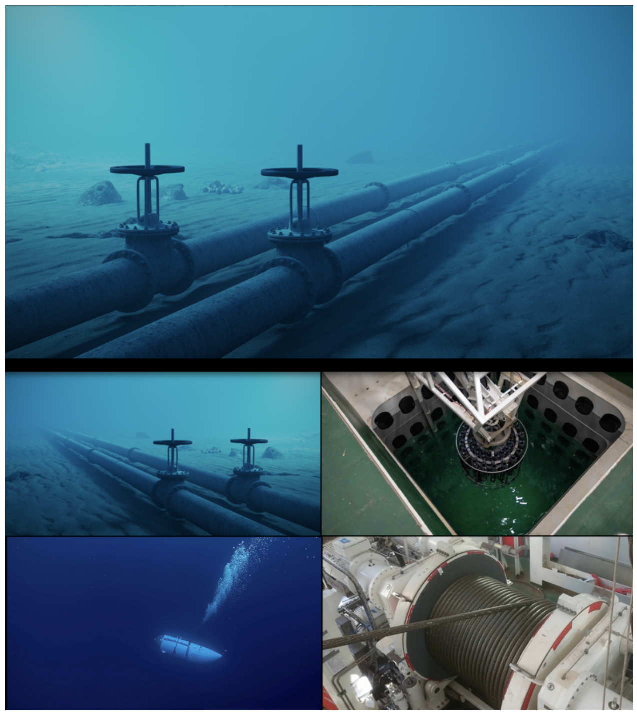


Figure 3.21: Prototype 1, PowerPoint

As shown in figure 3.21, the camera views are ordered in the manner suggested by the results of the focus experiments. The setup takes into consideration to place moving camera views and stationary camera views in close relation, in addition to the same or similar use of luminance and chroma. The pictures in the lower right corner represents surveillance camera views of the moon pool and winch. In addition to being stationary, these camera views share a similarity between the use of chroma and luminance as well. Regarding the bottom left corner, the one displaying the submerging ROV is a surveillance camera view from the moon pool, but it shares chroma with the camera view above.

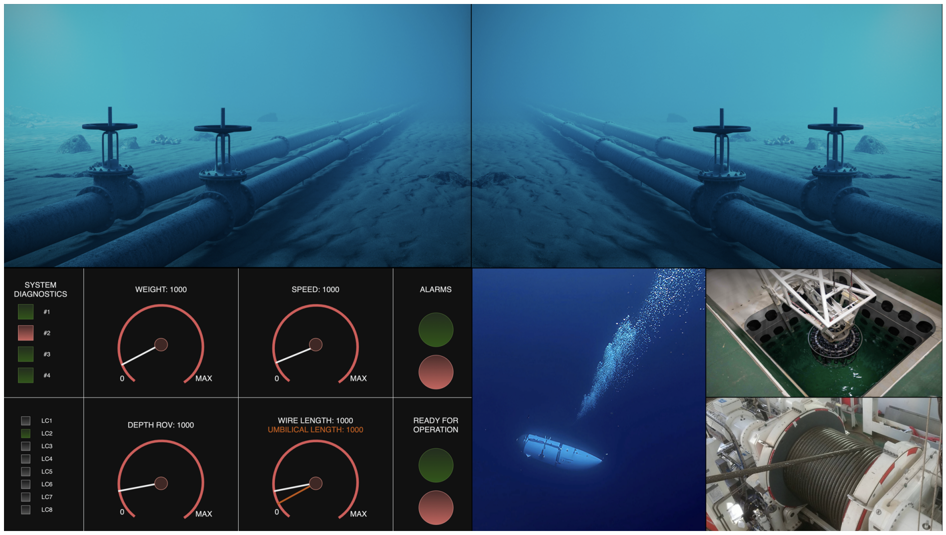


Figure 3.22: Prototype 2, PowerPoint

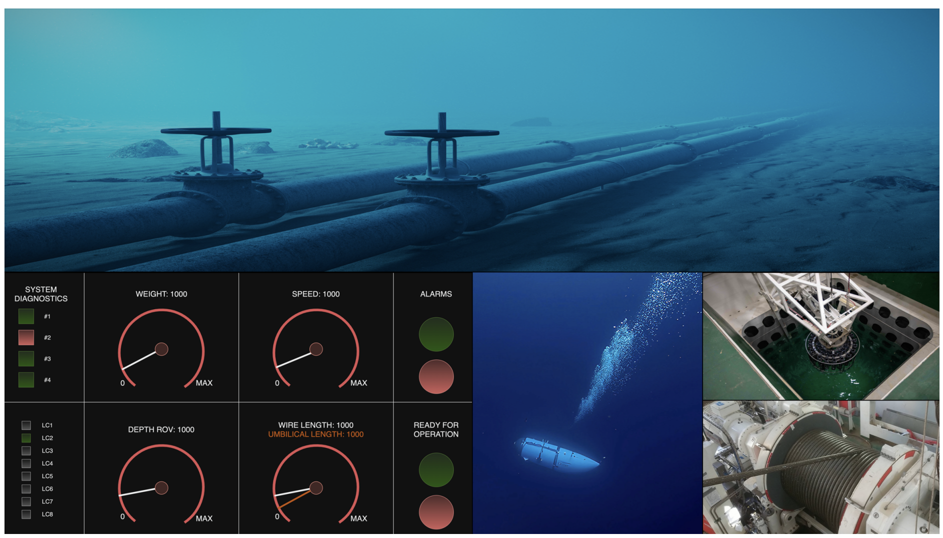


Figure 3.23: Prototype 3, PowerPoint

The same was done when forming the setup for the second and third prototype, displayed in figure 3.22 and 3.23. In these, however, all surveillance camera views were placed together in the lower right corner, while the moving camera views were placed in the upper part of the screen setup. The technical information screen was placed right below the main operation, in order for them to be placed in close relation.

Figure 3.24: Prototype 4, PowerPoint

The fourth prototype, displayed in figure 3.24, was formed in the same manner, taking consideration to chroma and luminance. This time, the surveillance camera views were placed in the upper screen, in the same order as before, while the technical information screen and the backwards view of the ROV placed in the lower screen.

Discussion

To obtain an even deeper understanding of how the screen setup for the different prototypes could be arranged, more prototypes could be designed. The screen setup could benefit from a bigger variety of setups. Additional prototypes could be made based on more diverse sources. The second and third prototype could benefit from being more differentiated, where the only difference between the two was the size of the main operation and the inclusion of the backwards view for the ROV. It could potentially lead to an alternative result for the screen setup if one of these were designed differently. Furthermore, even more combinations of both regular screens and screens placed on the armrests of the operator chair could enrich the screen setup. However, the number of setups were chosen to be four. More than four could potentially provide a too big workload for the participants when testing.

The pictures used in the screen setup could strengthen the screen setup if they were actual screenshots of camera views from operations performed by Seaonics. In addition, the screen setup could have been strengthened even further if video streams were made available. Pictures from real life operations were tried obtained, in addition to screenshots of the camera views from the simulators at Seaonics. The use of that kind of pictures could result in a better understanding of the different camera views and give a closer representation for an actual remote operation. Unfortunately, this kind of pictures and screenshots proved to be hard to gather. Therefore, time went into finding the pictures used, where efforts were made to find pictures that could in some way portray the actual camera views. If actual images from operations were made available, the number of camera views in the setup could change. However, based on the simulators and through conversations with employees at Seaonics, both what the images portray and the number of camera views could be said to be sufficient.

3.6.2 Prototype 1-4, Technical Information

Method

This section describes the process of designing the technical information screens used in the first four prototypes. At Seaonics's office, different simulators for their operations were presented. These consisted of technical information screens and a given screen setup. The technical information screens on these simulators based a foundation on the setup of the screen and gave a good impression of what key information regarding the system that should be included. In addition to the information showed on their simulators, other information, such as information regarding load cases and system diagnostics were included on the technical information screens. The foundation for including this and other information was research conducted on technical and operational data made available by Seaonics.

The screens visualizing technical information was formed in the program draw.io. The program had numerous features and provided the opportunity to customize the dashboard according to individual preferences. The screen in figure 3.25 was a further design of a similar technical screen made during an internship period at Seaonics. It was made in work outside the bachelor thesis, but got included in the thesis and was further designed. This figure will be presented in the report for this internship. This report has a submission date later than the submission date for the bachelor thesis. Therefore, at the time of delivery, this reference will not yet be published [15]. The original technical information screen is made available in E in Appendices. The screen is divided into eight different distinct sections, each displaying different key information necessary for the operator before, during and after the operation.

Additionally, screens representing the weather, system alarms and load cases were designed. Figure 3.26, 3.27 and 3.28, presented later on, represent the three screens. In the first, second and third prototype, all three screens are displayed on a single screen on the operator chair, with the intent that the operator could interact with the screens by pressing one of the three different blue icons on the left. Figure 3.26 represent the weathers impact on the vessel. Information regarding the wind, current and waves, and the pitch, roll and heave motion of the vessel are presented. The weather at sea plays a huge impact on the vessels motion and the ability to preform operations. Due to this it is crucial for the operator to receive this information. Through the display describing the system alarms, shown in figure 3.27, it is possible for the operator to gather information about both active and previous alarms, in addition to system diagnostics. The operator navigates through these on the touch screen by pressing the different tabs in the upper section of the screen. This is important for the operator to get additionally and necessary information regarding alarms, and is essential in order for the operator being able to address the alarm issue. Figure 3.28 shows information about the load cases and operational stages for a LARS-operation. The operator navigates through this screen in a similar manner as previously. This information is displayed in order for the operators being able to easily access it for guidance prior to an operation if they have any questions.

Figure 3.29, presented later on, shows the technical information screen used in prototype four. This screen is a combination of the screens showed in figure 3.25, 3.26, 3.27 and 3.28. The screens are adjusted in size and assembled into one larger screen where the information considered most important is placed in the upper section of the screen, and the screens regarding the alarms and load cases are placed in the lower section of the screen. In the first three prototypes, the operator has two screens where one is displaying the main screen of technical information 3.25, and the other displays the screens showed in figure 3.26, 3.27 and 3.28. However in the fourth prototype, only one screen with all technical information is utilized.

In regards to color theory, the technical screens were made with a darker background, since it is suggested to use lower chroma for larger areas [44]. Additionally, the use of higher luminance for important parts and symbols where taken into consideration, since bright light can boost attention, concentration, focus and cognitive abilities [23], as well as the eyes ability to notice changes in light level more than changes in color [44].

Result

Figure 3.25: Technical information, main screen

The screen showed in figure 3.25 above is one of the screens showing technical information used in the prototypes. This shows information about the weight, speed, depth of ROV, wire length and umbilical length. The wire length is the length of the wire used to submerge and ascend the ROV, while the umbilical length is the length of the umbilical chord connection the ROV with the end of the wire. These are displayed with a speedometer, as well as with a numeric value. The only values shown on the speedometer is 0 and max, therefore a numeric value is shown above each speedometer. Information about the wire and umbilical length is displayed in the same speedometer, based on the close relationship and interconnection between these two measurements. On the speedometer, they are represented by various colors and each has its own pointer. Information regarding different components in the system diagnostics is represented by a numbered square colored red or green, where red symbolize that there is an issue with the component and green indicates that there are no errors with the component.

Below the information about the system diagnostics, information regarding which load case the operation is executing is displayed. The eight load cases are listed and squares besides each load case light up when each case is active. This was included in the design in hope that it could provide a comprehensive overview of the current stage of the operation and give an understanding of the subsequent and coming steps. Four lights were placed on the right side of the screen. The upper lights gives indication on whether the system is ready for operation or not. The lower lights tells if there are any active alarms within the system. Here, green light signifies that everything is ready for operation and there are no alarms, while red indicates the opposite. This approach could provide necessary information to the operator in a simple manner prior to, during and after operations.

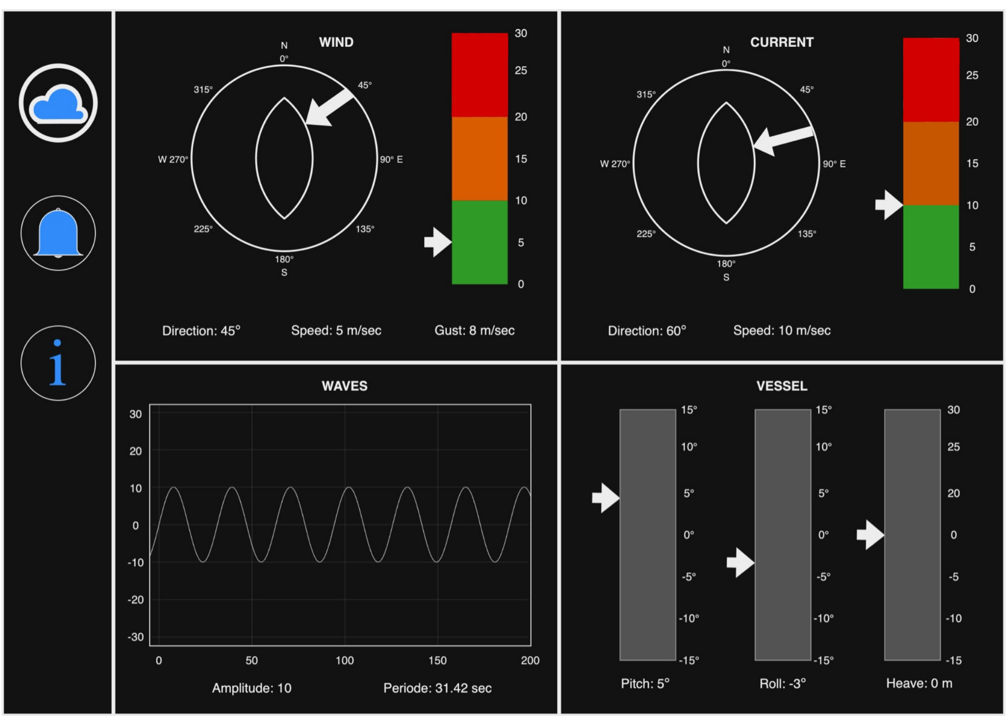


Figure 3.26: Technical information, Chair Screen 1

Figure 3.26 shows the technical information screen regarding weather and its impact on the vessel. In the upper right corner, information about the speed, gust and direction of the wind is presented in numeric values. Additionally, in this section, the direction of the wind on the vessel is visually represented using a 360-degree circle with a visualization of a vessel centrally positioned. An arrow indicates the direction from which the wind impacts the vessel. As shown on the figure, the speed of the wind is also represented using a scale divided into three different colors and an arrow pointing towards the given wind speed. Green represent a wind speed from 0-10 m/sec, orange 10-20 m/sec and red 20-30 m/sec. Based on Beuforts scale, a wind speed from 0-10 m/sec is categorized up to fresh breeze, 10-20 m/sec is up to gale and 20-30 m/sec is up to violent storm [18]. The green, orange and red areas represent whether it is safe or not to conduct the operation. Green color enlightens that the operation is safe to conduct and red informs the opposite.

In the upper right corner in figure 3.26 the current and its direction and speed are displayed due to its impact on the operation and the vessels motion. The direction and speed of the current is represented in the same manner as with the wind, and the use of color on the scale clearly indicates whether it is safe to preform the operation or not. In the lower left corner a graphic representation of the waves is displayed where the amplitude and period time are shown both numerically and in graph. This representation is valuable as it provides a comprehensive overview and understanding of the extent to which the waves vary. A high amplitude informs the operator about an increase in the wave height. This kind of information could be of high interest for the operator when there is big variation in the waves and increasing wind speed, in order to maintain safety. The pitch, roll and heave, representing the movement of the vessel in x, y and z direction, are also represented on the screen in the lower right corner. This is represented in a manner similar to the one used for wind speed and current, however the scale is not segmented into various colors. Here, the technique of different luminance is used, with the columns in a higher luminance than the background and the arrows indicating the value in a higher luminance than the columns.

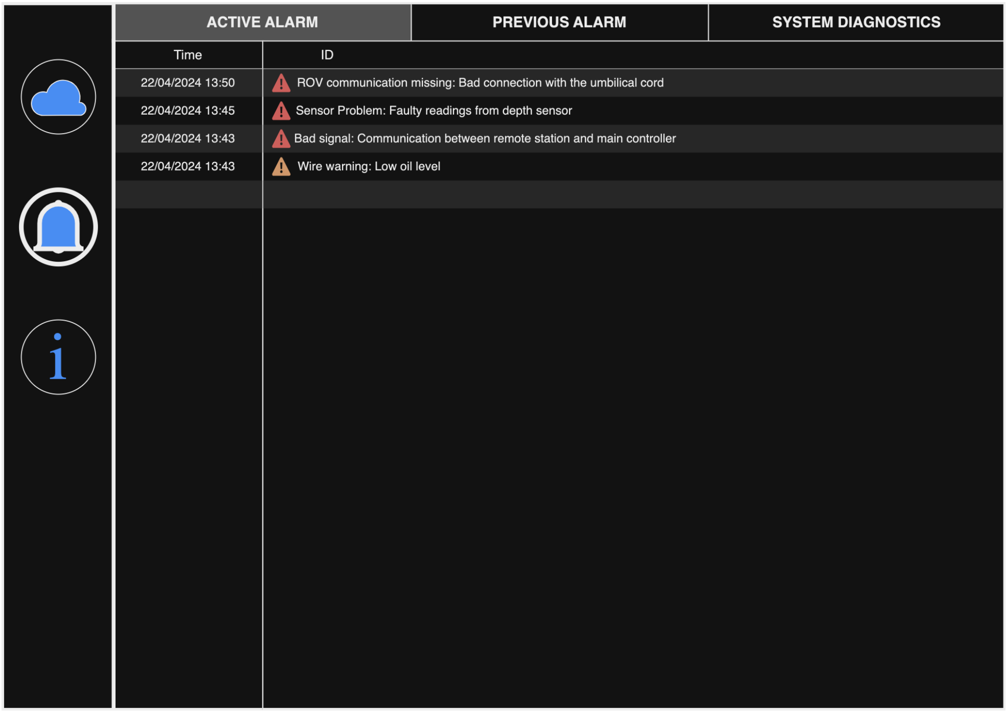


Figure 3.27: Technical information, Chair Screen 2

Figure 3.27 shows information about the active alarms, previous alarms and system diagnostics. The time and id of the alarms are presented, with a warning triangle in front of the id representing the level of danger. In this context, red is associated with high danger, orange with medium danger, and yellow with low danger. This provides the operator a clear overview of the alarms urgency, and weather it must be resolved before proceeding with an operation.

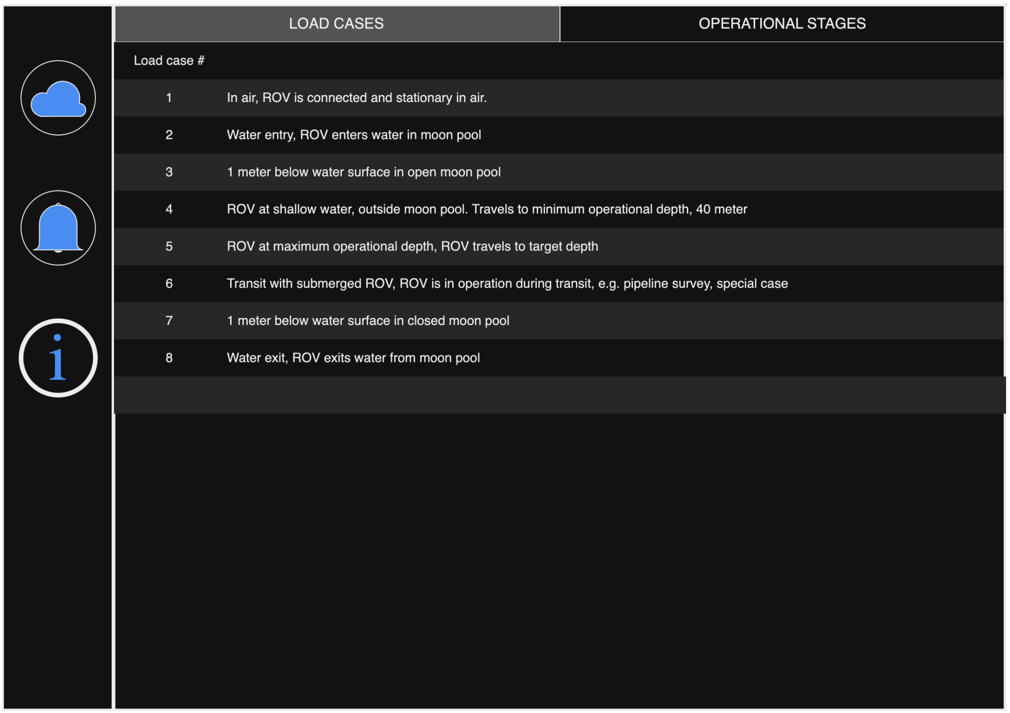


Figure 3.28: Technical information, Chair Screen 3

Figure 3.28 shows information about the load cases. There are eight load cases and these are each numbered and explained on the screen. Information regarding the operational stages are available by navigating trough the control panel at the top of the screen.

The screens presented in figure 3.26, 3.27 and 3.28 are as previously described visualized as one screen in the first three prototypes, where the operators navigates through the screens. When the operator performs this navigation, the symbol for the selected screen gets highlighted with a thicker white outline, which increases the contrast to the black background. This makes it clear for the operator which screen is being showed.

Figure 3.29: Technical information, Prototype 4

Figure 3.29 shows the technical information screen used in the fourth prototype. Unlike the other prototypes, the technical information in the fourth prototype is only viewed on one screen. However, the information displayed is identical with the other prototypes. The main technical information on the screen is displayed in the top left corner, information regarding the weather is placed in the top right corner, alarms are displayed in the bottom left corner, and in the bottom right corner information about the operational stages and load cases are showed. The screen regarding the main technical information and weather is placed in the upper section of the screen as this is the key information and is most important to have in direct eyesight before, during and after the operation. The information regarding alarms and operational stages are noticeable to the operator, even when placed further down on the screen.

The background on all the technical information screens are black, and the overall design has a dark color pattern, where black and gray are frequently used. This is done because the use of lower chroma for large areas are recommended [44], and this was an important factor leading to black and gray forming the basis for the background. The results from the focus experiment, showed that the participants found it easier to concentrate on the screens with higher luminance, rather than the ones with lower luminance. This result contributed in forming the basis for the main color of the information that appeared on the technical screens, that was chosen to be white, which is of high luminance. As previously mentioned, in the first three prototypes, the screens in figure 3.26, 3.27 and 3.28 are displayed on one screen and the operator navigates through the screens by them self. When the operator navigates to a given screen the symbol belonging the screen gets marked with a thicker white outline. The change of light levels and different levels of chroma, are also used in the screens to display alarms, system diagnostics, load cases and to inform the operator weather it is ready for operation or not.

Discussion

On the technical screens red, orange and green are used to provide operators with visual feedback regarding the system status. Red typically indicates a critical issue, orange suggests a warning that may not require immediate action and green symbolise that the system is functioning. Colors can be associated with different concepts and emotions in various cultures [44]. It is therefore not predetermined that the color green, orange and red are associated with whats mentioned above. Based on this, it would be appropriate to develop different versions of the interaction design for various cultures.

How well luminance and chroma were exploited can be discussed. For luminance, this regards the use of colors with brighter light and whether these elements gets highlighted enough through the use of luminance. For chroma, this regards whether elements of importance should only use one level of chroma or if different levels of chroma can be distracting. The technical information screens utilizes different hues of red and green. It could potentially be beneficial if these were the same hue and of the same chroma. The technical information screens also consist of white arrows pointing to different values on scales in gray. If this difference of luminance is enough to highlight the displayed values can be discussed. Both of these elements were of high importance through the testing of the prototypes, described further below. Additionally, whether the different aspects of the technical information screens utilizes the right element between luminance and chroma can be discussed. For example, the speedometer were formed with chroma and uses a bright red color. This could potentially be formed with luminance or a combination instead. With solely red speedometers, they could be associated with danger or other factors that could be distracting for the operator. This factor could be a contributor for the change of use from chroma to luminance. Furthermore, a low level of chroma for the background was chosen, as advised in [44]. If this background was to use a higher level of chroma, this could potentially decrease the distinction of the more important elements of the design, and cancel out the use of luminance where white was used to clearly display elements over a black background.

Regarding weather, one can discuss how these were visualized and whether there could be any better way in displaying these. Waves were displayed with a graph consisting of amplitude and period time. This could potentially benefit from being formed by a scale, or even only a number, in order to not be a distraction for the operator. However, a graph could be viewed as an actual representation for the motions of the waves. This could give the operator a good impression of how the waves behave. Regarding the movements of the vessel, pitch, heave and roll were visualized by both scales and numerical values. This could be displayed in a 3D coordinate system, with the vessel in the center indicating its movements. However, this could also present a visualisation that could result in a overload regarding cognitive workload, where a scale and numerical value could be regarded as a more dampened approach for visualisation.

As previously mentioned, the information on the technical screens are based on simulators at Seaonics and data made available by Seaonics. If other companies had been contacted, the outcome of the technical screens could have been affected, based on the possibility that these companies display different technical information on their screens compared to what is shown on the technical information screens by Seaonics. This could have led to a screen with different setup, displaying various information. However, given that this thesis was provided by Seaonics it was natural to get inspiration from their simulators and data.

The number of technical screens, the setup of these and the way these were formed could be an element for discussion. For the first prototype the technical information was divided into two screens placed on the armrest. For the second and third prototypes, the technical information was displayed on one screen on the armrest and the other screen next to the camera views. While the fourth prototype only showed technical information alongside the camera views. Whether or not these constellations were the most optimal can be a matter of taste and could be affected by level of knowledge and professionalism. However, through testing, which is presented later on, these setups were evaluated and could give an indication on how the technical information best could be presented.

3.6.3 Testing the Prototypes

Method

Testing is the final step of the design thinking method, which is a step used in order for the design team to be able to improve the prototypes and develop new designs [12]. Testing of the prototypes took place at the University, where other students from different fields of study participated. This was done in order to test the prototypes with fresh eyes and little to no expectations to and knowledge about both the prototypes and thesis. Conducting the test for employees at Seaonics was considered to be unfavourable in regards to biased opinions and preconceived thoughts and notions. The decision for the selection of test subjects was done with the intention that it could achieve a result better suited in regards to making a final prototype. This way, the final prototype could be made based on all techniques used throughout the thesis, theory, experiments, interviews and testing, since the participants were only able to give honest, personal and unbiased feedback based on the testing itself, the information given during testing as well as the conversation throughout and after the testing.

At first it was attempted to obtain multiple TV-screens of different sizes to use for the testing. This proved to be difficult. Therefore, it was decided that the TV screens already positioned on the wall could be used as the main display, positioned in the same height as the direct eye sight. The camera views for the other screens were then printed out in approximately right size, glued together in the different constellations and hanged on the wall in their respective positions.

In order to mimic the operator chair, desks was used. After some testing with chairs, stacked chairs and chairs on top of the desk, it was figured out that when sitting on the desk, the direct eye sight matched the position of the main TV screen. To achieve a substitution for the armrests, chairs were stacked both on a small cabinet and on top of the desk, one on each side of the operator. An iPad and a computer were then placed on these chairs to serve as the armrest screens. This setup for the operator chair was used for all prototypes. However, on the fourth prototype, the participants were asked to sit on their knees instead of sitting regularly on the desk. This was done in order to achieve some more height to compensate for the tall stack of screens.

During the testing the subjects answered five questions regarding the prototypes after each prototype were tested. Again, Likert scale was used to form the questions, where 1 indicated a low degree of agreement and 5 indicated a high degree of agreement. In supplement to these questions, each participant was asked four more questions after the test, in order to give a more detailed feedback. These questions were mostly formed in an open manner, in order to give the participants the chance to give their personal opinions uninterrupted.

Result

Figure 3.30a, 3.30b, 3.31a and 3.31b below show how the work station was put together during testing.

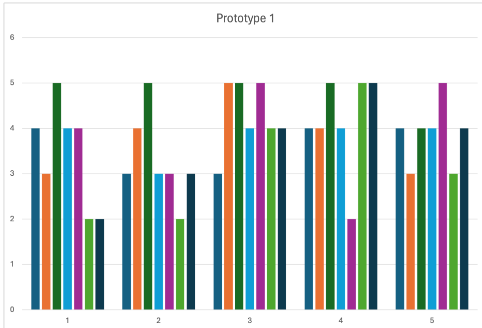
(a) Prototype 1 (b) Prototype 2

(a) Prototype 3 (b) Prototype 4

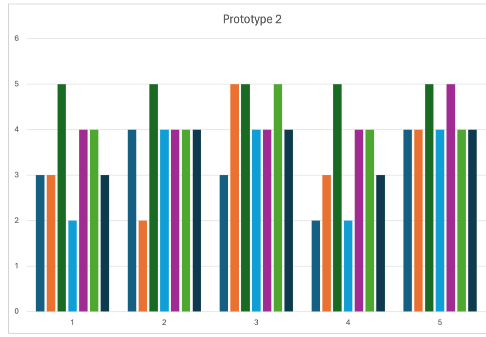
The questions asked during testing are listed below:

1. The screens were well organized.
2. It was easy to locate the necessary technical information before and during the operation.
3. The color composition of the interaction design was good, and the different colors (red, yellow, green) were well-coordinated with the operations status.
4. The camera view for main operation was well positioned in relation to eye level and the other camera views for the operation.
5. The workstation was well-suited for the operation and ergonomically well-designed.

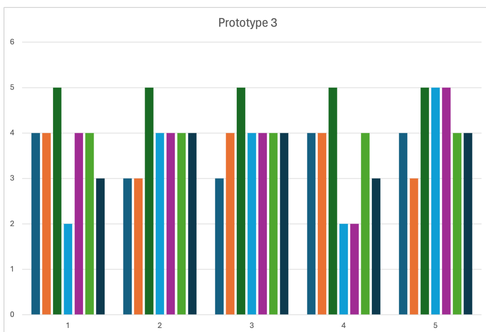
Figure 3.32a, 3.32b, 3.33a and 3.33b below shows the results from the questions. They show how the participants answered each of the questions, ranging from 1 to 5. There are little variations in the answers given. This could be a result of solely using participants with little to no knowledge and expectations about the prototypes and thesis.



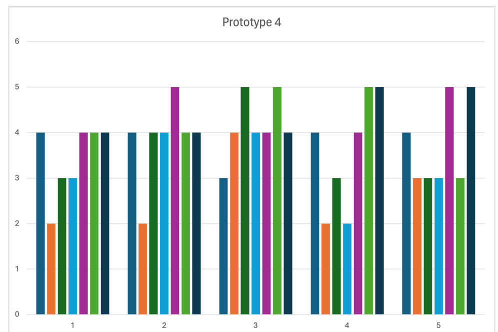
(a) Result, Prototype 1



(b) Result, Prototype 2



(a) Result, Prototype 3



(b) Result, Prototype 4

In figure 3.34 below, all the answers were put together, and a combined average score was made for each prototype based on the participants average score for each prototype. As displayed, the differences were minimal, all scoring approximately 3,8. Therefore, it can be argued that this result did not provide much value on its own. However, when looking at the results combined with the detailed feedback, the test results proved to be of higher significance.

	1	2	3	4	5	6	7	
Prototype 1								
Q1	4	3	5	4	4	2	2	
Q2	3	4	5	3	3	2	3	
Q3	3	5	5	4	5	4	4	
Q4	4	4	5	4	2	5	5	
Q5	4	3	4	4	5	3	4	**Total Average**
Average	3,6	3,8	4,8	3,8	3,8	3,2	3,6	**3,800**
Prototype 2								
Q1	3	3	5	2	4	4	3	
Q2	4	2	5	4	4	4	4	
Q3	3	5	5	4	4	5	4	
Q4	2	3	5	2	4	4	3	
Q5	4	4	5	4	5	4	4	**Total Average**
Average	3,2	3,4	5	3,2	4,2	4,2	3,6	**3,828571429**
Prototype 3								
Q1	4	4	5	2	4	4	3	
Q2	3	3	5	4	4	4	4	
Q3	3	4	5	4	4	4	4	
Q4	4	4	5	2	2	4	3	
Q5	4	3	5	5	5	4	4	**Total Average**
Average	3,6	3,6	5	3,4	3,8	4	3,6	**3,857142857**
Prototype 4								
Q1	4	2	3	3	4	4	4	
Q2	4	2	4	4	5	4	4	
Q3	3	4	5	4	4	5	4	
Q4	4	2	3	2	4	5	5	
Q5	4	3	3	3	5	3	5	**Total Average**
Average	3,8	2,6	3,6	3,2	4,4	4,2	4,4	**3,742857143**

Figure 3.34: Prototype Testing, Combined Results

Through the detailed feedback, it was uncovered that the preferred setup amongst the participants could be said to be the fourth prototype, with modifications. The ideal setup involves maintaining a large, central screen for the main operation, which provides a clear and comprehensive view of the primary operational activities. This screen could be improved by adding additional screens strategically positioned on either side of the main display to show technical information and other essential camera views.

The key features for adjustments to take into consideration based on the testing of the prototypes are screen setup, technical information, avoiding screens on the chairs and ergonomic considerations. The main operation screen could be positioned in between secondary screens at the same height, preferably on the sides rather than above or below. This arrangement avoids the cognitive overload associated with looking up and down and allows for quicker visual scanning horizontally, aligning more naturally with human eye movement. Technical information screens could be larger and placed adjacent to the main operation screen. This facilitates easy access to important operational data without overwhelming the primary field of view. Important but less critical information, such as the winch and moon pool camera views, could be placed to the sides and used only when necessary. There was a consensus amongst the participants that screens on the chair, while initially seeming to provide convenience, actually disrupt focus and reduce efficiency, at least for inexperienced users. These could be eliminated to enhance focus on the primary operation area, preventing the need for constant shifting of attention which can lead to errors or missed information. Ensuring that all screens are within easy visual reach without significant head movement is critical. The workstation could be designed ergonomically to reduce physical strain during operations that require prolonged monitoring.

Additionally, regarding the technical information screens, the speedometers could benefit from only using red at max capacity and display values throughout the speedometer. Another improvement could be the placement of the information regarding load cases, which could be placed directly below the lights displaying the active load case. The combined response from the test is available in G in Appendices.

Discussion

Similarly to the focus experiment, students were used during prototype testing. This was done in order for the participants to attend with open minds and as little bias as possible. The results of the testing could be affected if people with a bigger understanding of the problem statement and the technical aspects were used. However, if more knowledgeable people were to be included, the results could end up being influenced and formed by this knowledge and bias, which could result in nothing new compared to existing solutions. An open mind and unbiased, honest opinions were therefore evaluated to be of bigger significance for this thesis than participants with a deeper understanding and knowledge, in order to come up with something new and not shaped by current solutions. Some of the principals from the design thinking method are visible in these decisions, especially one of the main principals of the ideate step, which is to overlook the apparent solutions in order to create innovative solutions [12]. The apparent solution for the testing could be to test people with a high level of knowledge and expertise. By overlooking this apparent solution, innovation could be the result.

The number of questions and the use of Likert scale can also be a topic for discussion. In order for the participants to track their experience throughout the testing, they were asked questions right after each prototype, with the chance to explain further and give in-depth answers at the end of the testing as a whole. The result could be benefited if the participants had the chance to give in-depth answers right after each prototype. If the test was conducted in this manner, the in-depth answers could be more detailed for each prototype. It was revealed that the in-depth questions were the aspect that provided the most valuable insight, and therefore the result could be heightened if they were more detailed. However, the testing did not last for a very long time period, and therefore one can argue that the experiences from each prototype were fresh and easily remembered by the participants at the time of the in-depth questions.

The testing took place at the University, with the setup of desks, chairs and screens previously described. The testing could benefit from being conducted in a more realistic scenery, for example in one of the simulators at Seaonics. This could prevent any possible distractions made by the setup, where the chairs used as armrests were at an unfavourable height, the screens on the armrests were not placed in an optimal position in regards to the actual operation chair. Additionally, in a simulator the height of the screens would be better suited for an operation. In a simulator, the operator chair is closely resembling a real operation chair, and this could provide a better test result. On the other side, none of the participants complained or gave feedback closely related to the low level of similarities between the setup and an actual operation chair. Therefore, one can argue that this factor did not affect the result noteworthy. However, the participants had no previous knowledge about an operation chair, and therefore had nothing to compare the testing with. If the testing was done with participants with a higher knowledge, this could have affected the result more. Furthermore, as mentioned previously, the testing could benefit from the use of pictures actually displaying camera views from operations performed by Seaonics. In addition, the testing could have been strengthened even further if video streams were made available. This could have resulted in a more realistic work station and screen setup, providing a test environment for the participants more resembling reality.

Chapter 4

The Final Prototype

In this chapter the final prototype is presented. The chapter is divided into smaller sections of aspects that were taken into consideration when designing the final prototype. The use of these different aspects in the final prototype are described accordingly.

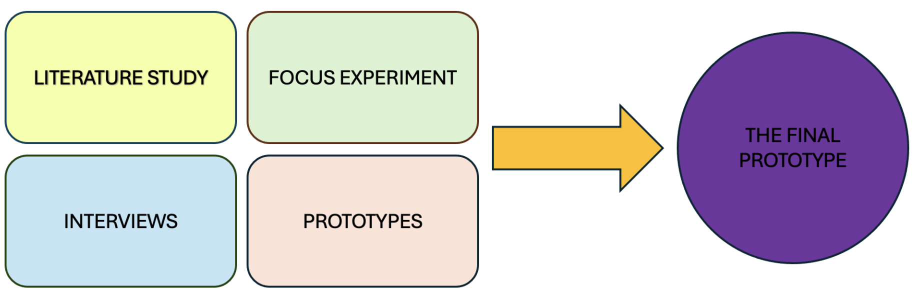


Figure 4.1: The Process, The Final Prototype

4.1 Prototype

The final prototype was constructed based on the results from all the completed steps in the process. These steps were done in order to explore the problem statement and to provide a final result built upon different points of view regarding how interaction design for remote operations can be formed. Figure 4.2 below shows the screen setup for the final prototype, made in Microsoft PowerPoint. In this setup, the main operation screen is placed in the central position. On the right side of the main operation, the screen displays the surveillance camera views, while on the left side the improved technical information screen is placed. Right beneath the main operation screen, there is placed a new screen. This screen shows information regarding the vessel, and is described later on.

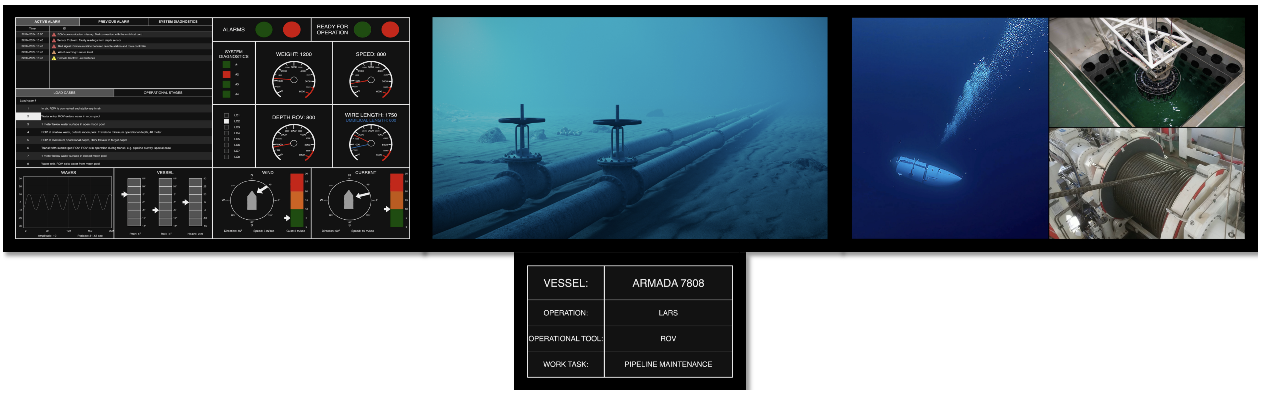


Figure 4.2: Screen Setup, The Final Prototype

Through testing of the previous prototypes, it was stated that the main operation should be the biggest screen, and preferably be placed in the center at direct eye-height level. Furthermore, the testing revealed that the work station could benefit from all screens being placed side by side instead of being stacked on top of each other. This should be done in order to place the screens in a more natural way in regards to eye movement and in order to ease potential strain on both neck and back if the operator were to look up and down on a stacked screen setup. The participants of the test concluded that the screen setup could become more user friendly with the use of a bigger technical information screen, that could be placed in the same focus field as the main operation rather than be placed on the armrest of the operation chair. The other camera views could be placed together in one additional screen, with the size of each view in connection with the importance of the view.

Through testing, the large consensus was that the work station could benefit greatly if no screens were to be placed on the armrests of the operation chair, in order to keep all screens in the same focus area. By placing all technical information in one screen, it was important to display all essential information for the operation together in an orderly manner. Feedback also stated that the technical information should be bigger, that the load case information window should be placed directly next to the lights indicating load case, and that the speedometers should only using the color red for max capacity instead of the whole speedometer being colored red. Additionally, the speedometers were adjusted to include numeric values. On top of that, some of the text was increased in order to enhance readability. A separate touch screen displaying the same visuals as the technical information screens is used to navigate the different tabs for alarms, system diagnostics and operational stages. In order to keep the armrests free from fixed screens, this separate screen would benefit from being portable. This separate screen is thought to be a portable tablet. Additionally, the scales displaying pitch, roll and heave were modified by dividing them into smaller sections in order to more clearly show the value. The vessel used to visualize wind and current were modified in order to more be clearly displayed by using a solid shape instead of a frame. This shape was also adjusted to appear more like an actual vessel. The new and improved technical information screen is displayed in figure 4.3 below.

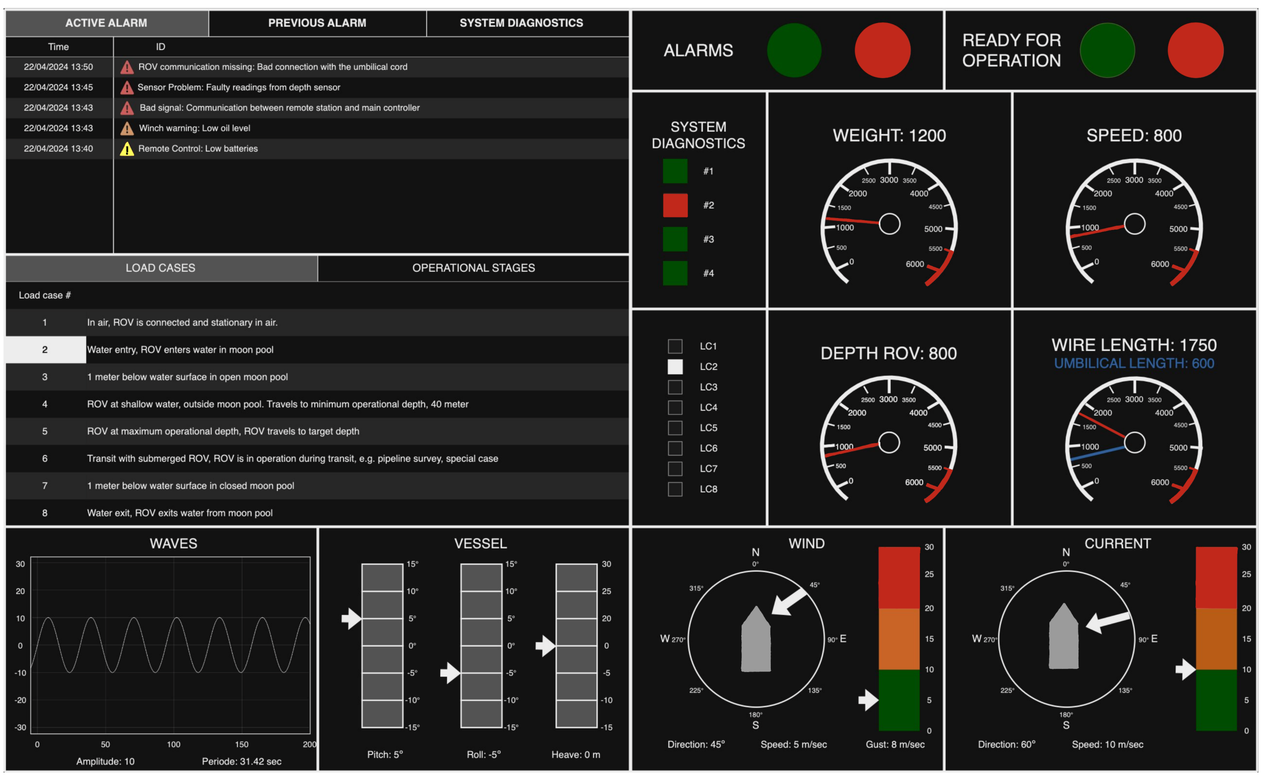


Figure 4.3: Technical Information, The Final Prototype

During a remote operation, it is of high importance for the operator to be informed regarding which operation is carried out, which vessel the operation is performed on and which operational tool on the vessel that is active. The information regarding the operation and operational tool is especially important since the vessel could have more than one of the same operational tool. Therefore it is important for the operator to know exactly which tool is being used. This is crucial in order to maintain safety on the vessel. In order to provide this information, a new additional screen were added to the screen setup, placed centered below the main operation screen. This screen utilizes different levels of luminance in order to convey the information in a clear and precise manner, with a black background and white text. As shown in figure 4.4 below, the screen shows the name of the vessel at the top, followed by operation, operational tool and work task. For this figure, the example operation is a LARS operation, the operational tool that is being used is a ROV, and the work task performed is pipeline maintenance. When working with crane and gangway operations, it could be appropriate to design a modified version of the vessel information screen.

VESSEL:	ARMADA 7808
OPERATION:	LARS
OPERATIONAL TOOL:	ROV
WORK TASK:	PIPELINE MAINTENANCE

Figure 4.4: Vessel Information Screen, The Final Prototype

4.1.1 Interaction Design

When designing the last prototype, it was of high importance to incorporate the main elements from interaction design and discovered in the literature study. One of these elements were the four basic activities regarding interaction design, establishing requirements, designing alternatives, prototyping and evaluating [24]. These four basic activities are closely related to the steps of design thinking method. These activities were done throughout the process, helped form the final prototype, and are closely tied together with the other aspects of the process as a whole. Regarding the prototype, it was decided to design a visual representation of the screen setup in stead of a physical prototype.

Furthermore, it was essential to understand who the users were, what the end-product was going to be used for and how this product actually would be used. This understanding is also central in the empathize step of the design thinking method [12]. This information was gathered through the interviews and conversations with employees at Seaonics. This was an important step to take into consideration in order to provide a final prototype that answered the problem statement as well as a prototype that represents the actual systems and techniques used in the real world. Since the thesis was ordered by Seaonics, it was important to always keep who they are and what they do in mind during all stages of the process.

Another element regarded as essential from interaction design was the up-keeping of a favourable prototype. It is important to focus on the favourable aspects in order to form a good design [24]. When creating the final prototype, this was tried done by following all information and feedback gathered through interviews, conversations and testing. This was achieved by placing the main operation in the center while the size remained as big as possible, moving all screens to the same focus area, removing the screens from the armrests and by placing the screens side by side instead of stacked on top of each other. By doing this, the favourable aspects would be heightened, and the unfavourable aspects could be minimized or eliminated in the process.

The last element from interaction design was to always strive for a great user experience, by focusing on usability, functionality, aesthetics and content [24]. For usability, it was tried to create the prototype with as low difficulty as possible, with few complicated aspects. The prototype consists of three screens of the same size, with the main operation as the main screen in the middle, other camera views on the right side, and technical information on the left side. In addition to these three screens, a smaller screen regarding vessel information is placed centered underneath main operation screen. By keeping all screens in the same focus area, the difficulty and complexity was held at a minimum. The only interactive screen is the technical information screen, where the user can navigate through different tabs for alarms, system diagnostics, load cases and operational stages. By keeping the number of interactive screens at a minimum, the complicity of the prototype was kept at a low level. In regards to the functionality, the prototype provides the operator with the information needed during a remote operation, with a clear display of the main operation, several other camera views to give a great sense of situational awareness, technical information related to the operation and necessary vessel information. For the aesthetic, it was important to attempt to keep Seaonics aesthetic by using similar colors and visuals as the simulators at Seaonics. Regarding content, this prototype was restricted by the importance to keep things simple and to focus on what is necessary for the related operations.

4.1.2 Physical Senses

The most important senses when operating vessels are the visual, aural, haptic and vestibular senses [16]. However, when forming the final prototype, the visual sense was the only natural one to take into consideration, because interaction design for this kind of prototype regards the visuals while not focusing on everything around the remote operation. Therefore, the visual sense is a central element throughout every aspect of the prototype. The three other senses are taken into consideration and talked about in 5 Discussion later on.

4.1.3 Color Theory

The result from the focus experiment, 3.4 showed that a gathering of screens with similar colors made it easier to concentrate and perceive information shown on the screens. This result was taken into consideration when designing the final prototype. As figure 4.2 shows, there are four different camera views on the final prototype, and the camera views with similar colors are placed close to each other. The selection of the four camera views were influenced by the result of the focus experiment, which suggested that the amount of color and contrasts should be kept to a minimum, because it was experienced as difficult to focus on camera views with a range of different colors and the amount of cognitive workload increased. On the technical information screen, changes were made in the setup of the information in order to being able to place all technical information in one screen. Additionally, other smaller changes were made. The speedometer on the previous prototypes was colored bright red, but after feedback from the testing, 3.6.3, the color of the speedometer was changed to white and was only colored red where the value was reaching max. This was done in order to not use the color red in situations were red could mean something negative. This could make it clearer for the operator when max speed was reached. On both the previous prototypes and the final prototype, the umbilical length is visualized on the same speedometer as the wire length. However, in the first four prototypes it was visualized using a deep orange color which is in close relation to red. Therefore the color of umbilical length was changed to blue in the final prototype in order to clearly separate the meaning of the red and orange color, and to make it easier for the operator to recognise the umbilical length by providing it with one specific color.

The active load case is visualized on the screen by a numbered box that lights up when the operator is preforming the given load case. On the previously prototypes this box turned green when the load case was executed. However, this was modified in the final prototype, where the box becomes white when the operator is preforming the given load case. This was modified due to the use of the color green on the rest of the technical information screen. Green on the technical screen symbolises that something is ready or good. It could possibly be inappropriate to use green when indicating which load case is active. The light is used to inform the operator of which load case is active, and does not necessary indicate whether the load case is completed successfully or not. White was chosen based on the theory of luminance, that tells how the eye notice changes in light level more than changes in color and this makes luminance important for displaying information effectively [44]. Additionally, the red and green color of the alarms, system diagnostics and light telling whether the system is ready for operation or not, has been changed to brighter colors to make them clearer on the screen and to minimize the amount of different colors used.

4.1.4 Concentration and Focus

Regarding concentration and focus it was uncovered through the literature study that anticipatory design, useful field of view and the use of light to boost concentration, focus, attention and alertness were important factors to take into consideration when forming the final prototype. These factors were therefore brought into the focus experiment in order to see how they could be highlighted for a best possible result for the final prototype.

Through the experiment, it was unveiled that the eyes naturally get drawn to screens and camera views with a high level of activity. This underscores the importance to place camera views with high activity in close proximity to each other in order for the user to keep focus on a smaller more compact area rather than all over the screen setup. Additionally, the focus and concentration was also mainly drawn to high-activity camera views during the experiment. Together, these two findings accentuate the importance of anticipatory design, by keeping the camera views with movement close together so there is less likely to be any surprise, and the useful field of view, by keeping the moving camera views together in the center within a smaller area of the total screen setup.

Additionally, through the use of moving camera views with a higher level of luminance compared to the stationary camera views, the focus experiment showed a result that spoke in favour for the effect of light in regards to boosted concentration, focus, attention and alertness. This led to the decision to use light and higher level of luminance as a main feature in the final prototype, with a dark background for the technical screen and clear dark frames around the screens. The use of different levels of luminance was especially utilized in the technical information screen, with elements of greater importance at a higher level.

Other findings from the focus experiment regarding focus and concentration that were brought into the creation of the final prototype were feedback regarding the number of screens and the placement of similar camera views. In the final prototype, six different displays were spread across screens, and the placement of similar camera views were taken into consideration. Furthermore, during the testing of the prototypes, the in-depth answers revealed that the prototype could benefit from all camera views being placed in the same focus area in order to minimize the risk of evoking tunnel vision and a smaller field of view during high-demanding periods of concentration.

4.1.5 Remote Operations

Regarding aspects that could prove to be essential when performing remote operations, the interviews provided results that could be utilized when forming the final prototype. One of the most important factor when creating interaction design for remote operations was revealed through the interviews to be situational awareness. This awareness could be obtained through a sufficient number of camera views of the operation, in addition to a technical screen showing all the information related to the situation and operation. Therefore, the final prototype displays a clear camera view of the main operation as well as camera views of the operations in addition to important equipment used. One camera view displays the ROV being hoisted under water, one camera view shows the winch used to hoist the ROV and to compensate for physical factors during the operation, and one camera giving a overview of the moon pool area.

Chapter 5

Discussion

In this chapter the discussion for the thesis is presented. The chapter is divided into two main sections, The Prototype and Problem Statement. In The Prototype elements taken into consideration when designing the the final prototype will be discussed. In Problem Statement a discussion of the problem statement is presented.

5.1 The Final Prototype

Alarms

The alarms in the final prototype are represented using two lights, showed in the upper right section in figure 4.3. If there is an alarm on the system the red lamp will light up, and if there are no alarm on the system the green lamp will light. It can be discussed whether this is the best way to visualize alarms on the system and catch the operators attention, both before, during and after operation. If the alarms were to be placed on the technical information screen, as done in the final prototype, there are several ways to visualize them.

One possibility is to have flashing light on the alarm when activated, in order to catch the operators attention. During an operation flashing light could be used on alarms categorized as urgent, this is the alarms marked with a red triangle in the screen describing the alarms. Alarms categorised with orange or yellow triangles are not urgent to solve during the operation. A possible way do show these during operation could be through a pop up symbol of the triangles on the main operation screen. To separate the level of risk on orange and yellow it could be appropriate to visualize them differently on the main operation screen. The orange triangle could pop up in the bottom left corner blinking for a short duration before it disappears and is shown on the active alarms screen. The yellow alarms could be shown in the corner and only light up, not blinking, before it is shown on the same active alarms screen. The eyes notice change of luminance to a higher degree than change of color [44]. If this solution with flashing light is integrated the operator will see both change in luminance and color. This could to a bigger degree capture the operators attention during an operation.

Another possible way to visualize the alarms on the screen is using a physical light behind the main operation screen that lights up the wall and area around the screens when an alarm is activated, in addition to the lights on the technical information screen. The colors of the physical light can vary between red, orange and yellow based on which alarm is activated. The orange and yellow light behind the screen does not necessary need to be constantly on during the operation, but could function more as a tool to draw the operators attention. However, when a red alarm is activated, it could be suitable that this light is shown until the alarm is sorted out.

A physical lamp on the work station could also be used to visualize the alarms. This could potentially make the alarms even clearer for the operator. If this solution were to be implemented, it would probably be beneficial to only have a green and red lamp, which lights up if alarms are activated and not.

For the suggestions mentioned above, it could be taken into consideration if sound should be used to amplify the importance of the urgent alarms, in addition to the different options for lighting. This is because sound can draw attention to and give contextual cues of the surroundings [29]. Sound could contribute to awaken the operators attention through the aural senses.

A description of the active alarms are displayed on the left part of the screen, and the operator can navigate through the screen on a tablet to see the previous alarms. The lamps regarding alarms and information about the alarms are placed in close relation to each other. This arrangement can be advantageous for the operator, as all necessary information will be within the same field of view and eye sight. If this information were not to be placed in close relation to each other, it could have resulted in the operator not having the same opportunity to efficiently locate the necessary information if an alarm were activated during an operation. It can be discussed how much this actually would have affected the operation. However, the decision to place these with close relation was made, both based on feedback from the testing of the prototypes and from the logical approach that information regarding the same matter should be placed in a rather close relation.

Work Station

The use of luminance and chroma in the interaction design could be affected if the work station were to be located in a brightly lit room. The effects tried achieved through the use of these terms could be canceled out. This could amplify the importance of the work station rooms to be lit with a lesser luminance and correlated color temperature than the workstation screens. This should be done in order for the operator to maintain the focus and concentration on the actual operation [23].

One aspect of remote operations that were not included in the final prototype is the work station, since the final prototype consists of a visual representation regarding screen setup and technical information. However, throughout the thesis, two different builds for work station were focused on. These were work stations where operation chairs similar to those used in on-site operations and more regular work stations, where the operation is conducted from a desk on a typical office setup. In the work station similar to the ones used in on-site operations, the joysticks are placed on the armrest of the chair. When operating from an operation chair, it is suggested to use a touch screen, such as a tablet to navigate through the technical information screen. This is suggested because the operator chair does not provide a stable surface to use a computer mouse. With the office setup, the operator works from a desk using permanently mounted joysticks. A computer mouse is used to navigate through the screen regarding the alarms and load cases. This is suggested in place of a tablet because the operator can remain their focus on the screens while using the hands to navigate with the computer mouse. Both of these work stations could be utilized with the final prototype from this thesis. The Crane Operator Stories, as mentioned previously, shows a work station done from a desk. An example of an operation chair using joysticks placed on the armrests is shown in figure 5.1 below, displaying one of the simulators at Seaonics.

Figure 5.1: Operation Chair, Seaonics

For both types of work station, ergonomically factors should be of focus. It is important to have a non-straining work situation no matter the work station. Sitting too much can negatively affect the health, leading to muscle issues and increasing the risk of heart and metabolic diseases, especially if sitting without taking breaks for a long period of time. People working at desks often sit for about 6 hours in an 8-hour workday, usually without moving for 30 minutes or more at one sitting [21]. Workstations that can have their height adjusted could be a good way to cut down on sitting at work. These desks allow for switching between sitting and standing while working on computers, without being a hindrance and interrupting the job. Regarding this, height-adjustable desks could be of great use for work stations using desks in order to prevent troubles affecting the operators health, both by being able to adjust and optimize height while sitting and rising the desk to a standing position. For work stations using an operation chair, either the screens showing the operation or the actual operation chair could benefit from being height-adjustable as well, making it possible for operators of different heights to work at comfortable positions. This could help reduce neck and back problems, when the operators have the possibility to adjust the height to reduce physical strain while working [21].

Another customisation for the work station of remote operations could be the tools used to navigate the technical information screens. One solution to this could be the use of a tablet displaying the same image as the actual screen. This tablet could be portable, used when needed and put away during operations. By using this tablet, the operator could get a closer look on the technical information, and use touch to navigate through the different tabs. On the other hand, another solution could be a more typical solution consisting of a computer mouse. With this solution, the operator could use the mouse when needed and put it away after use, just like with the tablet. The main difference between these two solutions could be stated to be a matter of taste. However, with the tablet, the operator can get a closer look on the technical information, in case the operator experiences the actual screen as too far away or too complicated for viewing at a distance.

An additional customisation that could be done for both work stations is curving of the screen setup. This could be done if the two screens placed next to the main operation were placed with an angle. This angle could be selected based on the operators personal preferences. Additionally, this curving could be achieved if a larger and wider monitor were used, with a curvature throughout the whole screen. This curving could ease potential strain for the operator if the screen setup proved to be too wide for working comfortably. Additionally, with a curvature, the edges of the screens would be closer to the operator than if the screens were completely flat. This could result in all information from the screens being closer to the operator, which could make it easier for the operator to perceive all information. Moreover, the useful field of view can turn into tunnel vision during high focused work sessions, where the field of view decreases to an angle as small as 1-15 degrees [44]. This would be unfavourable to happen during operations, and a curvature for the screen setup could potentially ease this problem.

Camera Views

The result from the interviews showed that an important factor to take into consideration when deciding the camera views is situational awareness. There are four camera views in the final prototype, one showing the main operation and the three others showing surveillance camera views regarding the operation. The camera view from the main operation is placed centered in the middle of the three screens. Results from the focus experiment and testing of the first four prototypes showed that having the main operation mid-centered was the best approach in order for the operator to carry out the operation in the best possible way. Which camera views being displayed were in addition to focus experiment and testing, also a result of the interviews with employees at Seaonics. One of the interviewees emphasized the importance of sufficient camera views in order to maintain situational awareness. It can be discussed whether the amount of camera views in the final prototype are sufficient and maintain situational awareness, but as mentioned these camera views were chosen based on a variety of aspects. If it was shown that more camera views were necessary, one could reorganize the screen setup in order to being able to place more camera views. If this were to happen, it could be suitable to modify the size of the three surveillance cameras on the right screen. Which camera views shown is also affected by the simulators at Seaonics. These simulators also provided a screen of the main operation, in addition to other camera views of moon pool and winch.

Physical Senses

When forming the prototype, the main sense that was taken into consideration was the visual senses. In order to achieve situational awareness through the use of the visual senses, the final prototype contains important technical information regarding significant aspects of a remote operation. The technical information screen displays information regarding wind, waves, currents and the vessels position in regards to pitch, roll and heave, which could provide the operator a clear image of all situations and affecting forces regarding the vessel. As stated previously, in order to effectively visualize these factors, a combination of chroma and luminance were used. The three remaining senses, aural, haptic and vestibular, all central to the operation of vessels, are described in the section below, where the problem statement is discussed.

5.2 Problem Statement

The problem statement for this thesis was, "What is the difference between operations done on-site and remote, what information can be lost when moving an operation from on-site to remote and how can this loss of information affect the operator?". Throughout this thesis, different prototypes for remote operations has been designed. The process for the thesis was separated into four different sections, literature study, focus experiment, interviews and prototypes, which together were utilized in the forming of the final prototype. Through these processes, significant knowledge was achieved regarding remote operations and all aspects of the problem statement.

Physical Senses

The loss of physical factors is an important aspect to take into consideration when answering the problem statement. It is important for the interaction design to strive for a high situational awareness, since this awareness gets weakened when an operation is performed from a remote location [16]. When the operator performs an operation on-site, they experience all the physical factors affecting the vessel. For remote operations, the operator can perceive and experience these physical effects, such as weather, wind and waves, through the visual, aural, haptic and vestibular senses.

The aural senses are some of the most important senses while operating vessels [16], and could be an important factor to bring along when moving an operation from on-site to remote locations. The use of sounds could therefore be important in order to obtain situational awareness of the operation from a remote location. During the interviews, it was suggested that one way to convey important sounds during a remote operation could be the use of microphones on-site that transmit sounds to the remote location. These sounds could be of weather, machinery and the vessel in general, and through sounds like these the remote operator could get a sense of operating on-site rather than remote. However, the expected sounds for an on-site operation could be a matter of habit, where the inclusion of the sounds on a remote location could result in a more distracting atmosphere than anticipated and wanted. The inclusion of sounds could be something one might think is important, but the lack of expected sounds might not actually affect the operator negatively when operations are done remote. The situational awareness regarding hearing and sound could be compensated for by other means, such as a clear and detailed visualisation.

The haptic senses could also be important to take into consideration when performing a remote operation. This sense could be satisfied through the use of force feedback in for example the joysticks used during the operations. The inclusion of this could give the operator a bigger situational awareness and sense of the operation, where for instance there would be a bigger need of strength when ascending the ROV from the water than when submerging it into the water during a LARS operation. Another example of technologies that can utilize the haptic senses during a remote operation is vibrations. Vibrations could be used in order to give the operator a sense of the vessels movements through the operation chair, or provide vibrations through the joysticks to signal situations were max capacity is reached or to signal the beginning and end of an operation. This type of technology could be important for both on-site and remote operations, in order to provide an understanding of the forces in play during an operation for the operator. Therefore, the haptic senses could be a factor to consider and keep when moving an operation to a remote location.

Lastly, the vestibular senses could also be of importance when performing an operation from remote locations, especially if the operator is experienced and used to on-site operations. On vessels at sea, the body and senses get affected by the movements of the vessel and the motion of the sea. These are factors that constantly will affect the operator on-site. Because of this, it could be important to compensate for this in a remote location, in order to provide situational awareness for the operator. However, this could be a factor the operators are used to and therefore expect, and that if these movements were not present, the operators could become used to it rather quickly. It could be a distraction if the operation station were to move like it was at sea when located on land and that could potentially affect the focus and concentration. It could be stated that the work station in a remote location would be expected to be as stationary as the rest of the location. On the other hand, if these movements are something the operators are highly used to, it could affect the concentration and focus unconsciously if they are not present because of a feeling that something is missing.

Safety

One of the main reasons behind accidents at sea are caused by human factors [9]. Research from the Netherlands on 100 ship incidents revealed that mistakes made by people played a role in 96 of these cases. Moreover, more than 80% of sea mishaps have human actions or organizational issues as a contributing factor. Additionally, ship collisions are often due to human errors, accounting for 89% to 96% of such events [9]. These numbers underscore the importance to take safety serious when working within the marine industry, an importance that might even grown when operations are to be moved from on-site to remote locations.

Through the interviews, it was stated that a clear chain of command could be a useful technique in order to upkeep the safety at the highest level. When following a chain of command, there should never be any confusion on who is to give the order and who to ask if there are any uncertainties. With a clear chain of command, if any incidents were to happen, it would also become easier to locate where and why the incident took place. When using this technique, it could also provide a bigger sense of comfort for the operators at remote locations regarding whether the operations are confirmed as ready to start. The use of a chain of command is dependant on clear communication in order to work. It is therefore of high importance for a remote operation to facilitate for good communication between the remote operator and the crew on the vessel to make sure the operation goes as planned and without any breaches in safety.

The operators ability to communicate with the rest of the team could become weakened when the operation is preformed remote. When the operation is executed on-site the operator has close relation to the rest of the crew on the vessel, and it is effortless for the operator to get in contact with them before, during and after the operation if necessary. An efficient communication with the crew is important in order to maintain good safety on the vessel, not only during operations, but in all aspects of the operation.

Another form of communication that needs to be looked after is the digital communication and connection between the remote work station, the vessel and the equipment used during the operation. This was stated during the interviews. If there were to be any loss of communication between any of these, there should be a clear indication on how to proceed with the operation until the communication is back again. Additionally, during remote operations, it could be beneficial if one person within the crew on the vessel was responsible to assist the remote operator whenever any circumstances that requires direct and fast help were to occur. This could be beneficial for the chain of command and in minimizing risks regarding safety.

When an operator is working remote, the operator could be in charge of various operations on different vessels. In order for this to proceed smoothly it is important to maintain a clear distinction between the operations and vessels. This was stated during conversations with employees at Seaonics. It needs to be clearly visualized on the remote operation station which operation and vessel the operator currently is working with. This information is displayed in the final prototype on a smaller screen placed directly beneath the main operation screen, and displays information regarding vessel name, operation, operational tool and work task. This information could also be visualized on the technical information screen or the screens of the camera views. By portraying this information, it would be clear for the operation which vessel, operation and tool that is being used. This information could then assist in keeping the operations safe, by preventing the use of any vessel, operation or tool by accident. If this sort of information were not to be included in the remote operation station the operator could lose track of the operation. This could, for example, lead to the operator starting to operate on the wrong system on the wrong vessel. Employees at Seaonics had experienced a similar situation in real life when working with remote operations. Adjusting the amount of operations and vessels each operator is in charge of, is crucial in order to maintain a suitable workload for the operators. Too many operations and vessels can cause the operator to lose control and overview, which can potentially lead to safety not being maintained and operations preformed incorrectly. How many operations and vessels an operator can be in charge of can depend on the complexity of the operations and how many operational systems each vessel has.

Motivations Behind Remote Operations

One of the motivations for preforming operations remote is the financial gain [25]. When the operation is preformed remote, the companies does not need to have an operator on the vessel. This results in less persons in the crew on the vessel, allowing companies to avoid the costs associated with having additional crew on board. Additionally, expenses related to the operators travel to the departure site will also be eliminated. If an operator works remote they have the possibility to be in charge of several vessels as the same time, which in turn decreases the costs on several vessels. Fewer persons in the crew on board will also help to reduce the need for cabins and crew common areas. A single operator will not make a significant difference alone, but it contributes to working towards a smaller crew area on the vessels. With a smaller crew area, companies will be able to use a larger part of the vessel for purposes such as transporting goods [25], which could provide a financial gain. The environment also benefits from having less crew on the vessel. The operators travel to departure site can often be long and demand flight travel, which gives a significant amount of environmental footprint. Additionally, the vessels could be made smaller which in turn could result in a lesser consumption of fuel [25]. This could also help companies reduce their environmental footprint.

Another motivation behind remote operations could be social factors. When working remote, the work hours are more closely resembling ordinary work hours. This can result in more time to spend alongside family and friends. Through the interviews, it was stated than when working remote, the operators can make a lesser effort in order to maintain an "ordinary" life. It was also stated in the interviews that some operators have a harder time remaining as an on-site operator over a longer period of time, because of the lack of time to spend with family and friends. With the opportunity to work as an operator remote, this problem could be solved.

Chapter 6

Conclusion

The purpose of this project was to provide better knowledge on interaction design for remote operations, such as LARS, crane and gangway operations. In the process of the thesis, different prototypes for interaction design for LARS operations were made in order to provide a sufficient design for the final prototype. Throughout the process, four steps took place. These steps were done in order to obtain knowledge and experiences regarding remote operations and how interaction design could be designed for these operations. The steps were literature study, focus experiments, interviews and prototypes. Based on the knowledge provided by results of these steps, the final prototype was designed. The final prototype was made, and it provides a sufficient interaction design for remote operations based on the results obtained through the process. The final prototype is a visual representation of the screen setup for a remote LARS operation. This prototype consists of four screens, three with equal size side by side and a smaller under the middle screen. The main operation is displayed in the middle screen, with the technical information screen to the left and a screen displaying three different surveillance camera views for the LARS operation to the right. The smaller screen below displays information regarding vessel, operation, operational tool and work task. This prototype utilized an operation chair with joysticks during operations, and the operator can navigate through the technical information screen through a tablet with touch screen mirroring the technical information screen.

A problem statement was made for this thesis in order to specify the task provided by Seaonics. The problem statement asked the difference between operations done on-site and remote, what information could be lost when moving an operation from on-site to remote and how this loss of information could affect the operator. The loss of physical factors is probably one of the biggest differences when an operation is preformed remotely. Losing these physical factors could affect the operators ability to preform a successful operation and weakening the situational awareness. When working remotely it is important to compensate for this and make sure that this loss is as small as possible. Moreover, the contact with the on-site crew is weakened when working from a remote location. In order to compensate for this loss, it would be appropriate for the operator to be assigned one crew member on the vessel to relate to. This could help maintain the safety on the vessel and provide a better starting point for the operator. When working remotely, the operator can be working with various operations and vessels. It is important to clearly distinguish between the operations in order to maintain safety on the vessels.

6.1 Further Work

The work presented in this thesis can be further developed. This include the prototypes designed. Testing of the final prototype was not preformed, and a physical prototype was not made. Therefore, this could be an appropriate starting point for further work if one is interested in continuing the development of interaction design for remote LARS operation. It is possible to further develop a physical prototype based on the testing. This prototype could take into consideration the physical senses, aural, haptic and vestibular, that were not represented through the visual representation of the final prototype. Gathering actual video streams from an ongoing operation would be appropriate to gain a better approximation of how the prototype will function in practice. It could also be possible to work with implementing a prototype on Seaonics system in order to being able to test the prototype on their simulators. This would provide a better impression of the functioning of the prototypes, and would provide better testing of the design. Conducting more interviews regarding the interaction design would be appropriate. It would be interesting to get in touch with both previously active and current active operators to gather their perspectives on the essential elements to consider when moving an operation from on-site to remote. Additionally, it would be interesting to interview various onshore personnel who actively work with remote operations, not only employees at Seaonics, but also employees from other companies working with similar technologies. This could gain insights into their thought and views on remote operations and the interaction design for these.

Appendices

A Preproject Report

FORPROSJEKT - RAPPORT

FOR BACHELOROPPGAVE

NTNU
Kunnskap for en bedre verden

TITTEL:
Interaksjonsdesign for fjernoperasjoner

KANDIDATNUMMER(E):

Ikke mottatt. Studentnummer finnes i punkt 3.1

DATO:	EMNEKODE:	EMNE:	DOKUMENT TILGANG:
25.1.24	**IE303612**	**Bacheloroppgave**	- Åpen

STUDIUM:	ANT SIDER/VEDLEGG:	BIBL. NR:
AUTOMATISERING OG INTELLIGENTE SYSTEMER	10 / -	- Ikke i bruk -

OPPDRAGSGIVER(E)/VEILEDER(E):

Seaonics / Øystein Bjelland, Ottar Osen

OPPGAVE/SAMMENDRAG:

Dette er en forprosjektrapport til bacheloroppgave som utfører våren 2024 ved NTNU i Ålesund. Oppgavens tittel er 'interaksjonsdesign for fjernoperasjoner' og er utarbeidet av Seaonics. Flere og flere marine operasjoner gjøres fra en operatørstasjon hvor man ikke har full oversikt over nødvendige forhold direkte (synsfelt). Det benyttes ofte flere video-strømmer og informasjonsdisplay med informasjon om maskinens ytelser/kapasiteter. For å fordype seg i dette blir det utført en litteraturstudie på hva som er god praksis for operatørlayout ved remote operasjoner. Litteraturstudie er gruppens første og primære oppgave, mens senere i prosjektarbeidet vil det blir forsøkt å utvikle en prototype av rigging av skjermer og innhold på disse.

Denne forprosjektrapporten inneholder også informasjon om prosjektgruppen og fordeling av deres oppgaver, informasjon om styringsgruppe, avtale med oppdragsgiver og gruppens samarbeidsregler. Prosjektet blir også nøye beskrevet, herunder blant annet problemstilling og planlagt framgangsmåte.

Denne oppgaven er en eksamensbesvarelse utført av studenter ved NTNU i Ålesund.

INNHOLD

1 INNLEDNING

Flere og flere marine operasjoner gjøres fra en operatørstasjon hvor man ikke har full oversikt over nødvendige forhold direkte (synsfelt). Det benyttes ofte flere video-strømmer og informasjonsdisplay med informasjon om maskinens ytelser/kapasiteter. For å fordype seg i dette blir det utført en litteraturstudie på hva som er god praksis for operatørlayout ved remote operasjoner.

Oppgaven blir utarbeidet for Seaonics, som er en bedrift som utvikler håndterings- og lifting løsninger for intelligent, effektiv og lønnsom drift for klienter i den maritime næringen. Gjennom kontinuerlig innovasjon skaper de fremtidsrettede løsninger som oppfyller høye sikkerhetskrav og standarder for nullutslipp (Seaonics, 2023). Seaonics leverer utstyr som blant annet LARS, gangbro og kraner. I denne bacheloroppgaven blir det derfor hovedsakelig fokusert på interaksjonsdesign for denne typen utstyr.

2 BEGREPER

- LARS: Launch and recovery system

3 PROSJEKTORGANISASJON

3.1 Prosjektgruppe

Studentnummer(e)
538042 460590

Tabell: Studentnummer(e) for alle i gruppen som leverer oppgaven for bedømmelse i faget ID 302906

3.1.1 Oppgaver for prosjektgruppen – organisering

Gruppen består av to personer, derfor ble det besluttet å ikke fordele spesifikke roller og fast arbeidsfordeling for akademisk arbeid i oppgaven. Ansvar for administrative oppgaver ble fordelt på de to gruppemedlemmene.

3.1.2 Felles oppgaver for gruppen

- Timeliste
- Utforming av oppgaven
- Litteratursøk
- Utarbeide prototype

3.1.3 Oppgaver for gruppemedlem 1

- Møteinnkalling
- Møteagenda og møtereferat

3.1.4 Oppgaver for gruppemedlem 2

- Framdriftsrapport
- Oppdatering av framdriftsplan

3.2 Styringsgruppe (veileder og kontaktperson oppdragsgiver)

- Ottar Osen, veileder ved NTNU
- Øystein Bjelland, veileder ved NTNU
- Stig Espeseth, bedriftskontakt ved Seaonics

4 AVTALER

4.1 Avtale med oppdragsgiver

Gruppen kommer til å signere en NDA med Seaonics i anledning denne oppgaven.

4.2 Arbeidssted og ressurser

- Tilgang på arbeidsplass
  - Gruppen får tilgang på arbeidsplass på Seaonics
  - Universitetets lokaler er også tilgjengelig
- Tilgang til ressurser
  - Seaonics gir gruppen full tilgang til relevant litteratur, utstyr samt kunnskap og kompetanse.
  - Universitetets bibliotek og database
- Tilgang til personer
  - Ansatte på Seaonics
  - Veiledere på universitetet
  - Relevant kontaktnett fra både Seaonics og veiledere
- Datasikkerhet/informasjon unndratt offentlighet
  - Det blir underskrevet en NDA med Seaonics
- Avtalt rapportering
  - Møte med veileder annenhver uke
    - Møtereferat
  - Framdriftsrapport skrives annenhver uke
  - Kontinuerlig oppdatering av framdriftsplan

4.3 Gruppenormer – samarbeidsregler – holdninger

Generelle samarbeidsregler går ut på at vi skal møte til de tidspunktene som er avtalt. Er man forhindret i å møte skal dette formidles så tidlig som mulig, og er man forsinket skal dette også fortelles ved første mulighet.

Det skal jobbes godt mot en åpen og fin dialog, hvor alt kan deles og ingenting skal kritiseres på en ikke-konstruktiv måte. Dersom det skulle oppstå konflikter eller uenigheter, skal det tas opp med vedkommende umiddelbart, på en ordentlig måte.

5 PROSJEKTBESKRIVELSE

5.1 Problemstilling - målsetting - hensikt

Oppgavebeskrivelsen fra Seaonics var i utgangspunktet følgende:
Gjør en litteraturstudie på hva som er god praksis for operatørlayout ved remote operasjoner. Bruk feks eye tracking for å verifisere operatørens fokus. Se på hvordan operatørens stressnivå kan reduseres ved plassering av videostrømmer og informasjon. Analyser fordeler og ulemper ved direkte oversikt, hybridløsning med kameraer og direkte oversikt og bruk av ren digital "flate". Vurder også hvordan forsinkelser i videostrømmen vil kunne påvirke operasjonen og hvilke forsinkelser som kan være akseptable (glass til glass). Vurder også hvordan man kan gjøre bruk av audio.

Etter møte med Seaonics kom det fram at bedriften holder på med flere prosjekt der de har behov for å styre forskjellig utstyr fra andre steder enn der utstyret befinner seg, som regel på en båt. De har flere kunder som tar utgangspunkt i å kunne styre utstyr fra land. Gjennom bachelor oppgaven vil vi prøve å finne ut hva det er som er viktig i utførelsen og beslutningen av disse remote operasjonene, samt hvilken informasjon som er viktig i slike situasjoner. I tillegg vil det belyses hvordan man kan støtte opp under situasjoner som gjøres fra en remote situasjon. Noen viktige aspekter rundt dette kan for eksempel være bruk av digitale tvillinger. Feedback på joystick må også tas i betraktning.
Et annet viktig spørsmål som skal forsøkes å besvares er hvordan situasjonen er for de som skal gjennomføre operasjonene. Hvordan ser den visuelle flaten ut, hva er det man ser? Hvordan er arbeidssituasjon, samt hvilken informasjon trenger man i ulike settinger? Hvor mange operasjoner (båter) kan en operatør ha ansvar for? Det vil bli sett på hva som kreves av videostrømmer med tanke på for eksempel forsinkelser i signaler. Seaonics peker på det at flere og flere ønsker å gjøre operasjonene fra land, eller andre lokasjoner.

Så tidlig i prosjektperioden er oppgaven enn så lenge noe flytende. Det vil derfor bli gjort et arbeid for å sette seg inn i de forskjellige perspektivene og områdene av oppgaven, da oppgaven i seg selv er veldig stor. I starten av prosjektperioden vil det først utføres litteratursøk i et bredere spekter, før gruppen skal fordype seg og forsøke å utvikle en prototype for rigging av skjermer og innholdet i disse. Prototypen er tenkt utviklet til enten gangbro, LARS eller kran. Etter prototypen er utviklet har gruppen en hensikt om å komme i kontakt med operatører som kan teste prototypen, og komme med tilbakemeldinger.

5.2 Krav til løsning eller prosjektresultat – spesifikasjon

Utforske god praksis for interaksjonsdesign av remote-operasjoner. Oppgaven vil bli gjennomført hovedsakelig som en litteraturstudie. Dette medfører at alt av litteratur og kilder må kvalitetssikres før de blir arbeidet videre med. En måte å kvalitetssikre litteraturen på kan være peer-review. Videre vil det bli stilt høye krav til kvaliteten til rapporten. Oppgaven krever hovedsakelig ingen spesielle økonomiske rammer. Med stor sannsynlighet vil det bli utarbeidet prototype mot slutten av prosjektperioden. Til prototype vil det med liten sannsynlighet oppstå spesielle økonomiske krav, da denne vil bli utformet ved hjelp av software. Eventuelle kostnader kan være lisenser.

5.3 Planlagt framgangsmåte(r) for utviklingsarbeidet – metode(r)

1. Utforme oppgaven og problemstillingen for å finne områder det kan fokuseres på. Vurdere om det skal utføres bredde- eller dybdesøk, eller en kombinasjon av disse.
2. Få innspill fra styringsgruppen om utforming av oppgaven.
3. Gjennomføre litteratursøk.
4. Samle informasjon.
5. Utarbeide prototype.
6. Utforme rapport.
7. Steg 3-6 gjennomføres i en flytende rekkefølge og hvert steg vil gjennomføres ved behov.

Design thinking metodikk kan benyttes i utførelsen av oppgaven.

5.4 Informasjonsinnsamling – utført og planlagt

Det vil bli gjennomført litteratursøk for å undersøke relevant forskning og artikler. Dette vil bli gjort via google scholar og oria. I tillegg kan relevant kunnskap og kompetanse samles fra Seaonics.

5.5 Vurdering – analyse av risiko

Realiseringen av prosjektet har ingen tydelige risikoelementer, da prosjektet i all hovedsak er en litteraturstudie. Godt litteratursøk og godt samarbeid med Seaonics er viktig for å lykkes i oppgaven. Når det er sagt er det en mulighet det vil bli utarbeidet en form for prototype i sammenheng med prosjektet. Dette kan medføre arbeid på lab, både hos universitet og hos Seaonics, hvor opplæring til bruk av aktuelle maskiner er et av hovedpunktene.

5.6 Hovedaktiviteter i videre arbeid

Nr.	Hovedaktivitet	Ansvar	Kostnad	Tid/omfang
1	Timeliste	CGP, JELE		Løpende
2	Møteinnkalling	CGP		Løpende
3	Møteagenda/referat	CGP		Løpende
4	Framdriftsrapport	JELE		Løpende
5	Oppdatering av framdriftsplan	JELE		Løpende
6	Utarbeide problemstilling	CGP, JELE		2-4 uker
7	Utføre litteratursøk	CGP, JELE		Intensivt i start, senere ved behov
8	Utarbeide prototype	CGP, JELE		4-6 uker
9	Testing av prototype	CGP, JELE		1 uke
10	Rapportskriving	CGP, JELE		Løpende, avhengig av godt litteratursøk

5.7 Framdriftsplan – styring av prosjektet

5.7.1 Hovedplan

Møteinnkalling, møteagenda/referat, framdriftsrapport og føring av timeliste er oppgaver som skjer løpende gjennom hele prosjektperioden. Gruppen jobber nå sammen om å utarbeide problemstilling, og har satt som frist å være ferdig med denne innen 25.2.24. For å fullføre denne oppgaven innen gitt sluttidspunkt skal gruppen utføre litteratursøk, og ha samtaler med både veileder på universitetet og bedriftskontakt på Seaonics. Utførelsen av litteratursøk blir gjort intensivt i starten av prosjektperioden, og deretter senere ved behov. Prototypen er tenkt utviklet i uke 14-17 prosjektperioden, med et tidsomfang på 4 uker. Etter prototypen er utviklet skal den testes, forhåpentligvis av operatører Seaonics kjenner til. Testing av prototype er satt til uke 18, og skal være ferdig utført i løpet av 1 uke. Begge gruppemedlemmene har ansvar for utvikling og testing av prototype. Rapportskriving gjøres løpende gjennom hele prosjektperioden, men blir mer intensivt mot slutten av prosjektperioden.

5.7.2 Styringshjelpemidler

Hjelpemidler som brukes:

- Confluence wiki
  - Timeliste
  - Møteagende/referat
  - Framdriftsrapport
  - Framdriftsplan
  - Samle litteratur
- Overleaf
  - Rapport
- Google Scholar
  - Til litteratursøk
- Zotero
  - Håndtering og sortering av kilder og referanser

5.7.3 Utviklingshjelpemidler

Hvilke utviklingshjelpemidler som vil bli benyttet avhenger av hvordan prototypen blir utarbeidet. Noen aktuelle eksempler er Figma, PowerPoint, Indesign og PyCharm.

5.7.4 Intern kontroll – evaluering

Framdriftsrapport blir utformet annenhver uke. Framdriftsplan blir oppdatert fortløpende. Møteagenda skrives i forkant av møte, og møtereferat skrives under/etter møte. Aktuelle mål/delmål for dette prosjektet vil være utforming av problemstilling, som det er antatt vil trenge 2-4 uker å utforme, utarbeiding av prototype, som det er antatt vil trenge 4-6 uker å gjennomføre. De resterende hovedaktivitetene for prosjektet vil blir arbeidet med parallelt med både utforming av problemstilling og utarbeiding av prototype.

5.8 Beslutninger – beslutningsprosess

Beslutningsprosessen vil være flytende da både oppgave og problemstilling i seg selv er ganske flytende. Det som menes med dette er at gjennom litteratursøk kan det oppstå nye ideer og synsvinkler som kan være bidragsytende på å endre fokus for prosjektet og dermed problemstilling og oppgaven. Det kan skje gjennom prosessen at både oppgaven og problemstilling reformuleres, som vil endre på hvilken informasjon som er relevant.

6 DOKUMENTASJON

6.1 Rapporter og tekniske dokumenter

- Konfidensielle papir og dokument mottatt hos Seanoics oppbevares der, og tas ikke med på universitetet.
- Framdriftsrapport skrives annenhver uke, og framdriftsplan oppdateres løpende, og er tilgjengelig gjennom prosjektets wiki-side.
- Timeliste skrives etter endt arbeid, og er tilgjengelig gjennom prosjektets wiki-side.
- Møteagenda og referat skrives før, under og etter møte, og er tilgjengelig gjennom prosjektets wiki-side.

7 PLANLAGTE MØTER OG RAPPORTER

7.1 Møter

7.1.1 Møter med styringsgruppen

- Første møte med styringsgruppen ble gjennomført 16.1.24
- Tidspunkt for videre møter er enda ikke avklart
- Møte med veileder på universitetet vil gjennomføres annenhver uke.

7.1.2 Prosjektmøter

- Prosjektgruppen jobber sammen torsdag og fredag hver uke. Etter endt eksamen i INGA2300 vil det arbeides med oppgaven mandag-fredag hver uke.

7.2 Periodiske rapporter

7.2.1 Framdriftsrapporter (inkl. milepæl)

- Framdriftsrapport skrives annenhver uke
- Framdriftsplan oppdateres kontinuerlig

8 PLANLAGT AVVIKSBEHANDLING

- Ved sykdom eller annet som hindrer en for å møte skal det gis umiddelbar beskjed om dette.
- Ved behov for store endringer i oppgaven blir dette løst i samarbeid med veileder.
- Dersom gruppen ikke klarer å utvikle prototypen som tenkt skal bedriftskontakt på Seaonics kontaktes for veiledning.

9 UTSTYRSBEHOV/FORUTSETNINGER FOR GJENNOMFØRING

Delen av oppgaven som omhandler litteraturstudie har ikke spesielle behov for fysisk utstyr. Gruppen er avhengig av ressurser hos Seaonics, både litteratur, kunnskap og tilgjengelige simulatorer. Når protypen skal utvikles har gruppen behov for programvare. Det er ikke bestemt hvilken programvare som skal benyttes enda, men det er tenkt Figma, PowerPoint, Indesign eller PyCharm.

10 REFERANSER

- Seaonics (2023) *We are Specialists.* Tilgjengelig fra: https://www.seaonics.com/about-us (Hentet: 15.01.24)

VEDLEGG

B Progress Reports

Framdriftsrapport – uke 4 & 5

- Formålet med arbeidet i perioden

Finne relevant litteratur. Utforme oppgave og problemstilling, samt å utforske mulighetene til hvordan disse kan løses. Generelle oppstarts-aktiviteter, som å opprette prosjektrapport i overleaf og en wiki-side, sette i gang rutiner for framdriftsrapporter, timelister og møtereferat. Forhøre oss med oppdragsgiver Seaonics om oppgave og problemstilling er som ønsket.

- Planlagte aktiviteter i perioden

Møte med veileder Øystein Bjelland for å fortsette utformingen av oppgaven og få innspill til endringer og utvidelser av problemstillingen. Ellers er det booket grupperom på skolen torsdager og fredager i disse ukene.

- Faktisk gjennomførte aktiviteter i perioden

Startet litteratursøk. Fastsatt en tidsperiode på 4 uker på å utforme problemstilling (uke 8). Gjennomført alt av aktuelle oppstarts-aktiviteter. Har fått fast arbeidsplass hos Seaonics, samt underskrevet NDA-avtale og fått tilgang på diverse dokumenter.

- Avvik og årsaker

Ingen avvik

- Avvikshåndtering og endringer

Ingen avvik

- Erfaringer fra perioden

Fått en god oversikt over bruken av programmet Zortero, som benyttes til å samle og kommentere kilder. Fått godt overblikk over god arbeidsmetode for litteratursøk. Kommet godt inn i rutinene for perioden, med tanke på de faste oppgavene som må gjøres, som framdriftsrapporter, føring av timeliste og møtereferat.

- Formål og fokus for neste periode (uke 6 & 7)

Fortsette litteratursøket. Starte utforming av problemstilling. Tilspisse fokus for oppgaven.

- Planlagte aktiviteter for neste periode

Planlegger møte med veileder i uke 7.

- Oppdatert framdriftsplan

Oppdatert

Framdriftsrapport – uke 6 & 7

- Formålet med arbeidet i perioden

Fortsette litteratursøket. Starte utforming av problemstilling. Tilspisse fokus for oppgaven. Se mer på hvordan interaksjonsdesign bør rigges, hvilken informasjon som er nødvendig, se mer på hva som er gjort tidligere. Sette oss inn alle ressurser vi har fått tilgang til via Seaonics.

- Planlagte aktiviteter i perioden

Planlegger møte med veileder i uke 7.

- Faktisk gjennomførte aktiviteter i perioden

Har jobbet mye med litteratursøk for å finne gode kilder til å bygge opp under oppgaven. Utformet to problemstillinger. Har satt oss inn i ressursene vi har fått tilgang til via Seaonics.

Gjennomførte veiledningsmøte med Ottar Osen og Øystein Bjelland. Fikk gode innspill på veien videre. Spesielt fokus for møtet var at det var på tide å fokusere mer i dybden på hva oppgaven skal omhandle, samt å utforme en problemstilling som representerer dette. Fikk tips om å snakke mer med de ansatte hos Seaonics for å få innspill derfra. Fikk også tips om å ta kontakt med Kjetil Nordby som har mye god kunnskap rundt interaksjonsdesign.

- Avvik og årsaker

Ingen avvik.

- Avvikshåndtering og endringer

Ingen avvik.

- Erfaringer fra perioden

Har blitt flinkere til å finne gode kilder gjennom litteratursøk, samt det å raskere se om en kilde inneholder det man er ute etter eller ikke. Har også tilegnet oss mer kunnskap rundt arbeidsområdene til Seaonics gjennom de ressursene vi har fått.

- Formål og fokus for neste periode

Fokusere mer i dybden på problemområdet, samt å omformulere problemstilling slik den representerer dypere fokus og problemområde for oppgaven.

- Planlagte aktiviteter for neste periode (uke 8 & 9)

Skal planlegge veiledningsmøte hos Seaonics i uke 9. Ta kontakt med ansatte på Seaonics for å få innspill derfra. Vil finne ut og forstå hvordan operasjonene fungerer on-site gjennom samtaler med personal hos Seaonics. Videre vil vi komme i kontakt med og planlegge møter med operatører for å finne ut hvilken informasjon som er nødvendig og ønsket under remote operasjoner. Sette oss inn i og tilegne oss enda mer kunnskap rundt interaksjonsdesign, slik at vi i neste periode kan ta kontakt med Kjetil Nordby.

- Oppdatert framdriftsplan

Ja

Framdriftsrapport – Uke 8 & 9

- Formålet med arbeidet i perioden

Fokusere mer i dybden på problemområdet, samt å omformulere problemstilling slik den representerer dypere fokus og problemområde for oppgaven.

- Planlagte aktiviteter i perioden

Skal planlegge veiledningsmøte hos Seaonics i uke 9. Ta kontakt med ansatte på Seaonics for å få innspill derfra. Vil finne ut og forstå hvordan operasjonene fungerer on-site gjennom samtaler med personal hos Seaonics. Videre vil vi komme i kontakt med og planlegge møter med operatører for å finne ut hvilken informasjon som er nødvendig og ønsket under remote operasjoner. Sette oss inn i og tilegne oss enda mer kunnskap rundt interaksjonsdesign, slik at vi i neste periode kan ta kontakt med Kjetil Nordby.

- Faktisk gjennomførte aktiviteter i perioden

Forsøkte å omformulere problemstillingen. Den var fortsatt for generell, fikk tips om hvordan denne kan konkretiseres. Tilspisset litteratursøket. Arbeidet med brainstorming rundt oppgavens innhold. Fikk gode tilbakemeldinger på veiledningsmøtet at brainstorming og tenkt innhold for oppgaven er bra, men at vi kunne fokusere litt på sikkerhet også. Har startet prosessen med å få kontakt med operatører.

- Avvik og årsaker

Har bestemt å utsette kontakt med Kjetil Nordby for å være best mulig rustet og forberedt før møtet.

- Avvikshåndtering og endringer

Jobbet færre timer grunnet mye tid til andre fag som snart har eksamen, i tillegg til sykdom.

- Erfaringer fra perioden

At konkretisering av problemstilling er vanskelig, lett å "gå i fella" med at den blir for generell. Gode erfaringer med læringsutbyttet av brainstorming.

- Formål og fokus for neste periode

Konkretisere en endelig problemstilling. Fortsette kontakten rundt både operatører hos Seaonics og eventuelt besøk hos verft i Brattvåg. Arbeide med rapporten for å få den oppdatert til dit vi har kommet med tanke på kilder og ressurser.

- Planlagte aktiviteter for neste periode (uke 10 & 11)

Eventuelt veiledningsmøte uke 11. Kan vurderes om dette skal gjennomføres i uke 12. Kanskje se på mulighetene rundt en tidlig prototype. Gjennomføre eksperiment, for eksempel ved hjelp av team-samtale, for å se hvor mange skjermer man kan ha fokus på før man mister kontroll. Sjekke opp boken Springer Handbook of Robotics, tips fra Øystein.

- Oppdatert framdriftsplan

Ja.

Framdriftsrapport – uke 10 & 11

- Formålet med arbeidet i perioden

Konkretisere en endelig problemstilling. Fortsette kontakten rundt både operatører hos Seaonics og eventuelt besøk hos verft i Brattvåg. Arbeide med rapporten for å få den oppdatert til dit vi har kommet med tanke på kilder og ressurser.

- Planlagte aktiviteter i perioden

Eventuelt veiledningsmøte uke 11. Kan vurderes om dette skal gjennomføres i uke 12. Kanskje se på mulighetene rundt en tidlig prototype. Gjennomføre eksperiment, for eksempel ved hjelp av team-samtale, for å se hvor mange skjermer man kan ha fokus på før man mister kontroll. Sjekke opp boken Springer Handbook of Robotics, tips fra Øystein.

- Faktisk gjennomførte aktiviteter i perioden

Grunnet eksamenslesing i et annet fag har denne perioden blitt nedprioritert. Nåværende periode er påske, så planlagte aktiviteter flyttes til første uke etter påske (uke 14 & 15).

Endelig problemstilling er ferdig laget.

- Avvik og årsaker

Eksamenslesing.

- Avvikshåndtering og endringer

Planlagte aktiviteter overføres til neste periode (uke 14 & 15).

- Erfaringer fra perioden

Det har væt utfordrende å arbeide med bacheloroppgaven når det meste av tiden går til eksamenslesing. Nå som dette faget er ferdig vil ikke dette lengre være et problem.

- Formål og fokus for neste periode

Planlagte aktiviteter overføres til neste periode (uke 14 & 15).

- Planlagte aktiviteter for neste periode (uke 12 & 13)

Planlagte aktiviteter overføres til neste periode (uke 14 & 15).

- Oppdatert framdriftsplan

Ja.

Framdriftsrapport – Uke 12 & 13

- Formålet med arbeidet i perioden

Uke 13 i denne perioden er påske og det er derfor ikke satt opp noen aktiviteter i den uken.

Det skal gjennomføres en elevator pitch.

- Planlagte aktiviteter i perioden

Lage elevator pitch, presentasjon og innhold. Denne skal presenteres 21.2.24.

- Faktisk gjennomførte aktiviteter i perioden

Gjennomført elevator pitch og forberedelse til denne.

- Avvik og årsaker

Ingen avvik.

- Avvikshåndtering og endringer

Ingen avvik.

- Erfaringer fra perioden

Fått mer erfaring i presentasjonsteknikk, og det å holde korte og konsise presentasjoner på engelsk.

- Formål og fokus for neste periode

Fortsette kontakten rundt både operatører hos Seaonics og eventuelt besøk hos verft i Brattvåg, kontakte veileder hos Seaonics da vi ikke har fått noe kontaktinformasjon enda. Arbeide med rapporten for å få den oppdatert til dit vi har kommet med tanke på kilder og ressurser. Starte arbeidet med prototype. Holde rapporten oppdatert til en hver tid.

- Planlagte aktiviteter for neste periode

Eventuelt veiledningsmøte uke 14. Kan vurderes om dette skal gjennomføres i uke 15. Se på mulighetene rundt en tidlig prototype. Gjennomføre eksperiment, for eksempel ved hjelp av team-samtale, for å se hvor mange skjermer man kan ha fokus på før man mister kontroll. Sjekke opp boken Springer Handbook of Robotics, tips fra Øystein. Planlegge intervju av operatører fra Seaonics, både aktive og tidligere.

- Oppdatert framdriftsplan

Ja

Framdriftsrapport – Uke 14 & 15

- Formålet med arbeidet i perioden

Fortsette kontakten rundt både operatører hos Seaonics og eventuelt besøk hos verft i Brattvåg, kontakte veileder hos Seaonics da vi ikke har fått noe kontaktinformasjon enda. Arbeide med rapporten for å få den oppdatert til dit vi har kommet med tanke på kilder og ressurser. Starte arbeidet med prototype. Holde rapporten oppdatert til en hver tid.

- Planlagte aktiviteter i perioden

Eventuelt veiledningsmøte uke 14. Kan vurderes om dette skal gjennomføres i uke 15. Se på mulighetene rundt en tidlig prototype. Gjennomføre eksperiment, for eksempel ved hjelp av team-samtale, for å se hvor mange skjermer man kan ha fokus på før man mister kontroll. Sjekke opp boken Springer Handbook of Robotics, tips fra Øystein. Planlegge intervju av operatører fra Seaonics, både aktive og tidligere.

- Faktisk gjennomførte aktiviteter i perioden

Sett gjennom 'Springer Handboook of Robotics' etter relevant litteratur. Laget intervjuspørsmål for ansatte på Seaonics og operatører. Vi har også vært i kontakt med Arne-Johan på Seaonics for å avtale intervju. Det blir forhåpentligvis gjennomført 12.4.24. Han jobber også med å finne andre vi kan kontakte for intervju. Vi har fått kontaktinfo til en kranoperatør, og har kontaktet han for mulig intervju. Ikke fått noe tilbakemelding fra han enda.

Gjennomført et fokus-eksperiment på NTNU. Kommet godt i gang med skisse på prototype. Gjennomført veiledningsmøte. Skrevet mye på teoridel i rapport.

- Avvik og årsaker

Ingen avvik.

- Avvikshåndtering og endringer

Ingen avvik.

- Erfaringer fra perioden

Større overblikk over oppgaven og god oversikt over teori, samt hva som er veien videre for oppgaven.

- Formål og fokus for neste periode

Komme videre i arbeid med prototype, intervjuprosess og rapport.

- Planlagte aktiviteter for neste periode

Implementere skisse på prototype i CDP studio. Gjennomføre intervjuer med Seaonics og kranoperatør som vi har kontaktet. Skrive på metode i rapport, skrive om de metodene vi har benyttet oss av så langt i arbeidet. Planlegge veiledningsmøte i uke 17 eller 18.

- Oppdatert framdriftsplan

Ja

Framdriftsrapport – Uke 16 & 17

- Formålet med arbeidet i perioden

Komme videre i arbeid med prototype, intervjuprosess og rapport.

- Planlagte aktiviteter i perioden

Implementere skisse på prototype i CDP studio. Gjennomføre intervjuer med Seaonics og kranoperatør som vi har kontaktet. Skrive på metode i rapport, skrive om de metodene vi har benyttet oss av så langt i arbeidet. Planlegge veiledningsmøte i uke 17 eller 18.

- Faktisk gjennomførte aktiviteter i perioden

Skrevet ferdig teori. Har skrevet ferdig empathize, define og ideat, og fokuseksperiment på metode. Ferdigstilt fire forskjellige prototyper, gjennomført testing, og analysert og visualisert resultatet. Gjennomførte intervjuer hos Seaonics. Hadde oppdateringsmøte med Øystein Bjelland i uke 16 og vanlig veildeningsmøte i uke 17.

- Avvik og årsaker

Har gått bort i fra CDP som program for prototype, benytter heller draw.io. Har ikke kommet i kontakt med kranoperatører.

- Avvikshåndtering og endringer

Benytter draw.io og powerpoint for prototype både på grunn av vanskeligheter rundt lisens, tid og fordi draw.io fungerte godt. Angående kranoperatører har vi ikke fått svar med de vi har kontaktet.

- Erfaringer fra perioden

Ferdigstilling av prototype tok mye tid, samt gjennomføring og klargjøring av testing.

- Formål og fokus for neste periode

Ferdigstille metode-delen av rapporten. Planlegge veien videre for både resultat og drøfting. Ferdigstille endelig prototype basert på både intervju og testing.

- Planlagte aktiviteter for neste periode

Rapportskriving. Ferdigstilling av prototype. Veiledningsmøte, samt å sende utkast av rapport til veiledere. Planlegger å være ferdig med rapporten innen 16. mai i uke 20.

- Oppdatert framdriftsplan

Ja.

Framdriftsrapport - Uke 18, 19 & 20

- Formålet med arbeidet i perioden

Ferdigstille metode-delen av rapporten. Planlegge veien videre for både resultat og drøfting. Ferdigstille endelig prototype basert på både intervju og testing.

- Planlagte aktiviteter i perioden

Rapportskriving. Ferdigstilling av prototype. Veiledningsmøte, samt å sende utkast av rapport til veiledere. Planlegger å være ferdig med rapporten innen 16. mai i uke 20.

- Faktisk gjennomførte aktiviteter i perioden

Prototypen ble ferdigstilt tidlig uke 18. Gjennomførte veiledningsmøte i uke 19. Har fullført rapporten, og får derfor brukt dagene etter 16. main til forberedelser av presentasjonen, som skjer 21. mai.

- Avvik og årsaker

Ingen avvik.

- Avvikshåndtering og endringer

Ingen avvik.

- Erfaringer fra perioden

Har brukt mye tid på å lese gjennom oppgaven, gjennomført de endringer og rettskriving som trengtes. Dette er en tidkrevende prosess man gjerne har en tendens til å undervurdere lengden på. Har tilegnet oss bedre erfaringer rundt større prosjekt og utforming av større rapporter.

- Oppdatert framdriftsplan

Ja.

C Meeting Reports

Møterapport 24.01.24

Deltagere

- Camilla G. Persen
- Jan-Erik Listou Ellefsen
- Øystein Bjelland

Mål

- Fortsette utformingen av oppgaven
- Få innspill til endringer og utvidelser av problemstillingen
- Eventuelle spørsmål rundt forprosjektrapport

Debattpunkter

Tidspunkt	**Element**	**Hvem**	**Notater**
20 min	Utforming av oppgaven	Alle	Vis punktene vi har satt opp, er det ok?
20 min	Forprosjektrapport	Alle	Vi har fått ført inn i riktig mal. Har Øystein sett på den og er den ok?
10 min	Mal for bacheloroppgave i overleaf	Alle	Finnes det en mal eller er den vi har brukt grei
10 min	Eventuelle spørsmål rundt bruken av wiki	Alle	Dobbeltsjekke at vi ikke blir tatt for plagiat for det vi skriver i wiki. Er den satt opp ok ift møter osv.
	Framdriftsplan		Syntes det er vanskelig å sette opp denne da mye av det vi gjør er litteratursøk og vi ikke vet helt hvordan oppgaven vil forme seg.

Møtereferat

Element	**Diskusjon**	**Konklusjon**
Utforming av oppgaven	1. Fordeler og ulemper 2. Utforming av skjermer	1. Menneskelig intuisjon og maskin presisjon 2. Støtte seg på litteratur, hva har andre funnet ut før 3. Som en trakt, starte brett og gå mer spesifikt utover, beskrivelse av ulike måter å utføre remote operations på generelt, velge en case

Element	Diskusjon	Konklusjon
	3. utforming av oppgave 4. skjermer 5. artikkel 6. anbefaling 7. 5 faser 8. generell fremgang 9. kontakt 10. kilder	etterhvert, hva fungerer i hvert tilfelle, hovedvekt på det vi utforsker, 4. Hva som vises, hvor de er plassert, det finnes måter å gi stimuli gjennom andre sanser enn syn - multimodal feedback, haptisk feedback - kan nevne at det finnes men mer enn nok med det andre, 5. Overvåke stressnivå for docking av skipskapteiner, samme problemstilling og hvordan man legger til rette for at operatøren skal gjøre det best mulig 6. Følge en metodik, show dont tell, focus on human values - empati for å forstå bruker og team, craft cearity - vær presis i formuleringer for beskrivelse av visjon, embrace experimentation - tørre å teste ut "ville" ideer uten å la seg begrense av andres erfaringer, be mindfull of process - være åpen før man fokuserer, bias towards action - om du står fast bare gjør noe for å komme videre, radical collaboration - samarbeid med folk fra forskjellige bakgrunner for å få nye synspunkter 7. Empathize - forstå, observere, møte, få en opplevelse av brukers opplevelse. define - etter at problemstillingen er forstått (2-4 uker) må man gå inn å definere hva man skal jobbe med, bestemme lars, kran eller gangbro, point of view rundt hva som er problemet og hvorfor det blir fokuser på, ideate - problemstillingen er definert, hva kan gjøres innenfor denne problemstillingen, divergere og konvergere, generere flere ideer enn de man skal bruke for så å kutte vekk de som ikke fungerer (grønn og rød sone, utforske og spisse inn), testing av prototyper med bruker, lag prototype og test for tilbakemelding (trenger ikke være koding, kan være for eksempel i powerpoint), 8. Litteraturstudie bør gi flere ideer til testing, radikale ideer mot faktisk utforming,

Element	Diskusjon	Konklusjon
		strukturert søk (definerer nøkkelord og får resultater ut fra det) eller snowballing (søker med spesifikke nøkkelord, finner artikkel og går videre via henvisninger og så videre), prøv å ha et tall på antall artikler (20-30), 9. Få kontakt med faktiske operatører, både på båt og remote 10. Software for kilder, zotero.
Forprosjektrapport	Generelt	Før inn det som er blitt snakket om på møtet
Overleaf/mal	Overleaf eller ikke	Bruk gjerne overleaf
Wiki	Ikke snakket om	Ikke snakket om
Framdriftsplan	Microsoft planner vs gantt	Microsoft planner fungerer fint

Møterapport 16.2.24

Deltakere

- Jan-Erik Listou Ellefsen
- Camilla G. Persen
- Ottar Osen, veileder NTNU
- Øystein Bjelland, veileder NTNU

Mål

- Innspill til problemstilling
- Tips til videre litteratursøk
- Framdriftsplan, utforming
- Generelle innspill fra veiledere

Debattpunkter

Tidspunkt	Element	Hvem	Notater
15 min	Problemstilling	Alle	• Er problemstillingen god nok? • Dekker problemstillingen hele problemområdet? • Bør/kan den omformuleres?
10 min	Litteratursøk	Alle	• Generelle tips til litteratursøk i tider det går sakte. • Hvor mye lengre bør vi drive litteratursøk? • Når bør vi si oss fornøyd, med tanke på antall kilder?
10 min	Framdriftsplan	Alle	• Anbefalt oppsett til framdriftsplan? • Kan den utformes så enkelt som i en tabell? • Om ikke, hvordan?
15 min	Innspill fra veiledere	Alle	• Veien videre? • Er vi kommet godt i gang?

Møtereferat

Element	Diskusjon	Konklusjon
Problemstilling	• Er problemstillingen god nok? • Dekker problemstillingen hele problemområdet? • Bør/kan den omformuleres?	• Fint utgangspunkt, men koke ned til noe mer konkret, for eksempel kommunikasjon eller hvordan informasjon skal framstilles. • De er kanskje allerede svart på, åpne spørsmål. Bør kunne kvantifiseres. • Forslag 2 er bedre enn forslag 1, to spørsmål som ikke henger for mye sammen.

Element	Diskusjon	Konklusjon
		• Kanskje heller stille spørsmål rundt forskjellen på hva som er og hva som bør være med tanke på remote eller ikke. Hva må og bør gjøres annerledes. • Hvordan formidle forskjellen på input man får om bord mot remote, lyd, bevegelse, vibrasjoner. Hvordan gi feedback for dette. • Forskjell på remote og on-site. • Kamera-view, hvor er det lurt å se operasjonen fra, skal man switche mellom view eller flere samtidig. • Kommunikasjon. • Plassering av skjermer. • Virtuell guiding. • Opplæring av operatører, hvordan lærer man seg å være en remote operator.
Litteratursøk	• Generelle tips til litteratursøk i tider det går sakte. • Hvor mye lengre bør vi drive litteratursøk? • Når bør vi si oss fornøyd, med tanke på antall kilder?	• Søk opp Kjetil Nordby, jobber med lignende og skal ha et samarbeid med NTNU. • Finn noen å snakke med i Seaonics, for eksempel montør/operatør for å få innspill i veien videre. • Kommunikasjon mellom operatør og de som er på skipet, for å få fram informasjon rundt bevegelse i skip osv. • Informasjon som kan gjøre det lettere og hjelpe operatør, naturkrefter som bør påvirker operatør.

Element	Diskusjon	Konklusjon
		• Visuelle ting man ser i virkeligheten, bør dette vises remote? • Det som skjer på skjerm er av større interesse enn det rundt, som hender, spaker osv. • Hva er interessant? Dykk inn i det fortest mulig. • Prat mer med de på Seaonics, som on-site operatører. God informasjon. • Arkitekt og designhøyskolen, Kjetil Nordby, interaksjonsdesign. Open remote, open zero, rapport. Sett inn i, for så å mulig få et møte. • Alsos Trondheim. Driver med det samme, men mest design av autonome ferger.
Framdriftsplan	• Anbefalt oppsett til framdriftsplan? • Kan den utformes så enkelt som i en tabell? • Om ikke, hvordan?	• Grei som overordnet, men del det opp i mindre prosesser og aktiviteter gjerne på maks 1 dags lengde. • Begynne tidligere med prototyping, gjerne samtidig med ideate.
Innspill fra veiledere	• Veien videre? • Er vi kommet godt i gang?	• Spisse problemstillingen mer. Vil gjøre det lettere å fortsette. • Se på differansen av remote vs on site. • Finn noe som kanskje mangler, kan være viktig informasjon. • Negative funn har verdi i at man da vet at det faktisk ikke fungerer. • Tom Jøran Giske, Seabreefe.

Møterapport 29.02.24

Deltakere

- Camilla G. Persen
- Jan-Erik Listou Ellefsen
- Øystein Bjelland
- Ottar Osen
- Stig Espeseth

Mål

- Få 'satt' problemstilling
- Få kontaktinfo fra Stig til noen på Seaonics vi kan spørre angående 'å forstå hvordan operasjonene fungerer on-site'.
- Få innspill på 'Brainstorming til innhold i oppgave' dokumentet vi har laget til.

Debattpunkter

Tidspunkt	**Element**	**Hvem**	**Notater**
10 min	Problemstilling	Alle	• Hva syntes dere om problemstillingene vi har laget? Utkast 1 og 2. • Kan vi ha en av de som endelige problemstillinger eller bør de modifiseres?
5 min	Kontaktinfo til noen på Seaonics	Stig, Camilla, Jan-Erik	• Vet Stig om noen på Seaonics vi kan kontakte for å få informasjon og forståelse av hvordan operasjonene fungerer on-site?
15 min	Innspill til brainstorming til innhold i oppgaven	Alle	• Ting som mangler? • Ting som må endres? • Ting som må fjernes?

Tidspunkt	Element	Hvem	Notater
15 min	Generell diskusjon	Alle	• Generelt

Møtereferat

Element	Diskusjon	Konklusjon
Problemstilling	• Hva syntes dere om problemstillingene vi har laget? Utkast 1 og 2. • Kan vi ha en av de som endelige problemstillinger eller bør de modifiseres?	• Ta utgangspunkt i at det finnes interaksjondesing idag som brukes on-site. Ser på hva som er utfordringene når det blir remote. Få det tydeligere fram i problemstillingen. Hvilke tiltak må gjøres? • Tenk at målet ikke er å minimere forskjellene, men å se på hva som vil virke remote og on-site. Hva 'mister' du når du går fra on-site til remote? • Kommentar fra Stig: Det kan bli utfordrende med forsinkelser fra skjerm til skjerm når operasjonene gjøres remote. Feks at man skal klare å se hvor og hvor mye kranen svaier og når man skal sette ned objektet. Husk at det er forskjeller på om man sitter remote på båt eller remote på land. • Problemstillingene er fortsatt for generelle. Se på forskjellen fra on-site til remote. Ikke bruk ord som 'optimalisere brukeropplevelsen'. Konkretiser problemstillingene. Kommentar fra 'brainstorming til innhold':

<table>
<tr><th>Element</th><th>Diskusjon</th><th>Konklusjon</th></tr>
<tr><td></td><td></td><td>Fjernoperasjoner:
Sikkerhetsaspekt. Drøft rundt dette med sikkerhet. maskiner skal stoppes så fort som mulig bla. Når man sitter remote får man ikke gjort dette på samme måte. Hvordan kan man løse det?
Fra Ottar: 'Minimum risk condition'. Handler også om dette med sikkerhet.
Hvordan får operatøren forståelse av at det er oppstått en kritisk situasjon? Hvordan får man info om det? Er du på on-site får du omfanget av dette tydelig fram. Hvordan skal man klare det samme når operatøren er remote?
Interaksjonsdesign:
På open bridge har de 4 moduser.
Tips: Sett opp en Teams samtale og se hvor mange skjermer man klarer å ha fokus på.
Dynamisk skjerm. Skal man kunne flytte på skjerm? Det kan være bra i noen tilfeller, men forvirrende i andre tilfeller.
Er det noe informasjon som bør overføres fra det ene systemet til LARS?
Se på flytårnoperasjoner. Der må forskjellige folk ha ansvar for ulike ting. Hvordan vet de at det jobber på det samme?</td></tr>
</table>

Element	**Diskusjon**	**Konklusjon**
Kontaktinfo til noen på Seaonics	• Vet Stig om noen på Seaonics vi kan kontakte for å få informasjon og forståelse av hvordan operasjonene fungerer on-site?	• Norvind i Brattvågen. • Erik for Ocean infinity
Generell diskusjon	• Generelt	• Kunne man gitt en visuell feedback på det? Se båtens bevegelse? Utfordring: Få den informasjonen til land i sanntid. Mulig delay i videostrøm Stig sa, 300-400 m/s. • På ocean infinity båtene til Seaonics sender de operasjonene 'steg for steg'. • Tips fra Stig: Let opp artikler om ROV-operasjoner, ting på mars(?). • De har tidligere hatt forced feedback i joystick. • Bok: Springer Handbook of Robotics

Møterapport 10.04.24

Deltakere

- Camilla G. Persen
- Jan-Erik Listou Ellefsen
- Ottar Osen

Mål

- Statusoppdatering for prosjektet
- Innspill til hva som kan endres og veien videre

Debattpunkter

Tidspunkt	**Element**	**Hvem**	**Notater**
15 min	Prototype	Alle	• La oss inspirere av prototyper hos Seaonics vs lage helt egne, upåvirkede forslag til prototyper basert bare på teori og kilder? • Prototypen blir nå basert på litteratur, intervju, eksperiment og videoer. Hva mer kan vi basere den på? • Interaksjonsdesignet til det som er knyttet til praksis blir naturlig å flette inn i bacheloren, da de er en del av hele interaksjonsdesignet. Er dette problematisk, da skillet mellom praksis og bachelor blir svakere?
15 min	Fokuseksperiment	Alle	• Forklare hvordan vi gjennomførte det samt tankene bak • Vise oppsett • Vise resultater • Er det tilstrekkelig med deltakere?
15 min	Intervju	Alle	• Vise intervju-spørsmålene • Hvordan kildeføre og henvise til svarene fra intervju
15 min	Generelt	Alle	• Hvordan referere til kunnskap som oppnås gjennom samtaler med ansatte hos Seaonics? • Hvordan referere til kunnskap som man allerede innehar/er åpenbar? Som for eksempel hva en on-site og remote operasjon er? Er det nødvendig å kildeføre dette? • Hvordan referere til en PDF uten utgiver, forfatter, dato osv (Design Thinking Method for eksempel)?

Møtereferat

Element	Diskusjon	Konklusjon
Prototype	• La oss inspirere av prototyper hos Seaonics vs lage helt egne, upåvirkede forslag til prototyper basert bare på teori og kilder? • Prototypen blir nå basert på litteratur, intervju, eksperiment og videoer. Hva mer kan vi basere den på? • Interaksjonsdesignet til det som er knyttet til praksis blir naturlig å flette inn i bacheloren, da de er en del av hele interaksjonsdesignet. Er dette problematisk, da skillet mellom praksis og bachelor blir svakere?	• foreslå gjerne 3-4 alternativ og drøft disse. en av disse kan gjerne være seaonics sin, og denne kan dere få input fra seaonics på. konklusjon kan baseres på argumentene for samtlige forslag. kan ende med en hybrid, trenger ikke ende på bare en. benytt gjerne seaonics angående deres prototype, for eksempel intervju. hør gjerne med seaonics om de andre alternativene også. en løsning er ikke nødvendigvis bedre enn en annen, drøftingen som betyr noe. drøfting og diskusjon. vis at det foregår tankevirksomhet. forklar hvorfor man gjør som man gjør. det som er interessant er veien til mål, ikke hva man har fått til. • Kjetil Nordby, professor arkitekt og design høyskolen, design utforming. ressurser i trondheim, Alsos - arkitekt og desing i trondheim - autonome ferger. stikkord + lett forklaring på utforming, typ powerpoint, planlegg spørsmål. Kan bruke samtaler som kilder og benyttes i konklusjon og drøfting - personlig kommunikasjon (dato, sted og tid). • Draw.io - kan benyttes til prototype, stort bibliotek. Grad av teknikk for prototypen avhenger av hva vi er på jakt etter i oppgaven, hva vi vil oppnå. Mock up er mer enn godt nok som ende-resultat. cdp studio annet eksempel. • Praksis + bachelor går fint, men må skille det når man skriver rapportene. Bachelor-arbeid tilhører bachelor, praksis-arbeid tilhører praksis. Det som er gjort i praksis kan refereres til i bacheloren, og motsatt. Referer til

Element	Diskusjon	Konklusjon
		rapporten fra praksisen og poenger at den ikke er publisert ennå, kan legges ved som vedlegg.
Fokuseksperiment	• Forklare hvordan vi gjennomførte det samt tankene bak • Vise oppsett • Vise resultater • Er det tilstrekkelig med deltakere?	• Fint • Forklar antall, vær forsiktig å trekke bastante konklusjoner, men vis til at det var en tydelig trend. Gode muligheter til å gjennomføre flere og utvide. Tilstrekkelig resultat for å benytte i drøfting. unngå "vår forskning", vær ydmyk og vis til hva som er gjort og hvordan det ble gjennomført.
Intervju	• Vise intervju-spørsmålene • Hvordan kildeføre og henvise til svarene fra intervju	• Spør bibliotekaren angående kildeføring, henvisning og om dette skal legges ved som vedlegg. Kan høre med Hans Georg, som har tidligere gjort lignende oppgaver.
Generelt	• Hvordan referere til kunnskap som oppnås gjennom samtaler med ansatte hos Seaonics? • Hvordan referere til kunnskap som man allerede innehar/er åpenbar? Som for eksempel hva en on-site og remote operasjon er? Er det nødvendig å kildeføre dette? • Hvordan referere til en PDF uten utgiver, forfatter, dato osv (Design Thinking Method for eksempel)?	• Personlig kommunikasjon (dato, sted, tid). • Forskjellen mellom lokal og remote er det som er av interesse her, ikke interaksjons designet på egenhånd. ○ "Det blir ikke det samme å jobbe remote som lokalt. Man får en helt annen tilknytting til settingen lokalt. På et kontor langt unna er det mye informasjon man ikke får med seg som lokalt. Mye man ikke kan kompensere for. Med remote er man mer en overvåker, man er da kanskje mer opptatt av å oppdage avvik og kanskje stoppe situasjoner før det går alarm" - Ottar. • kunnskap via seaonics - personlig kommunikasjon som kilder. men da må vi vite dato og tid osv. Bør

Element	Diskusjon	Konklusjon
		ha en drøfting av prosessen, skriv litt om hvordan prosessen har vært mens vi jobber, der kan dere skrive hvordan kontakten med seaonics har vært og si litt hva dere har lært og hvilken dypere kunnskap dere har fått. • Enkle begrep kan skrives i terminologi med kort beskrivelse. Innledningen er også en god plass å forklare. Miriam webster, SNL. Forklar hvordan terminologien fungerer for Seaonics, hva som menes med de forskjellige terminologiene i seaonics sin setting. "Det kan for eksempel være". Forklar at noe er allmenngyldig, men i vårt arbeid er det koblet opp mot A og B osv. Hva er spesielt for vår oppgave når det gjelder allmennkunnskap. Forklar hvorfor noe er viktig for å dra inn leseren slik at de forstår. Snakk om det som ligger bak, motivasjon osv, som innledning. Forklar verdien i oppgava før det diskuteres rundt hva for eksempel remote er og hva det koker ned til med LARS osv. Konkretiser til slutt. Gi en "muntlig" beskrivelse av en remote operasjon, beskriv settingen, gi et eksempel. Skriv slik at til og med bestemor kan forstå introduksjon og begynnelse for hvert kapittel + konklusjon. Viktig å skrive rapporten slik at konteksten er klar for alle, ikke bare oss selv, sensor og seaonics. • Spør Øystein angående hvordan referere til og føre kilde av PDF for Desgin thinking method, finner ikke denne på nett.

Møterapport 25.04.24

Deltakere

- Jan-Erik Listou Ellefsen
- Camilla G. Persen
- Øystein Bjelland

Mål

- Gjennomgang av prototypetest
- Videre arbeid
- Generelt

Debattpunkter

Tidspunkt	Element	Hvem	Notater
20 min	Gjennomgang av prototypetest	Alle	• Forklare gjennomføring • Vise oppsett • Gå gjennom resultat • Tanker rundt videre prototype
20 min	Videre arbeid	Alle	• Sende utkast av oppgaven etter at metode og teori er ferdig, eller vente til resultat også er på plass?
10 min	Generelt	Alle	• Åpen diskusjon

Møtereferat

Element	Diskusjon	Konklusjon
Gjennomgang av prototypetest	• Forklare gjennomføring • Vise oppsett • Gå gjennom resultat • Tanker rundt videre prototype	Enklere å ha alt på samme flata. Tenke på at de som bruker briller må ha ulik styrke for skjermer nærme og fra hverandre. Dette spesielt på prototype 1. Tenker også at vi ikke trenger reverse kamera. Antallet testpersoner er greit. Lag heller en ny prototype og få tilbakemeldinger på denne. **Visualisering i Excel.** Prøv å visualiser en score per prototype.

Element	Diskusjon	Konklusjon
		Sammenlikning til biler: Mer og mer skjer på en stor skjerm. Man står friere til å velge hva som vises, kontra hvis man har flere små skjermer. Trenden er å dele opp en stor skjerm slik at man har mer fleksibilitet. Overlay? Får opp et bilde over det du ser? Feks speedometer over overvåkningskamera. Har man all teknisk info på stor skjerm er det vanskelig å trykke seg inn på ting. Man kan vurdere å ha den infoen både på stor skjerm og på Pad ved siden av.
Videre arbeid	• Sende utkast av oppgaven etter at metode og teori er ferdig, eller vente til resultat også er på plass?	**Prototype.** Ta med oss det vi har lært, lage en ny prototype og få tilbakemeldinger på denne. I den siste prototypen vi presenterer skal alle detaljer være på plass. Prøve å få det demonstrert i simulator på Seaonics. Størrelse og oppsett må være slik det faktisk er tenkt. Vi sender teori og metode til tirsdag morgen.
Generelt	• Åpen diskusjon	Møte neste torsdag. Få med Ottar.

Møterapport 30.04.24

Deltakere

- Jan-Erik Listou Ellefsen
- Camilla G. Persen
- Ottar Osen, på teams
- Øystein Bjelland

Mål

- Oppdatere Ottar på gjennomført prototypetest
- Tilbakemelding på utkast av oppgaven
- Generelt

Debattpunkter

Tidspunkt	Element	Hvem	Notater
10 min	Rask oppdatering for Ottar av gjennomført prototypetest	Alle	• Presentere prototypene • Presentere gjennomgang • Presentere resultat
20 min	Tilbakemelding på utkast av oppgaven	Alle	• Hva kan bli gjort bedre? • Hva kan bli gjort annerledes? • Noe som bør legges til/fjernes?
20 min	Generelt	Alle	• Referere til praksis, gjelder bare et bilde. Holder det å forklare at dette bildet kommer fra praksis eller må praksisperiode og rapport refereres? • Referering av intervju, som tidligere fortalt med navn, sted og tid, eller nok å referere til intervjuene i appendix?

Møtereferat

Element	Diskusjon	Konklusjon
Rask oppdatering for Ottar av gjennomført prototypetest	• Presentere prototypene • Presentere gjennomgang • Presentere resultat	• Sender på mail.
Tilbakemelding på utkast av oppgaven	• Hva kan bli gjort bedre? • Hva kan bli gjort annerledes? • Noe som bør legges til/fjernes?	• generell kommentar er at det er veldig mange ord. dere sier veldig me. jobbe mer med å være konsis. til prototype blir det veldig bra. teori er mye bra. noe vi ikke trenger å ha så mye av. teori skal ta for seg det leser må kunne for å forstå resten av rapporten. henviser mye tilbake til teori i metode, dette er bra. når det kommer til dette med litteratursøk og snowballing, trenger ikke beskrive hvordan dette gjøres.måtte lese mye før man kommer til hva som er gjort og bygd, det er mye å lese. forklar hva som gjøre

Element	Diskusjon	Konklusjon
		kortere. lengden gjør at poenget blir litt uklart. • dropp unødvendige underoverskrifter. skriv alt kortest mulig, flere subsections gjør at alt blir lenger. SENSES • flytt og flett sammen literaturstudie fra teori inn i metode. • brainstorming kan gå inn under ideat. kortere, en setning eller to. • reasearch prosess er i utgangspunktet unødvendig, flytt til metode om dette er noe dere vil ha med. ikke la det ta mye plass, delvis unødvendig og dobbelt opp med design thinking method. • bastante utsagn må kildeføres direkte i utsagnet. • intervju og undersøkelse, skriv alt under metode. henvis gjerne til kilder, men trenger ikke være eget avsnitt under teori. • Project organisation kan kortes ned, er ment som en kort beskrivelse. • Progress plan, trenger ikke fortelle om små forandringer som dette, det holder å beskrive den endelige planen. beskriv endelig plan kort og konsist. • Kan droppe eller flytte til vedlegg punktene fra framdriftsrapport. • Meetings og timeliste trenger ikke egne subsections. skriv kortere. • Software - beskriv heller prosessen og når de forskjellige softwarene blir benyttet og der de hører hjemme. liste med all software gi en mindre oversiktlig oversikt over når de benyttes. confluence og teams, prosjekt organisering. PP draw goodnotes, skisser. ChatGPT holder i KI-erklæringen.

Element	Diskusjon	Konklusjon
		• Hold komplisert-nivå for synonym litt mer nede, elucidate for eksempel. • DTM i metode er hoved-delen. Flett inn flere bilder. Emphatize, Screenshots fra Youtube crane story for eksempel. • Ikke snakk om Seaonics som en person, skriv om slike setninger. • Leseren må føle at det er en historie som er interessant å følge, få leseren på kroken tidligst og fortest mulig. • Behold DTM i metode slik det er, men kan slå sammen metode og resultat for prototype. Resultat-kapitlet kan være bare resultatet fra den endelige prototypen. • Fokuseksperiment og Setup-test kan bestå av hver sin metode og resultat-del. • Literaturstudie i metode må komme tidligere, gjerne i starten. • Få med keywords fra literatursøket. • Spesifiser hvilken teori som benyttes i metode. • Lag en oversikt over de forskjellige metodene som benyttes, gjerne i introduksjon. Bruk gjerne figur.
Generelt	• Referere til praksis, gjelder bare et bilde. Holder det å forklare at dette bildet kommer fra praksis eller må praksisperiode og rapport refereres? • Referering av intervju, som tidligere fortalt med navn, sted og tid, eller nok å referere til	• skriv på figuren og legg rapport som kilde.

Element	Diskusjon	Konklusjon
	intervjuene i appendix?	

Møterapport 08.05.24

Deltakere

- Camilla G. Persen
- Jan-Erik Listou Ellefsen
- Øystein Bjelland
- Ottar Osen

Mål

- Gjennomgang av omstrukturering av rapport

Debattpunkter

Tidspunkt	Element	Hvem	Notater
20 min	Gjennomgang av omstrukturering av rapport	Alle	• Gå gjennom omstrukturering av rapport og få tilbakemeldinger på eventuelle forbedringer. ○ Hvor skal vi svare på problemstillingen? Bare i drøfting eller nevne det i prototype 5 også?
5 min	Kildeføring praksis	Alle	• Har vi kildeført praksisarbeid riktig?
15 min	Generelt	Alle	• Generelle spørsmål og innspill ○ Presentasjon 21.mai

Møtereferat

Element	Diskusjon	Konklusjon
Gjennomgang av omstrukturering av rapport	• Gå gjennom omstrukturering av rapport og få tilbakemeldinger på	• Bra med omstruktureringen, god ide å fravike fra mal om det forklares godt. • Bør drøfte og analysere intervju i The Process og ta det opp igjen i endelig diskusjon. Leser bør

Element	Diskusjon	Konklusjon
	eventuelle forbedringer. ◦ Hvor skal vi svare på problemstillingen? Bare i drøfting eller nevne det i prototype 5 også?	forstå hva som læres gjennom prosessen og ikke bare i endelig diskusjon og konklusjon. Detaljert analyse bør komme tidligere, i nærheten av hvor intervjuet beskrives. Del Interview i for eksempel plan (forberedelse), oppsummering av hva som blir sagt, og så en analyse. Knytt det gjerne opp mot teori fra tidligere, da kan dere vise at teori kan knyttes til faktisk og at vi har forstått situasjonen og problemet. Får bedre fram budskapet, og man kan gjenta det som er viktige resultat. • Legg til en analyse og drøfting i The Process for hver del, og bruk Discusion til en samlende kapittel for analyse og drøfting. • Veien videre, future work. For eksempel intervju, kvalitativ - senere kunne man ha kjørt i en større skala, kvantitativt, kan dette gi bedre resultat? Kvalitativt kan føre til bias, som kan gjøre resultatene ikke-representative. Future work kan være siste del av Diskusjons, bedre å ha det i diskusjon enn konklusjon. • Bruk både forsknins-briller i tillegg til Seaonics-briller. Ikke tenk bare Seaonics for veien videre. Kan være at oppgaven kan gi arbeid videre for andre senere. • Problemstilling - summen av arbeidet skal svare på denne. Samle trådene fra alle prosessene for å svare på problemstillingene. Gjør det i Diskusjon. • Se over Ottars tips på rapportskriving på Blackboard. Begynn med en god kontekst-beskrivelse. Nesten alle har en tendens til å overvurdere lesers evne til å forstå hvorfor, skriv slik at bestemor forstår. Hva har vi holdt på med og hvorfor er det viktig? Begynn i det store "2/3 av planeten er hav..." - "man skal gå fra å være ombord til å være på land". Se det fra månen, det kan virke enkelt, dumt og banalt, men tenk at man står langt unna og zoomer inn helt til man er nede på oppgaven, da er ingen i tvil om hvorfor arbeidet utføres. Poengene forsvinner om kontekst ikke forklares godt. Ha en introduksjon for hvert kapittel som forteller hva som kommer, bestemor skal kunne lese introduksjon og konklusjon og forstå oppgaven uten å nødvendigvis forstå det tekniske. • Kommenter og diskuter alltid figurer, "legg spesielt merke til..". Hjelp leser å forstå.

Element	Diskusjon	Konklusjon
Kildeføring praksis	• Har vi kildeført praksisarbeid riktig?	• Det holder i bøtte og span, det er egentlig mer enn dere trenger. Det holder med å cite og nevne NOT YET PUBLISHED i føring av kilder.
Generelt	• Generelle spørsmål og innspill ○ Presentasjon 21.mai	• Står på Blackboard. Gjør introduksjon live. Bruk gjerne en video for å formidle oppgaven. Avslutt med Q&A. • Kan bruke videoer fra YouTube eller ressurser og videoer fra Seaonics for å gi en situasjonsforståelse i presentasjon. • Kan enten klippe alt til en lang video eller legge hver videosnutt i en PP. • Norsk eller engelsk, det velger vi selv. • Alt dere har produsert, anse det som en slags innhold i en portefølje som kan vise erfaring. Så når dere skal søke jobb for eksempel så har dere materiell fra bachelor dere kan vise til osv. poster, rapport, video osv. Video er ikke så vanlig, så derfor enda bedre å ta med i en slik setting. • Diskusjon er det viktigste kapitlet, gjør det grundig. Utrolig viktig del. Det er her vi viser egen forståelse. Alle kan lese opp teori osv og alle kan lage eksperiment osv. Det er når man analyserer og diskuterer kandidaten viser forståelse fra hva man har holdt på med. Dårlig følelse og undervurdering av seg selv er vanlig, men det vi kommer med er noe helt nytt som ingen andre har kommet med før. Lett å overse hva man har gjort for å komme i mål. Må ikke glemme alle stegene man har gjort gjennom hele arbeidet. • Finn gjerne bedre kilder enn SNL, Merrian-Webster osv. "Bedre" referanser framstår bedre. Sensor kan ofte gå gjennom referanser før man leser gjennom rapporten, for å se på styrken til referansene.

D Time Sheet

Timeliste

Dato	Camilla	Jan-Erik	Aktivitet	Kommentar
10/1	02:00	02:00	Oppstartsmøte	
Uke 2	**02:00**	**02:00**		
16/1	03:00	03:00	Møte med Seaonics	Første møte, gjennomgang av oppgaven
18/1	06:00	06:00	Oppstarts-aktiviteter	Generelle oppstarts-aktiviteter, oppretting av dokument, timeliste, osv.
19/1	05:00	05:00	Oppstarts-aktiviteter	Opprettet wiki, ferdigstilt forprosjektrapport og sendt den til veileder
Uke 3	**14:00**	**14:00**		
24/1	07:00	07:00	Møte med veileder og planlegging	Generelle spørsmål rundt oppstart av oppgaven og administrativt arbeid. Planlegging av videre oppstartsfase.
25/1	08:00	08:00	Litteratursøk	Generelt litteratursøk + utforming av problemstilling og oppstarts-aktiviteter
26/1	07:00	07:00	Litteratursøk	Generelt litteratursøk
Uke 4	**22:00**	**22:00**		
31/1	07:30	07:00	Litteratursøk	Lesing av aktuelle artikler og søk av nye artikler.
1/2	07:30	07:30	Litteratursøk + intoduksjon hos Seaonics	Lesing av aktuelle artikler og søk av nye artikler, samt første arbeidsdag hos Seaonics.
Uke 5	**15:00**	**14:30**		
8/2	07:30	07:30	Litteratursøk	Lese gjennom og finne flere kilder
9/2	07:00	07:30	Litteratursøk	Lese gjennom og finne flere kilder
Uke 6	**14:30**	**15:00**		
14/2	08:00	08:00	Litteratursøk	Lese gjennom og finne flere kilder
16/2	07:00	07:00	Veiledningsmøte og litteratursøk	Veiledningsmøte med Ottar Osen og Øystein Bjelland og fortsettelse på litteratursøk
17/2	09:00	09:00	Lest ressurser hos Seaonics og utforming av problemstilling	Alle dokumenter og ressurser mottatt av Seaonics er gått gjennom, og undersøkt hva som er relevant. Utformet to forslag på problemstilling.
Uke 7	**24:00**	**24:00**		
22/2	07:00	07:00	Tilspissing av litteratursøk	Tilspisset fokuset i arbeidet, for å finner fokusområder for oppgaven. Har arbeidet med brainstorming rundt innhold, samt omformulering av problemstilling.
25/2	08:00	08:00	Litteratursøk	Videre arbeid med litteratursøk.
Uke 8	**15:00**	**15:00**		

1/3	07:00	07:00	Veiledningsmøte og litteratursøk	Forberedelse, gjennomføring og etter-arbeid. Møtet ble gjennomført hos Seaonics, med Ottar, Øystein og Stig. Fortsettelse på litteratursøk og arbeid med problemstilling
3/3	08:00	08:00	Rapport	Rapport-arbeid
Uke 9	**15:00**	**15:00**		
Uke 10	-	-	Eksamen	Eksamen
Uke 11	-	-	Eksamen	Eksamen
19/3	08:30	08:30	Presentasjon og rapport	Elevator-pitch, forberedelse. Rapport arbeid.
21/3	08:00	08:00	Presentasjon og rapport	Elevator-pitch, presentasjon. Rapport arbeid.
Uke 12	**16:30**	**16:30**		
Uke 13	-	-	Påske	Påske
2/4	09:30	10:00	Intervju	Funnet nødvendig teori for intervju-prosessen, tenkt ut og forberedt utforming av intervju, og skrevet teorien inn i rapporten.
3/4	08:00	08:00	Undersøkelse av kilder	Springer Handbook of Robotics
4/4	13:00	12:00	Div	Forberedelse til intervju. Planlegging av veiledningsmøte. Rapport-arbeid.
6/4	09:00	10:00	Div	Fokus eksperiment. Rapport-arbeid.
7/4	08:00	08:00	Rapport	Fortsettelse på fokuseksperiment i rapport.
Uke 14	**47:30**	**48:00**		
8/4	03:30	03:30	Div	Forberedt spørsmål til intervju. Videre arbeide med rapport. Brainstorming til prototype. Forberedelse til veiledningsmøte.
9/4	12:00	12:00	Prototype	Fortsatt arbeidet fra igår med prototype. Sett div YouTube videoer om remote operasjoner. Mye refleksjon rundt hvordan prototypen kan se ut. Startet på et forslag til prototype.
10/4	11:00	10:30	Prototype og veiledningsmøte	Fortsatt mer på arbeidet med prototype. Forberedt til veiledningsmøte og gjennomført dette, samt skrevet referat.
11/4	08:30	08:30	Rapport	Videre arbeid med å føre inn teori, terminologi og kildeføring
13/4	07:30		Rapport	Skrevet ferdig design thinking metode på teori.
14/4	08:30	08:30	Rapport	Videre rapport arbeid.
Uke 15	**51:00**	**43:00**		
15/4	10:00	10:00	Rapport	Skrevet ferdig teori. Begynt på metode for design thinking og fokuseksperiment.
17/4	08:00	08:00	Rapport	Skrevet ferdig metode-delen til fokuseksperimentet.
18/4	09:30	09:30	Rapport	Skrevet ferdig define og ideate på design thinking method i metodedel. Oppdateringssamtale med Øystein Bjelland.
20/4	08:30	08:30	Prototype	Jobbet med forslag på tre ulike prototyper. Laget dagsplan for neste uke.
21/4		08:00	Rapport	Videre arbeid med rapport.
Uke 16	**36:00**	**44:00**		
22/4	12:00	10:00	Prototype og forberedelse testing	Laget ferdig teknisk info skjermer til prototypene. Laget spørsmål til testpersoner. Forberedt til testing.
24/4	12:00	11:30	Testing av prototype	Gjennomførte testing av prototyper.
25/4	08:00	07:30	Rapport	Skrevet ferdig litteraturstudie, intervju og samtale i metode. Videre arbeid med Design Thinking Method i metode.
27/4	05:30	05:30	Rapport	Videre arbeid for å fullføre Metode. Innkalling og planlegging av neste veiledningsmøte, 30/4.
28/4	09:00	09:00	Rapport	Skrevet videre på Metode, prototype.
Uke 17	**46:30**	**43:30**		
29/4	09:30	09:30	Rapport	Lest over og rettet teori og metode.
30/4	07:30	07:00	Rapport og veiledningsmøte	Skrevet videre på prototype i metode. Skrevet ferdig prosjekt organisering og innledning på DTM.
1/5	10:30	09:00	Rapport	Omstrukturert rapport etter konklusjon fra forrige veiledningsmøte. Skrevet ferdig på teknisk info Prototype 1-4 i metode. Begynt arbeid med prototype 5, endring av teknisk info skjermer.
2/5	08:00	08:30	Rapport	Omstrukturert metode på Prototype teknisk info, skrevet på resultat Prototype teknisk info. Flettet inn teori inn i The Process for literaturstudie, fokuseksperiment og intervju. Skrev resultat for disse + resultat for Prototype 1-4 screen setup og Testing the Prototypes.
3/5	08:00	07:30	Rapport	Gjort ferdig hele metode og resultat.
Uke 18	**43:30**	**41:30**		
6/5	SYK	06:30	Rapport	Forberedt innhold og seksjoner i The Final Prototype. Satt inn bilder fra Prototype Testing i metode. Utarbeidet Technical Information Screen og Screen Setup for siste prototype.
7/5	09:00	09:00	Rapport	Skrevet videre på The Final Prototype.
8/5	12:00	12:30	Rapport og veiledningsmøte	Skrev videre på The Final Prototype. Skrev analyse og drøfting for hver steg i The Process, etter tips fra veiledningsmøtet.
9/5	08:00	07:30	Rapport og poster	Lest gjennom kapittel 4, The Final Prototype. Skrevet ferdig diskusjon i Kapittel 3 og lest gjennom. Laget Poster til presentasjon. Planlagt diskusjonskapittlet.
10/5	11:30	10:30	Rapport	Videre arbeid med Discussion.
11/5	10:00	10:00	Rapport	Skrevet videre på Discussion, Problem Statement og Future Work. Ferdig med 1. utkast av diskusjons kapitlet.
Uke 19	**50:30**	**56:00**		
13/5	10:30	09:00	Rapport	Skrevet ferdig det siste som gjensto, skrev ut rapport for gjennomlesing.
14/5	11:00	08:00	Rapport	Lest gjennom og gjort endringer, til og med 3.4.
15/5	10:30	10:30	Rapport	Fortsatt arbeidet fra i går.
16/5	09:30	09:30	Rapport	Har ferdigstilt oppgaven. Mangler bare litt på appendices.
19/5	12:00	12:00	Rapport	Lest gjennom oppgaven og gjort nødvendige endringer.
Uke 20	**53:30**	**49:00**		
20/5	12:00	12:00	Presentasjon	Forberedelse og innspilling av presentasjon
TOTALT	466,5	463		

Totalt:

466,5 / 463

E Original Technical Information Screen

F Interviews

Intervju 1

Hva er forskjellene mellom operasjoner som gjennomføres on-site og remote, hvilken informasjon vil man miste fra on-site til remote og hvordan kan dette tapet av informasjon påvirke operatøren?

- Hvordan blir dere som teknisk støtte på land påvirket av hvorvidt operasjonene utføres on-site eller remote?

For noen som er om bord i en båt så er det mer mulighet til å se hva som skjer. Kan gå og måle på ting, ikke så avhengig av å stole på sensorer som kan måle feil. Viktig at de har mye kameraer og ikke bare ser sensorene.

- Hvilken teknisk informasjon tenker du er viktig å videreføre fra on-site til remote operasjoner?
    - Er det teknisk informasjon som ikke er viktig on-site som kan være viktig remote?

Det visuelle. Hvis du er on-sight og sitter i et operatørrom er du like 'blind' som hvis du sitter remote. Det er viktig med nok kamerear så man ser last osv. Lyd er viktig når man sitter on-sight, men vanskelig å overføre remote. Dersom du sitter on-sight vil du alltid høre det som skjer på båten, feks at ting faktisk kjører og flytter på seg.

- Dersom operasjonene gjøres remote, tror du det er nødvendig og hjelpende å ha en fast person på fartøyet som kan hjelpe til å videreformidle viktig informasjon?

Kontakt gjennom skipet. En 'fast' person.

- Tror du det er noen fysiske faktorer som er viktige å overføre og få med når man skal flytte en operasjon fra on-site til remote?

Vær og vind.

Det er sensorer for slikt, men det er ikke alltid lett å se hva som skjer ved det. Det er ikke alltid så lett å forstå hva sensorene betyr i praksis. Kamerabilde kan være viktig for dette.

- Hvilke fordeler ser du ved å utføre operasjonene on-site?

Lyd, vær, vind. Så lenge man sitter slik at man ser operasjonen vil det 'alltid' være bedre enn å se ting gjennom kamera. Hvis man får gode kamerabilder kan det være like bra som on-sight. På gangbro feks, så er det viktig å ha kamera nært tuppen på broa.

- Hvilke ulemper ser du ved å utføre operasjonene on-site?

Krever mye mannskap. Kan bli mye venting for mannskapet. Det sosiale kan bli utfordrende dersom det er lite å gjøre. Mye venting mellom hver operasjon. Gangvei kan bli brukt hver dag, kraner kan gå flere dager mellom hver gang de blir brukt.

- Hvilke fordeler ser du ved å utføre operasjonene remote?

Den sosiale biten. Man kan leve et mer normalt liv. Bedre tilgang på et utvalg av de folkene man trenger. Avhengig av gode sensorer og overvåkning av ting. De som lager systemet vil få logging av sensordata. Det er ikke så viktig hvis man gjør operasjonen lokalt, men dette kan bli nyttig når operasjonen gjøres remote.

- Hvilke ulemper ser du ved å utføre operasjonene remote?

Utfordrende å få et godt bilde av hva som skjer, et godt kamerabilde. Internett er ikke alltid ideel. Utfordrende å få god nettforbindelse og kommunikasjon. Hvis man mister nettverksforbindelsen, må systemet klare seg uten for en periode. Avhengig av å ha mer automatiserte system. Må regne med noen sekunders forsinkelse. I beste fall er det bare noen millisekunders forsinkelse, men det kan være opp til flere sekunder forsinkelse.

- Hvordan informasjon tenker du er viktig å få med i en LARS operasjon kontra andre operasjoner?

Hvis du mister forbindelse har du noe som henger under båten som kan være vanskelig å få den inn igjen. I enkelte tilfeller må ROV roteres i en spesiell retning for å få plass gjennom Moon Pool. Fordel å se hva man gjør når man skal ha en stor ROV gjennom Moon Pool.

Se hvordan vinkel ROV kommer i når den skal kjøres gjennom Mool Pool. Det er vanskelig å måle når du sitter remote. QR-kode rundt Moon Pool er til for å måle vinkel. Mulig å snu ROV til vinkelen eller så vil den rotere seg til vinkelen.

- Avsluttende utfylling

Intervju 2

- Hvordan blir dere som teknisk støtte på land påvirket av hvorvidt operasjonene utføres on-site eller remote?

En del av feilsøking er lettere å gjennomføre lokalt enn remote. Da kan man utelukke ting på sensorsiden, koble den fra osv, eliminerings-metode for feilretting. Lettere å finne feil med fysisk tilgang. Klarer kun feilsøking gjennom logger og gjennom utleste verdier fra kontrollsystem ved remote. Tar en andel av casene, men for å fastslå hvor feilen kom fra kan man måtte koble fra og måle osv. En del feilsøking er vanskelig/får ikke dekket ved remote. On-site er på denne måten lettere. Men ikke stor nok grunnlag til å holde på lokalt og ikke gå over til remote. Remote kan man få hjelp av lokalt crew, skeleton crew – minimums crew som har mange roller hvor jobben er å holde skipet i drift og folk på land gir kommando, de agerer på initiativ fra de på land. Ocean Infitity har 12 mann ombord, hvor noen styrer båten mens resten drifter skipet.

Bruker lenger tid på å finne feil uten direkte tilgang ved remote. Vil ha behov for en "forlenget arm" for å få det operativt.

- Hvilken teknisk informasjon tenker du er viktig å videreføre fra on-site til remote operasjoner?
    - Er det teknisk informasjon som ikke er viktig on-site som kan være viktig remote?

Remote er man avskåret fra situasjonsforståelsen for skipet. Situasjonsforståelse på båten, situasjonsforståelse for utstyret. Operasjonsforståelse. Situasjonsforståelse - vær vind bølger, hva skjer osv. Utstyr – virker alt, hva er status, noen feil i systemet? Operasjon – hva holder skipet på med, skal den følge en bane på sjøen for å inspisere osv, ligger den stasjonært i ro og observerer. Båt, utstyr og vær vil gi en lignende forståelse på land. "Helse-tilstand" på utstyret, virker del-system 1-3 osv. "vinsjen er i orden, men har et problem med docking" - informasjon man kan gå dypere på.

Load Cases er viktig on-site, litt mindre viktig remote men fortsatt av stor viktighet for situasjonsforståelse. Vær og vind fører til mer forbruk gjennom for eksempel bevegelses-kompensering.

- Dersom operasjonene gjøres remote, tror du det er nødvendig og hjelpende å ha en fast person på fartøyet som kan hjelpe til å videreformidle viktig informasjon?

Ja, det må være en definert chain of command, det må aldri være tvil om det er de på land eller de på skip som bestemmer. Da blir det et forutsigbart resultat når man har en definert rekkefølge på ordrer. En fast person? Mer en regel man ivaretar sikkerheten til skipet og de rundt. En definert cain of command, gjennom flytskjema for eksempel. Før de får lov å bruke skipssystem må det gis klarsignal fra båt (marint crew) at alt er ok og at utstyret (teknisk crew) er ok.

- Tror du det er noen fysiske faktorer som er viktige å overføre og få med når man skal flytte en operasjon fra on-site til remote?

Det er delte meininger rundt dette. Man må ha et minimum visuell feedback på vær. Folk mener en audio-visuell overføring er bra, med en mikrofon som plukker opp lyd. Taktil informasjon, hvor man tar opp lyder og gjenskaper disse i remote-stolene, typ surround lyd og vibrasjoner. Man kjenner det når det smeller osv on-site, dette blir man fra-skåret fra på land. Mange mener at dette kan være lurt. Filosofi-basert. Det viktigste er å finne mekanismer hvor man får best mulig situasjonsforståelse. Har man det ikke via audio må det komme gjennom styresystem eller prosedyre, men man må ha en forståelse for at ting er trygt og at man ikke setter andre i fare. Feedback i joy-stick. Hvordan kommunisere stress og påføring. Tyngre last oppfører seg annerledes enn lett last. Det er innebygd i lokalt. Klarer man ikke overføre det, må man ha styringsalgoritmer, da kan man overleve med litt mindre informasjon. Seaonics har bare visuell fra kamera og fra styresystem ved alarmer og grafisk grensesnitt. De syns dette fungerer greit så langt, ser at det er forskjellige ting som bør implementeres ting som går på vær og bevegelse av båt. LARS er det som kjøres fra remote. Har kunder som ønsker kran, men det er mye farligere og vanskeligere produkt hvor man må virkelig tenke gjennom ting som sikkerhet.

- Hvilke fordeler ser du ved å utføre operasjonene on-site?

Situasjonsforståelse. Man kan bruke alle sansene hele tiden gjennom operasjonene. Man vet mer som man blir avskåret fra remote. Om det lukter svidd, man forstår situasjoner mye bedre. Raskere respons om noe skulle skje.

- Hvilke ulemper ser du ved å utføre operasjonene on-site?

Tøffere arbeidsmiljø. Kroppen er mer i bevegelse, man får mer utsatt for vibrasjoner, støy, sosialt, man får små omgangskretser, 6 uker gir institusjons-preg, lite input fra verden rundt deg. Mer eksponert for arbeidsrelaterte skader og ulykker.

- Hvilke fordeler ser du ved å utføre operasjonene remote?

Fordel med remote er man har lavere miljøfotavtrykk på marine operasjoner. En båt med 60 personer har gjerne to crew som rullerer, kanskje til og med tre. Miljøavtrykket synker. En stor andel av båten blir brukt til støttesystem for å ha mennesker ombord, treningsrom, luft og messer. Bruker en stor andel av båten til dette, som ikke har noe mer operasjonen p gjøre. Kan bygge båtene mindre som bruker mindre energi med mindre folk ombord. Operasjonskost og miljøavtrykk er de store fordelene med remote.

Work-life balanse, man kan gå på jobb og kommer hjem til middag. På lang sikt er det mange sjømenn som faller av midt i livet, det er ikke så gøy å være bort i seks uker i svingen.

- Hvilke ulemper ser du ved å utføre operasjonene remote?

Kan gå utover sikkerhet med færre ombord i båtene. ER mer krevende å få et fjern-opererte system like sikkert som en fullbemannet båt. Reaksjonstiden er mye mindre med fullt crew. En utfordring som må løses. Man må få det like trygt som et bemanna skip. Internasjonalt Maritimt Organisasjon, IMO, sliter med å gi ordentlig forsikring på grunn av manglende regelverk. Den største utfordringen med å gjøre remote, det kan ikke være tvil rundt sikkerheten, den må være like stor som med en bemannet båt. Eller må man skalere ned på en måte hvor man kan dekke alle roller ombord på båten.

- Hvordan informasjon tenker du er viktig å få med i en LARS operasjon kontra andre operasjoner?

Ting som ligger under situasjonsforståelse for vær og vind, utstyr og operasjon. Under der er det på vær og vind – hvor mye blåser det, hvor store bølger, hvor mye beveger båten seg. Viktig. Utstyr – helse på utstyr, er alt fint eller lyser en rød lampe fordi noe er feil. Relevant data, hastighet, turtall, hvor langt ute er vaieren, hvor mye veier last, hvor mye beveger den seg. Viktig med hvor larsen befinner seg, situasjonsforståelse rundt load case.

- Avsluttende utfylling

SITUASJONSFORSTÅELSE, systemet må løse den informasjonen som ikke videreformidles via lyd eller visuelt osv. Vær er også kjempeviktig å få en forståelse for.

G Test Result

Test resultat #1

1. Ved hvilken arbeidsstasjon (1-4) hadde du best oversikt over operasjonens kamerabilder og teknisk informasjon?

Nummer 4

2. Hvilken arbeidsstasjon (1-4) foretrakk du og hvorfor?

4, man skal føre ROV greit at den er hovedbilde, teknisk nedenfor og alt som har med «det oppe». Ser ikke det som nødvendig med backkamera, liker 4 best for man har alt det man trenger rett foran. Ville kanskje plassert de nedre skjermene på siden av main operation i stedet nedenfor. Større teknisk info, eventuelt delt den opp for å få fram info.

3. Foretrakk du arbeidsstasjonene som også hadde en skjerm på stolen eller ikke?

Ikke, føler den hindrer effektiviteten i hvordan man tar inn informasjon. Går fra en stilling, og må gå over til en ny som setter en stopper for å ta inn informasjon fra det man ikke ser på. Tidkrevende å måtte bla på en ipad, vil ha alt på en flate som da vil gi en bedre situasjonsbeskrivelse.

4. Skilte noen arbeidsstasjoner seg ut som tydelig mindre oversiktlig enn andre? Hvis ja, hvorfor?

Likte ikke de med mindre skjermer, for da måtte jeg endre fokus og bevegelse for å få inntrykk av informasjonen. Main operation er viktigst, den bør vær størst. Likte minst nummer 2.
Angående farger, endre fargene på speedometerene, der maks er rødt i stedet for hele sirkelen.

Test resultat #2

1. Ved hvilken arbeidsstasjon (1-4) hadde du best oversikt over operasjonens kamerabilder og teknisk informasjon?

Nummer 1. kunne sett for meg at skjermene på stolen var lengre fram slik at alle skjermer var innenfor samme fokusfelt. I tillegg var det ikke for mye informasjon per skjerm.

2. Hvilken arbeidsstasjon (1-4) foretrakk du og hvorfor?
1 best, fikk det meste på samme høyde og klare store bilder.

3. Foretrakk du arbeidsstasjonene som også hadde en skjerm på stolen eller ikke?

Ja, mer oversiktlig. Ikke distraherende. Blir mer distraherende om all info er på en og samme blikk.

4. Skilte noen arbeidsstasjoner seg ut som tydelig mindre oversiktlig enn andre? Hvis ja, hvorfor?

4, for mye som skjer på en gang. Blir mye med skjermer både over og under. Hadde sett for meg en med skjermer stablet i siden i stedet for oppover. Oppover fører til at man må se opp og ned mens med sidelengs får man lettere inn informasjonen.

Test resultat #3

1. Ved hvilken arbeidsstasjon (1-4) hadde du best oversikt over operasjonens kamerabilder og teknisk informasjon?

2. den hadde kamera både fram og bak.

2. Hvilken arbeidsstasjon (1-4) foretrakk du og hvorfor?

2. litt mer oversikt over informasjon. Det hadde vært optimalt og man får teknisk info ved siden av i stedet for over og under..

3. Foretrakk du arbeidsstasjonene som også hadde en skjerm på stolen eller ikke?

Ikke skjer på stolen. Føler det tar tid å ha fokus på både stol og skjerm, lettere å jobbe når mann har alt på en flate foran seg.

4. Skilte noen arbeidsstasjoner seg ut som tydelig mindre oversiktlig enn andre? Hvis ja, hvorfor?

4. skjermene under utgjorde det. Ville har flyttet både skjermen under og over til hver sin side, lettere å sjekke raskt og rasker ta inn informasjon.

Bytt plass på varsling og load case i teknisk 4

Test resultat #4

1. Ved hvilken arbeidsstasjon (1-4) hadde du best oversikt over operasjonens kamerabilder og teknisk informasjon?

1.

2. Hvilken arbeidsstasjon (1-4) foretrakk du og hvorfor?

3, men ville heller hatt mindre info på en og samme skjerm. Main operastion bør være større og på egen skjerm. Kan gjør teknisk info mindre eventuelt. For mye med tre mindre nede til høyre.

3. Foretrakk du arbeidsstasjonene som også hadde en skjerm på stolen eller ikke?

De med bare en skjerm. Ikke så veldig distraherende med skjerm i to fokusfelt om main opeartion er stor for å rette fokus på det som skal gjøres.

4. Skilte noen arbeidsstasjoner seg ut som tydelig mindre oversiktlig enn andre? Hvis ja, hvorfor?

1. for mye med to skjermer og to stol-skjermer. Vanskelig å ta inn hele bildet når alt er i samme synsfelt.

Smak og behag om skjermene er stablet i høykant eller side om side. Skjermstørrelse spiller en rolle om man skal ha skjermene side om side, kan være vanskelig å holde fokus om skjermene går alt for langt bort over.

Test resultat #5

1. Ved hvilken arbeidsstasjon (1-4) hadde du best oversikt over operasjonens kamerabilder og teknisk informasjon?

4, litt mer oversiktlig å ha blikket festet i en høyde enn noe nært meg og noe litt lengre unna. Main var stor, som er bra. Jeg tror at operasjonens mest interessante er det man skal gjør, og at alarmer og teknisk var nært plassert, som gjør det lettere å catche skulle noe skje. Deilig å få ting som er mindre viktig litt vekk, vinsj er kanskje viktig under noen faser men ikke nødvendigvis gjennom hele operasjonen, mindre relevant å ha like stort som main. Ville heller hatt side om side enn stablet oppå hverandre. Main og teknisk informasjon på samme sted var deilig, for da slepper man å «passe på», de andre skjermene får man beskjed om på teknisk skjerm.

2. Hvilken arbeidsstasjon (1-4) foretrakk du og hvorfor?

4, samme som over.

3. Foretrakk du arbeidsstasjonene som også hadde en skjerm på stolen eller ikke?

Ikke skjer, se over. Litt som med et tastatur, hvor mye erfaring kanskje er nødvendig for å få til operasjonen med skjermer på stolen. TUNNEL VISION, FOCUS AREA.

4. Skilte noen arbeidsstasjoner seg ut som tydelig mindre oversiktlig enn andre? Hvis ja, hvorfor?

De med skjerm på stolen, vanskelig å vite hvor fokus skal vær til en hver tid.

Sidestiller mindre viktige skjermer med main i midten. Opp og ned kan føre til at man ikke oppfatter og ikke får med seg endringer. Lettere å ha fokus side til side i stedet for ovenfor hverandre.

Test resultat #6

1. Ved hvilken arbeidsstasjon (1-4) hadde du best oversikt over operasjonens kamerabilder og teknisk informasjon?

Arbeidsstasjon 3. det var oversiktlig at viktig teknisk info var plassert mer rett i synsfeltet isteden for å måtte se ned på en liten skjerm.

2. Hvilken arbeidsstasjon (1-4) foretrakk du og hvorfor?

Foretrekker arbeidsstasjon 4, men med noen justeringer. Teknisk info burde være plassert mer midt i øyehøyde, feks til venstre for hovedskjerm. Skjermene som var plassert over hovedskjerm kunne også blitt plassert på siden av hovedskjerm. Fokus på å bygge skjermene bredere enn å ha det så høyt.

3. Foretrakk du arbeidsstasjonene som også hadde en skjerm på stolen eller ikke?

Foretrakk arbeidsstasjon uten to skjermer på stol. Arbeidsstasjon med en skjerm på stol var greit, men det gikk også fint uten skjerm på stol.

4. Skilte noen arbeidsstasjoner seg ut som tydelig mindre oversiktlig enn andre? Hvis ja, hvorfor?

Syntes arbeidsstasjon 2 hadde for mange kamerabilder til at man faktisk klarer å få med seg informasjonen. Bildene var oversiktlig plassert på et vis, men det ble for mange bilder i nøyaktig samme synsfelt.

Test resultat #7

1. Ved hvilken arbeidsstasjon (1-4) hadde du best oversikt over operasjonens kamerabilder og teknisk informasjon?

Nummer 4. Bedre å få all informasjon i samme avstand og samme synsfelt, og ikke en-to skjermer på stol som gjorde at det ble travelt å endre fokus fra ene til andre skjermen.

2. Hvilken arbeidsstasjon (1-4) foretrakk du og hvorfor?

Nummer 4, men ville ha endret layout til side om side i stedet for ovenfor hverandre. Behold main som stor, forstørr teknisk og ha de «mindre viktige» camera views til siden. På 2 og 3 ble main for liten. På 1 ble det overload med to skjermer på stolen, men fin størrelse på main. Hadde heller sett de skjermene som var undre i to skjermer på hver sin side.

3. Foretrakk du arbeidsstasjonene som også hadde en skjerm på stolen eller ikke?

Uten skjerm på stolen.

4. Skilte noen arbeidsstasjoner seg ut som tydelig mindre oversiktlig enn andre? Hvis ja, hvorfor?

2 og 3, fordi main var mindre og det var skjerm på stolen. Mange flater av samme eller lignende størrelse.

H Poster

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Institutt for IKT og realfag

Interaction Design for Remote Operations

Camilla G. Persen & Jan-Erik Listou Ellefsen

Introduction

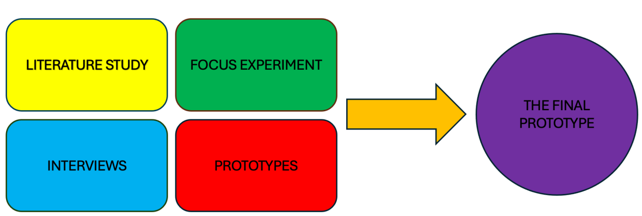
This thesis was ordered by Seaonics as a literature study regarding interaction design for remote operations. Seaonics develops handling and lifting solutions and is actively working towards moving operations from on-site to remote locations. Throughout the thesis, different prototypes were created in order to test different aspects of interaction design.

Problem Statement

What is the difference between operations done on-site and remote, what information can be lost when moving an operation from on-site to remote and how can this loss of information affect the operator?

SEAONICS™

Method



The process were divided into four different parts, literature study, focus experiments, interviews and testing of prototypes. Based on these processes, the final prototype was formed.

The Final Prototype

The final prototype utilizes an operation chair where the operation is performed with the use of joysticks.

Supervisors: Øystein Bjelland & Ottar Osen

I Elevator Pitch

Project name:
Interaction design for remote operations

Group members:
Jan-Erik Listou Ellefsen, Camilla G. Persen

NTNU

Project description

- Cooperation with Seaonics
- Interaction design for remote operations
- Structure of thesis

Problem Statement

What is the difference between operations done on-site and remote, what information can be lost when moving an operation from on-site to remote and how can this loss of information affect the operator?

Motivation and technologies

- Literature study
- Prototype

Q & A

Bibliography

[1] Interview Object 1. Interview at seaonics, 1, 2024. NOT PUBLISHED, conducted on 16/04/2024.

[2] Interview Object 2. Interview at seaonics, 2, 2024. NOT PUBLISHED, conducted on 16/04/2024.

[3] ABB. Remote crane operator stories, part 1: Jan peeman, apm terminals maasvlakte ii, 2018. URL https://www.youtube.com/watch?v=ID9ksGcj4To. Accessed: 05/04/2024.

[4] ABB. Remote crane operator stories, part 2: Ben den otter, apm terminals maasvlakte ii, 2018. URL https://www.youtube.com/watch?v=Ic9UrW77UGA. Accessed: 05/04/2024.

[5] ABB. Remote crane operator stories part 3: Eric gonzales, lbct, 2018. URL https://www.youtube.com/watch?v=ehWQz_Z3-ic. Accessed: 05/04/2024.

[6] ABB. Remote crane operator stories part 4: Linus gellborn, hutchison ports stockholm, 2023. URL https://www.youtube.com/watch?v=z0jZhbsL61I. Accessed: 05/04/2024.

[7] ABB. Abb-gruppen, 2024. URL https://new.abb.com/no. Accessed: 14/05/2024.

[8] Hosam Al-Samarraie and Shuhaila Hurmuzan. A review of brainstorming techniques in higher education. *Thinking Skills and creativity*, 27:78–91, 2018.

[9] NFSH Al-Shammari and J Oh. Effects of human error on marine safety: Case study. *Journal of Enginering Research and Applications. Ijera*, 8(11 Part II):11–19, 2018.

[10] Henrik Baumann. Berøringssansen, 2024. URL https://sml.snl.no/ber%C3%B8ringssansen. Accessed: 04/04/2024.

[11] Ákos Borbély, Árpád Sámson, and János Schanda. The concept of correlated colour temperature revisited. *Color Research & Application: Endorsed by Inter-Society Color Council, The Colour Group (Great Britain), Canadian Society for Color, Color Science Association of Japan, Dutch Society for the Study of Color, The Swedish Colour Centre Foundation, Colour Society of Australia, Centre Français de la Couleur*, 26(6):450–457, 2001.

[12] Dave Both, Thomas; Baggereor. bootcamp bootleg. URL https://dschool.stanford.edu/resources/the-bootcamp-bootleg. Accessed: 11/04/2024.

[13] CM Labs. Remote Operating Station (ROS) Simulator, 2024. URL https://www.cm-labs.com/en/simulators/remote-operating-station-ros/. Accessed: 2024-02-20.

[14] Rikke Friis Dam and Teo Siang. Stages in the design thinking process. *Interaction Design Foundation*, 5.

[15] Jan-Erik Listou Ellefsen. Praksisrapport, 2024. NOT YET PUBLISHED, submission date 29/05/2024.

[16] Sebastian Gnatzig, Frederic Chucholowski, Tito Tang, and Markus Lienkamp. A system design for teleoperated road vehicles. volume 2, 07 2013.

[17] Frederik Kragerud Goplen. Likevektssansen, 2024. URL https://sml.snl.no/likevektssansen. Accessed: 04/04/2024.

[18] Scott Huler. *Defining the wind: the Beaufort scale and how a 19th-century admiral turned science into poetry*. Crown, 2007.

[19] iStock. Underwater oil pipelines stock photo, 2024. URL https://www.istockphoto.com/photo/underwater-oil-pipelines-gm1363511660-435047944. Accessed: 20/04/2024.

[20] SWZ Maritime. What the damen-built icebreaker nuyina is up to in antarctica, 2022. URL https://swzmaritime.nl/news/2022/01/24/what-the-damen-built-icebreaker-nuyina-is-up-to-in-antarctica/attachment/nuyina-moon-pool-pete-harmsen_add/. Accessed: 20/04/2024.

[21] Maike Neuhaus, Genevieve N Healy, David W Dunstan, Neville Owen, and Elizabeth G Eakin. Workplace sitting and height-adjustable workstations: a randomized controlled trial. *American journal of preventive medicine*, 46(1):30–40, 2014.

[22] CPN Online. Cat command remote control operation expands to cat 349, 352, 374, and 395 large excavators, 2022. URL https://cpnonline.co.uk/products/cat-command-remote-control-operation-expands-to-cat-349-352-374-and-395-large-excav Accessed: 2024-02-20.

[23] Kathrin Pollmann, Oilver Stefani, Amelie Bengsch, Matthias Peissner, and Mathias Vukelić. How to work in the car of the future? a neuroergonomical study assessing concentration, performance and workload based on subjective, behavioral and neurophysiological insights. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, pages 1–14, 2019.

[24] Jennifer Preece, Yvonne Rogers, and Helen Sharp. *Interaction Design: Beyond Human-Computer Interaction*. John Wiley and Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, UK, fourth edition, 2015.

[25] Marilia Abilio Ramos, Ingrid Bouwer Utne, and Ali Mosleh. Collision avoidance on maritime autonomous surface ships: Operators' tasks and human failure events. *Safety science*, 116:33–44, 2019.

[26] Maud Ranchet, John C Morgan, Abiodun E Akinwuntan, and Hannes Devos. Cognitive workload across the spectrum of cognitive impairments: A systematic review of physiological measures. *Neuroscience & Biobehavioral Reviews*, 80:516–537, 2017.

[27] Reuters. Crews searching for titanic submersible detect sounds, 2023. URL https://www.reuters.com/world/titanic-tourist-submersible-missing-third-day-with-five-aboard-2023-06-20/. Accessed: 20/04/2024.

[28] Kjell Sandvig. Syn, 2024. URL https://sml.snl.no/syn. Accessed: 04/04/2024.

[29] Nitin Sawhney and Pattie Maes. Situational awareness from environmental sounds. *Project Rep. for Pattie Maes*, pages 1–7, 1997.

[30] Scenic Scenes. Amazing scene of wild animals in 4k - scenic relaxation film, 2021. URL https://www.youtube.com/watch?v=5kozt0uDa4c. Accessed: 04/04/2024.

[31] Scenic Scenes. Winter wildlife in 4k, 2021. URL https://www.youtube.com/watch?v=wUhMIn1UO7Q. Accessed: 04/04/2024.

[32] Scenic Scenes. Ocean and marine life in 4k, 2021. URL https://www.youtube.com/watch?v=lBWZ9ls9-0c. Accessed: 04/04/2024.

[33] Leon G. Schiffman, Leslie Lazar Kankun, and Håvard Hansen. *Consumer Behaviour*. Pearson Education Limited, Edinburgh Gate, Harlow, Essex, UK, second edition, 2012.

[34] Seaonics. About us - seaonics, 2024. URL https://www.seaonics.com/about-us. Accessed: 13/05/2024.

[35] Seaonics. Launch and recovery systems, 2024. URL https://www.seaonics.com/product-categories/launch-and-recovery-systems. Accessed: 13/05/2024.

[36] Seaonics. Products and technology, 2024. URL https://www.seaonics.com/products-technology. Accessed: 16/05/2024.

[37] Seaonics. Winches - seaonics, 2024. URL https://www.seaonics.com/product-categories/winches. Accessed: 20/04/2024.

[38] Johannes Skaar. Lys, 2024. URL https://snl.no/lys. Accessed: 04/04/2024.

[39] Red Squirrel Studios. Squirrel and bird watching: 10 hours nature fun for cats and dogs and humans alike (4k hdr), 2023. URL https://www.youtube.com/watch?v=jAxaYH_c17g. Accessed: 04/04/2024.

[40] Fiona Timmins and Catherine McCabe. How to conduct an effective literature search. *Nursing standard*, 20(11):41–47, 2005.

[41] Four Paws TV. Entertain your pets | 10-hour dog and cat tv | bunnies, birds and squirrels | background ambience, 2023. URL https://www.youtube.com/watch?v=S7Qf0BuMeZY. Accessed: 04/04/2024.

[42] Four Paws TV. Entertain your pets with a forest stream, 2023. URL https://www.youtube.com/watch?v=t36lxBkp-Mc. Accessed: 04/04/2024.

[43] Sigmund Grønmo Ulrik Malt. Likert-skala, 2024. URL https://snl.no/Likert-skala. Accessed: 30/04/2024.

[44] Colin Ware. *Information visualization: perception for design*. Morgan Kaufmann, 2021.

[45] Finn Ø. Winther. Hørsel, 2024. URL https://sml.snl.no/h%C3%B8rsel. Accessed: 04/04/2024.

[46] Claes Wohlin. Guidelines for snowballing in systematic literature studies and a replication in software engineering. In *Proceedings of the 18th international conference on evaluation and assessment in software engineering*, pages 1–10, 2014.

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