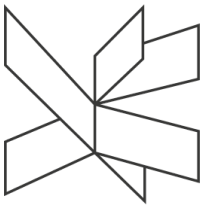

VIA University College

herningvand

Bachelor's Thesis

Process Report

Reduction of Physical Supervision

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Number of characters: 32588

Software Engineering

7th Semester

18th December 2020

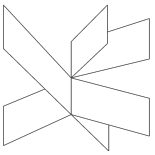
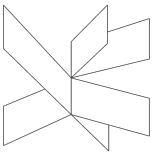


Table of contents



1 Introduction

This report documents the process of group work for the Herning Vand Reduction of Physical Supervision project conducted as a bachelor in the year of 2020. The group consisted of three members: Mihail Kanchev, Amahdya Delkescamp and Dominika Kubicz. The report describes how the group was formed, the background of each member, and their personalities. This information also shows how we managed to work together as a team and what struggles have occurred.

Next the report describes different phases of the project work. Starting with the Project Initiation, we describe the progress made in that phase and what struggles that came upon us. Then we move on to Project Description where we examine the documentation that was required to be written and how we handled it as a group. The Project Execution section explains how we managed our meetings and how the workflow went.

Later in the Personal Reflections each member reflects on the group work of the project, and how the project was conducted. After that the Supervision section all meetings with different supervisors are documented. Finally, the whole report is wrapped up with a Conclusion section that sums up the whole experience of the project.

2 Group Description

We decided to work together on our bachelor project back in February 2019 during the initial planning of the bachelor project. We continued our partnership into the second portion of the bachelor, which began in September 2020. We are a group of three students from the United States, Bulgaria and Poland. We all started studying Software Engineering at VIA in August 2017. Dominika and Mihail have been attending the same class from the first semester, while Amahdya joined the same class in the 4th semester. During the same semester we all had a chance to work together on the SEP4 project. We were separated in different subgroups for most of the project, but in the beginning we worked together. We also have previous experience in working together thanks to the SEP6 project. This project allowed us to get to know each other better and gave each of us a chance to discover the best roles in the team.

2.1 Cultural differences

Each of us comes from a different county, therefore we have different cultural backgrounds. Amahdya comes from the United States, Mihail form Bulgaria while Dominika from Poland. According to https://www.hofstede-insights.com each of these countries has a different score in the following dimensions:

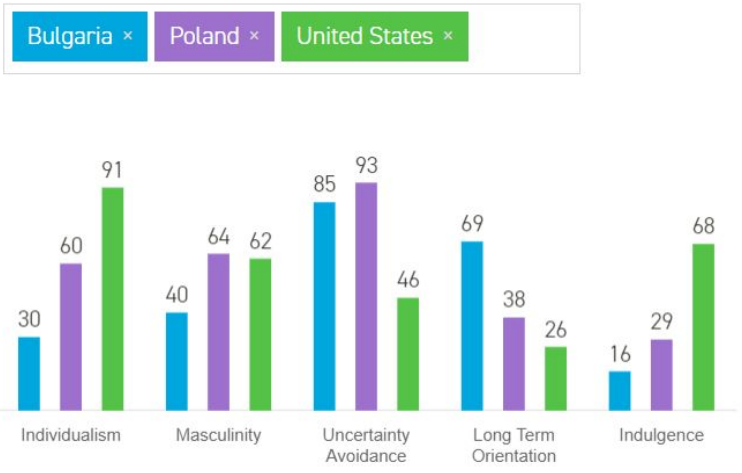
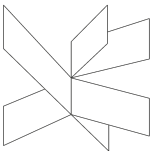


Figure - Country Comparison

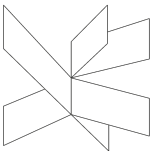


The United States

The USA's score in the 'Power Distance' dimension is the lowest of the three countries. This means that the culture is based on the idea that everyone is different therefore we are unequal. Some people can have more influence over others. The very high 'Individualism' means that people are encouraged to develop a strong sense of "the self". As the saying goes "whether you succeed or fail, it's your own fault". The 'Masculinity' in the United States indicates that people are driven by competition and success. The below average score on "Uncertainty Avoidance" indicates that the USA's culture is open for new technologies, ideas and solutions. The score on the "Long Term Orientation" dimension shows that the culture is very pragmatic. The biggest amplitude has the "Indulgence" dimension. The USA has a much higher score than any of the other countries. It means that the citizens are not raised to restrain their desires.

Bulgaria

Bulgaria and Poland have almost the same score in the "Power Distance" dimension. The score is higher than the USA's score. This means that both countries accept the hierarchy of society and know where they fit in it. The lowest score in the "Individualism" dimension means that bulgarians take care not only of their family, but also acquaintances and friends. This means they have a great sense of group responsibility. Bulgaria has the lowest score of "Masculinity" between the three countries, therefore it has the strongest mindset that "we work to live". A fairly high score on "Uncertainty Avoidance" indicates that the society is not open for unorthodox ideas, and there is a big need for rules. The score of 69 in "Long term orientation" means that Bulgaria is the country with the most pragmatic culture. In the "Individualism" dimension the country scored very low. That means that the people are taught from a very young age to restrain their desires, which causes pessimism and cynicism.



Poland

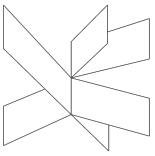
Poland has almost the same score in “Power Distance” as Bulgaria, therefore it has the same vision of the hierarchical order. The “Individualism” score is exactly between Bulgaria and the USA. The society tends to take care only of the closest people and the employer-employee relationship is only contract based. The score of 64 in the “Masculinity” dimension is the highest, therefore it is the most masculine country. This means that in work places there is often competition between co workers, and conflicts are solved by fighting them out. Poland reached an almost maximum score in the “Uncertainty Avoidance”. This means that the Poles are punctual and precise. They are also not open for unorthodox ideas, and have an emotional need for rules. The “Long term orientation” indicates that the culture is more normative than pragmatic. The same as Bulgaria, Poland has a tendency to restrain their desires which is shown by the “Indulgence” dimension.

2.2 Personalities

In order to understand each other's personalities better and improve our cooperation each member of the team took a personality test from *https://www.16personalities.com*. Each member received the following results.

2.2.1 Mihail Kanchev - Advocate (INFJ-A)

Mihail’s result indicates that he is an assertive advocate. This means that he is confident and relaxed. This type of personality is associated with strengths such as creativity, imagination, and sensitivity. They are known to be emotionally honest and in conversations with other people they show sensitivity and warmness. Such a personality can focus intensively on a goal and can’t rest until it is reached. That can cause stress and burnout. Most importantly they stand up for any unfairness and protect what they believe in.



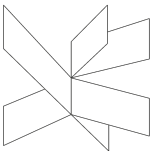
Such a personality will be an important part when it comes to solving conflicts in the group. Mihail can be expected to dispute wrong behaviours and always stand up for matters that are important to him.

2.2.2. Amahdya Delkescamp - Mediation (INFP-T)

Amahdya's result shows that she can be feeling, introverted and intuitive. This personality is said to be very rare. People from this group can be open-minded, imaginative and quiet. Since there are not a lot of people with this personality, they can feel misunderstood or out of step with the world. Thanks to their caring trait they can develop deep connections with people close to them. Authenticity, empathy and harmony are very important to them, and they might be discouraged by people who do not feel the same way. Mediator's are interested in people's true feelings, therefore they are quite empathetic. Since they are known for their imagination, they can find themselves daydream and fantasize rather than take action.
During teamwork such a person with the big creativity trait can be very helpful with coming up with new ideas. Also open-midness can help when working on the project, to not exclude any obvious ideas.

2.2.3. Dominika Kubicz - Defender (ISFJ-T)

Dominika's result indicates that she can be introverted, observant, feeling and judging. She can be distant, but her analytical trait can notice little details. The relationships in the group can be very important to her. This personality is also often associated with perfectionism. All tasks that she will be assigned to will be done in time. Also such a person can lack assertiveness, and need to watch out for being taken advantage of.
In a team Dominika can be expected to make sure there is a good relationship between members. Her sensitivity toward relationships can create a pleasant atmosphere in the meetings. Another useful trait can be her perfectionism. She can pay attention to the details, and ensure everything is done in time.



3 Project Initiation

The project was initiated in August 2019. We formed a group and started looking for an idea for a project that we all would like. We were presented with choices from numerous companies that wanted to collaborate with the students. Since each member of our team was interested in different specializations (Dominika - embedded, Mihail - data, Amahdya - front end) we concluded that it would fit everyone best if we did an IoT project. Two projects of this sort caught our attention. One project was in collaboration with Climate and Supply Engineering. The system was supposed to measure rising sea levels. The other proposal that was considered was a project with Herning Vand on Reduction of Physical Supervision.

The Herning Vand employees were not able to present the project in person, so we weren't able to ask about any details at first. As a result, it took us about a month to decide which project we would like to take upon ourselves. Amahdya was very dedicated to work with a company due to the potential support a company could give to the bachelor and to gain more experience with working with a client. It was also discussed that working with a company may provide an opportunity to find our own solutions to the problems they present. For these, among other reasons, we agreed to proceed with the Herning Vand.

In the first weeks after finalizing our choice we had our first online meeting (due to corona we were not able to meet in person) with the company. The purpose of this meeting was to extract more information about their expectations for the project. However, not so long after the meeting we received an email from the project lead at Herning Vand that because of the COVID-19 situation they would be unable to manage most of the communication with us and wanted to cancel the project. This information took us completely by surprise, since it would be hard to switch into a different project after our comprehensive analysis was well underway. Our supervisor Poul Væggemose helped us and contacted the company himself and resolved the issue. We were told that we could continue work on the project.

4 Project Description

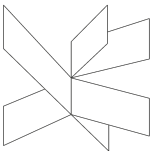
The project description was written before the first live meeting with Herning Vand. We received email contact with them, but we hadn't had the chance to speak with them online or in-person. Based on the presentation Herning Vand had provided and the initial email correspondence, we had a general understanding of what the project was about to begin defining the problem in official documentation.

From there we decided to split different sections of the Project Description among each other. Mihail agreed to look for sources and find the background description, which requires the most efford. Dominika took upon herself to write the Definition Of Purpose, Time Schedule and Risk Assessment. Amahdya took the remaining sections of Choices Of Model and Methods and Appendices. In order to define Milestones in the Project Description, Amahdya and Mihail joined forces and brainstormed some ideas. The following table presents the time schedule that was set at the time of writing the Project Description. In the next section the actual time schedule that has been implemented in the duration of the project will be shown.

Week	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Requirements																		
Analysis and Design																		
Implementation																		
Testing																		
Deployment																		

Table 1 - Time schedule 7th semester as of BPR1

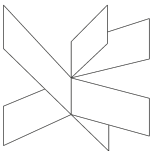
After everyone contributed to the Project Description we all met and discussed our notes about the document. Afterwards we handed in the first draft.



After receiving feedback on the Project Description we updated it and handed it in again. We also decided to keep Herning Vand in the loop and when the document satisfied us, we agreed to send it to the company, so they could read and comment on our work. This helped solve some misinformation about the project. Ultimately, the Project Description helped us define the background and the problem areas of the project, which we were satisfied with by the time the document was fully approved.

Another document we had to hand in not so long after the Project Description was the Software Requirement Standard based on the IEEE standards. In order to be able to write it we had to meet with representatives from Herning Vand and receive even more clarifications regarding their requirements for the system they wanted. This document was more challenging because this was the first time we had seen such a document since it had not been required in any of the previous semester projects. Regardless, just like with the Project Description, we decided to split the document's sections amongst ourselves and reviewed it together afterwards. We updated the document as needed after receiving feedback from Herning Vand and our supervisor respectively. Same as before we sent the document to Herning Vand afterwards.

Ultimately, these documents provided the necessary framework for the group to understand the requirements and goals for the project. We wanted to build a system that would meet the company's expectations, allow us as much of a learning experience as possible and satisfy the requirements for our bachelor.



5 Project Execution

The planning stages for the project concluded around May 2020 and the project picked up again around September. While the corona pandemic was not trending as high, the execution of the project was kicked off with a group visit, including the supervisor, to Herning Vand. The point of the meeting was to reaffirm the requirements as established in the Project Description and our Software Requirement Standard. After the meeting, was able to officially begin work on the Analysis phase of the project and truly get the development for the bachelor project underway.

The project was executed using an Agile workflow. More specifically, during the project description phase of the bachelor, the group agreed on a workflow that consisted of using Kanban combined with the Unified Process. The reasoning behind this was that Kanban would allow for a more free working style compared to Scrum. Our group only consisted of 3 people, so Kanban seemed a little less rigid while still giving us tools, such as the Kanban board, to track progress. The Unified Process was combined into Kanban to introduce an easier way for us to keep track of the bachelor's progression without introducing too many more constraints. It was also used to allow us to plot out hard deadlines that were easier to enforce than a simple Kanban task.

While the workflow was solid, it wasn't enough to counteract unfortunate occurrences that ended up stalling progress. The corona pandemic and the various stages of lockdown impacted the entire project. As a group, we meet far less frequently than we needed and wanted. It was also nearly impossible to plan any further in-person meetings with Herning Vand and communication was greatly slowed down. This could not be helped however, since it was necessary to ensure everyone's safety during the project. The pandemic situation also impacted everyone's schedules and made it more difficult to coordinate work overall. These delays impacted progress to the point where the project was set back a month behind schedule, as can be seen in the table below.

Week	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Requirements																	
Analysis and Design																	
Implementation																	
Testing																	

Table 2 - Time schedule 7th semester during BPR2

However, the group was able to overcome these delays with help from our working methods, support from the supervisor and the ability to get creative with each member taking tasks where they could. Making up for lost time meant that tasks had to be shifted a lot. This is where Kanban proved to be very helpful. The freeflow style of this particular Agile workflow made it easier to reassign tasks as needed. This led to a quicker recovery time from priority rearrangement than what would have happened under a Scrum workflow. These efforts proved effective in the end. The project was completed on time with all requirements met, receiving approval from Herning Vand.

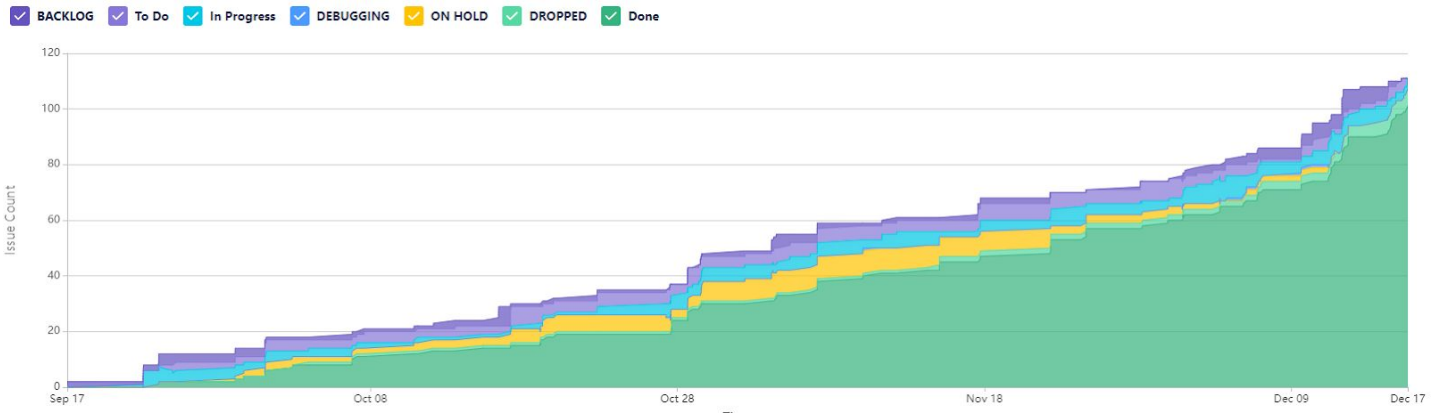
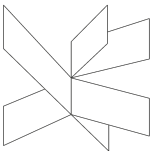


Figure - Completed Tasks During the Project Chart Created by Jira



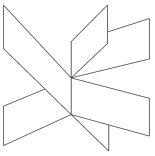
6 Personal Reflections

Amahdya Delkescamp

I liked working with my chosen project group. We all came from varied backgrounds and profession-wise, this ended up working in our favor. The group had experience with different aspects of IOT such as data, sensors, and applications, that helped the project progress a little faster sometimes because everyone had their smaller projects of choice. Everyone was also very helpful in supporting each other when someone was stuck on a problem, which also helped alleviate the time spent on serious bugs and stoppages.? The documentation was difficult, not so much due to the length of the report, but due to all the parts that had to be included. It's always an issue of "did we miss anything?". The project came to a point where we had written too much and had to cut parts down or out completely.

It was a bit troublesome to work around other project deadlines, as usual. However, it was also unexpectedly difficult for the group to coordinate our meeting times against our personal schedules this time. I'd imagine this was partially due to the pandemic and the lack of need to set aside as much of a predetermined amount of time for classes. Regardless, it was just something that we all had to deal with and we made the schedule work in the end.

Finally, I really liked the idea of working with a company because doing so provided the group with a real use case to work with. This made it a very valuable learning experience because we had to work with unfamiliar people and learn to deal with more unexpected situations. Personally, I liked it because it reminded me of my internship, which I really enjoyed as well. We really had to apply what we had learned from our time at VIA to a real situation and it was nice to step back and see how we all handled it.

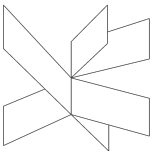


The bachelor project was a true test of what we had learned from VIA. Both when things were going well and not so well. I liked that there weren't any "SEP" classes to attend and the project period lasted pretty much the entire semester. It was sometimes difficult to learn things on the spot, but thankfully we were never working on something that was so niche that a tutorial didn't exist for it somewhere. Our supervisor was also helpful in that he was familiar with the company hosting the bachelor enough to help us get in contact with people in a pinch.

In a general sense, it would have been nice if there was more of a reference regarding which instructors taught what classes to make it easier to figure out who to ask about particular software issues. The hardest parts of the project in connection with learning at VIA was remembering some of the necessary steps we had learned and keeping time under control. Fortunately, we had our project reviewed enough to keep everyone in the group on track to a degree.

I think I learned a lot from this project. All things considered, I liked it better than the other SEP projects because this particular problem was based in real life and not an assigned and constricted use case. It felt like there was more room to solve the project our own way and the constraints that we were given by the host company did not feel constricting. I like to work with projects with real people and problems, but it can also be nerve-wracking to deal with unexpected problems that might not have a direct or obvious solution. Overall, I think that the problem-based learning was easier to work with this semester. Although, this also might be due to the amount of experience acquired versus what was had at the start. It's frustrating to work without knowing very much about what to do and problem-based learning can start to feel like an intentional lack of guidance rather than a chance to figure things out for oneself.

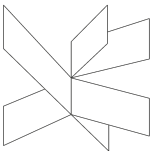
While I don't like to adhere myself too much to personality exams, I'm not going to dispute the result I was given. I want to work in a way that keeps the project moving at all times. It's difficult sometimes, but I think when one gets stuck on a problem or a bug, then it's better to work around the problem, on something that can be solved, until a solution is found for the main problem instead of spinning one's tires with the hope of



a lightbulb moment. I am still guilty of the tire spinning however. I also tend to overthink problems or perceived problems and if I can't or don't resolve them, then it can result in a type of paralysis over deciding how to best resolve an issue.

Dominika Kubicz

This project was the most challenging one for me among all the projects I took part during my education at VIA. What made it challenging was the new group. Since other semester projects at VIA allowed around 6 people per group, the bachelor only allowed 3. This forced me to work with classmates that I had not much experience working with. Finding our own dynamic as a group was time consuming and caused some disagreements. The task would be less challenging if we were able to continue working with groups we had formed in previous semesters. Getting to know each other with the new group members was even harder due to the fact that most of the project was conducted during lockdown. It was very hard to organize meetings in person, since not all group members were living in Horsens. Because of that we didn’t manage to get to know each other as well as we would without the lockdown. I think our team could use some more teambuilding time to make the work together more efficient.
The next challenge was to make a project for a client. Because it was the first time making a project for an external company, it was a bit more demanding than what I was used to. Furthermore the company was hard to contact. The person who we were in contact with, had no knowledge about software engineering, so it was hard to receive any information. Also the company could not provide us with all the data we needed therefore we had to improvise with our own solution. Overall I would say that I did not enjoy making my bachelor for a company, since it caused more trouble than the experience I gained from it.
The last challenge was the COVID-19 situation. Working remotely on the project is much more difficult for me than when working face-to-face. We were not able to meet regularly because of that, so the working pace was changing from one week to another. It was hard to motivate myself to work, since usually I get my motivations from the meetings with the group, discussing what we had done, and in general the positive energy that usually is during physical meetings. Also in the very end of the project



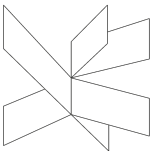
period the VIA University was locked for us, and I was performing tests from there. That was one of the places that the LoRa transceiver was able to connect to the tower, and I had to find another location that would allow me to continue testing. All of this trouble caused a lot of extra stress right before the hand in.
Apart from the project being challenging and stressful I enjoyed working on it. I enjoyed a lot combining knowledge from my multiple electives and using it in the project. I could see how much knowledge I have learned during my time at VIA and how I can use it in a productive way. I could implement an embedded application which matches the specialization I took. Since I was working in a field that I am interested in, the implementation phase passed really quickly.
Overall I am satisfied how the project went. We managed with all the tasks, even though we were not able to meet in person. I can see I have learned a lot from this project. There were many issues we had to overcome and even though we didn't get to know each other a lot, we were able to join forces and solve them in time.

Mihail Kanchev

I enjoyed the group work. Having to rely on engineers from different specializations unloaded some of the burdens that come with system design for me. The support of my group mates helped me focus on the data manipulation and model fitting as much as I wanted. The research that was done on the datasets provided a lot of insight into the data manipulation processes. Having to test multiple classification models expanded my experience with the machine learning field. The analysis of the dataset took me from pipelines to forecasting, showing me the prospect of implementing such systems.

The lockdown did have an influence on the working process. Company communication was limited leading to the group having to adapt to the circumstances. This did prove to be an obstacle, but not one that could not be solved.

Communication through discord, source control through google docs and github, combined with the task management of Jira, helped me navigate the workflow and spread the tasks accordingly. These instruments laid grounds to frequent meetings



similar to Scrum standup meetings, where achieved results were discussed and weekly tasks were assigned.

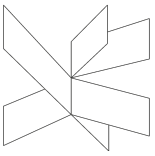
This project expanded my developer experience, giving me insight and confidence to pursue development of similar systems in the future. The project also has shown me my weaknesses as a product developer, pointing in the directions I should follow, in order to become a valuable company asset.

7 Supervision

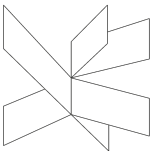
We were assigned a supervisor by the university. Our supervisor was Poul Væggemose. He gave us a lot of feedback during the project and guided us in the right direction. Also he offered to drive us to meet the Herning Vand employees in person, which helped us understand the project even more. Since he didn't have knowledge about all the technologies used in the project we also got a lot of help from Ib Havn. Ib helped us a lot with making the connection to and from LoRa work properly. We also received help from Jan Ravn who was our main contact person in Herning Vand. He provided us with information about their system, so we can meet the requirements for the project.

The following list documents all the meetings that were conducted during the project:

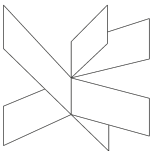
- 2nd September 2020 - Bachelor kick off meeting with our supervisor Poul Væggemose. The following topics were discussed:
    - Bachelor project templates
    - Possibility of using LoRaWan
    - Planning first meeting with Herning Vand
- 9th September 2020 - First meeting with Herning Vand. The meeting was conducted with Jan Ravn and we were accompanied by our supervisor. The following topics were discussed:
    - Explanation of received data
    - Overview of the current interface
    - Discussing possible sensors
    - Data that needs to be sent after the email
- 16th September 2020 - A meeting between Amahdya Delkescamp and Poul Væggemose discussing the following matters:
    - Analysis phase of project
    - Requirements and user stories and where to find them in IEEE standard



- 23rd September 2020 - Weekly check up meeting with our supervisor Poul Væggemose. Following issues were discussed:
    - Slow time of response from Herning Vand
    - Not enough amount of pump failure data from Herning Vand
    - What can be done without response from the company
- 30th September 2020 - Meeting of Amahdya Delkescamp and Mihail Kanchev with the supervisor to discuss the next steps of the project. Following matters were mentioned:
    - What proof of concept is, and what it includes
    - Information that is still missing from the company
    - Documentation that needs to be done
- 9th October 2020 - Meeting of Amahdya Delkescamp and Mihail Kanchev with Poul to discuss the completed work. Following matters were discussed:
    - Adjusting the requirements
    - Adding new delimitations
    - Revisiting the diagrams
- 20th October 2020 - A meeting between Dominika Kubicz and the supervisor to discuss connecting sensors to the PLC. Following matters were discussed:
    - Discussing new findings about the PLC
    - Finding a solution to the no code required problem
- 28th October 2020 - Meeting of Dominika Kubicz and Mihail Kanchev with Poul to review the diagrams. The following topics were discussed:
    - Feedback on the diagrams
    - The machine learning algorithm
    - The possibility of using LoRaWan
- 4th November 2020 - Meeting of Dominika Kubicz and Mihail Kanchev with the supervisor in order to discuss the following matters:
    - Dispute over use case diagram
    - No response about LoRaWan from Ib
    - Feedback on the delivered analysis
- 13th November 2020 - Meeting with Amahdya and Poul which included the following topics:
    - Using interview as sources
    - SCADA system in our project
    - Remaining work with the project
- 11th December 2020 - Meeting between Mihail Kanchev and Ib Havn discussing the following topics:
    - Message types to LoRa server.
    - Accessing the cache of the LoRa server
- 12th December 2020 - Meeting between Dominika Kubicz and Ib Havn solving the following issues:



    - LoRa OTAA join
    - Reading data from LoRa server
- 14th December 2020 - Meeting between Mihail, Amahdya and Poul Væggemose. The following issues were discussed:
    - Documenting the system possible failure
    - Feedback on Project Report Implementation and Design
    - GUI testing
- 15th December 2020 - Meeting with Jan Ravn to present the results of the project. All group members attended the meeting. The meeting included the following topics:
    - Requirements, Design, Implementation
    - Results of The Project
    - Benefits for Herning Vand
- 16th December 2020 - Meeting with all group members and the supervisor. During the meeting the following topics were mentioned:
    - Integration Testing
    - Documentation of Testing
    - Results of the meeting with Herning Vand



8 Conclusion

In conclusion our group work was successful. We came from different cultural backgrounds and had different work ethics. We had worked together on the SEP6 project which was some kind of a test before we started working on the bachelor. Each of us has a different personality type and was able to contribute to the team in their own way. Mihail has been very helpful with resolving disagreements. He has always stayed calm and reasonably found a solution that fit everyone. Amahdya has been very helpful with keeping the workflow going. Also she always stayed open-minded and managed to keep in mind simple solutions when other members were over analyzing the details. Whereas Dominika seemed to remember about the details. She made sure so that no detail is forgotten before the project has been handed in. Overall each member served a purpose and as a result the group was able to cooperate smoothly.
We have collaborated with Herning Vand. We met the employers in person and were in touch during the whole project. Because one employer who was in contact with us had to take a break from working at the company, only one person was in contact with us. This caused some responses to take more time than we expected. Due to company policy we also weren't able to receive all required data to complete the project, but we managed to go around it. Even though there were some issues we managed to exchange enough information with the company, to deliver them a project that satisfied their needs.
We also handled the lockdown pretty well. The COVID-19 situation for sure made it harder to complete this project. First of all it stopped us from meeting with Herning Vand personally, which would improve communication. Not only with the company, but also we couldn't meet with each other. Because one member lived outside of Horsens, it was risky to take public transportation. We managed to meet 2 times in person, and the meetings were held in Horsens Bibliotek. Even though our options were limited we managed to succeed with the project, when most of the meetings had to be online.
To sum up this was a quite challenging project. We came upon many issues which we had to solve. Our problem-solving skills were tested. We overcame all of the challenges, and finished the project with success.