

## Bachelor REPORT

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## Preface

We, as students at the University of Agder, created a group named NAVA Tech. We have been working together since the third semester. In this semester, spring of 2020, we have worked on the bachelor project that concerns the development of quality inspection using machine learning and image processing. We have been given that project by Rebartek AS to check welding spots if they are strong enough or not. Using image processing and machine learning, we want to be able to see if welding is good enough using still images.

We hope that our project is going to benefit both UiA students and Rebartek AS in the future. We, the following members of the NAVA Tech group:

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Would like to thank everyone who has contributed to the success of our project including the supervisor and teachers who are:

- **Hallgeir Nilsen**
- **Sara Hofmann**
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We would like also to thank the product owner (CEO) at Rebartek AS:

- **Max Trommer**

And our contact person at Rebartek AS:

- **Felipe Delgado**

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## Summary

We have gone through the project using two management methods. Kanban and Scrum. With Kanban, we have a good overview of all our tasks and their current status allowing us to prioritize and constantly keep up with the status of the different tasks. With Scrum, we gain the benefit of good communication between the team members. An example of this is having a morning meeting every day where we go through everyone's status, problems, and what they plan to work on until the next meeting.

We can say that there are four different activities in our project, they are: Research, Analysing, Implementation, and Testing. The research done was based on our needs, being a more unified system for keeping track of tasks and data. We also had to find out what kind of tools we were going to use for the system itself. Thus, we ended up with OpenCv2[1] for its easy use for manipulating images and Keras for Machine learning. By looking at the existing tools and after checking what Rebartek would be most interested in, we chose to create our system in the Python[3] programming language.

In the analyzing stage, we looked into how we could use the tools in the most efficient way for our project. To do this, we started with reading the tools documentation, running some quick tests, and creating a proper structure. We split up the tasks for each person, so everyone was responsible for each tool. Then, we gathered the results and went through them as a group.

After that, we started implementing the tools and the structure we defined. We split the implementation part into four different tasks: Image processing, Machine learning, Controller, and the report. At this stage, we started having fewer morning meetings from every day to every other day as the tasks were bigger and more complex and we preferred spending that time working on our tasks.

The final step was the testing stage. In this stage, we tested how long the program used per image, how good the images were, and how many of the images the system managed to guess correctly. To check how high accuracy we had, we used a document that contained the result for every image in our dataset.

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# 1. Introduction

We are a group of third-year students who have worked together for three semesters. During these semesters, we have worked together on many projects such as making a website in java, and innovative design for the museum in Kristiansand. In addition to the courses that each one of us has taken, we have a broad spectrum of skills within practical coding and management skills. This has given us a combined experience in management, design, and technical skills.

For our bachelor project, we were given a chance to work with Rebartek AS[4]. They are a startup company that is trying to automate the process of welding rebars with the use of robots. Their goal is to automate the entire process of making rebars from putting them together to sending them out. Doing this removes the safety risks and reduces the amount of manual labor required. Thus, this project is important as we learn new technologies, apply them in actual life as a need for many construction projects and create an automated process that fits well for the present days.

Keeping this in mind, they gave us the opportunity to create a quality inspection program to automatically check if the welding is good enough or if it would break during transport. To do this, they have supplied us with several datasets that contain hundreds of images of both good and bad weldings. Our job is to manipulate the images to reduce the amount of noise. Then, using machine learning, we achieve a 90% accuracy rate when checking if the welds are good or bad. Our goal is also to have more false negatives than false positives. We would rather have our system called as a good weld bad than calling it as a bad weld good. Thus, if we called it a bad weld good, it could break during transport or after putting it in a building. Instead, we have agreed with Rebartek AS to spend some extra time checking false negatives.

During this report, we will go through the process we have gone through while working on the project. We will mainly focus on the management of the project during the report. This shows how we controlled the tasks, which work method we used, how we planned ahead for unexpected situations, and what our results were.

## 2. Project preparation

At the beginning of the preparation, we as a team have agreed on the basics of the project including choosing the suitable methodology for the project, defining the project tools, disclosing the milestones and the goals of the project, and so on.

### 2.1 Methodology

Methodologies are a set of roles and rules around how software is to be designed and built. It refers to the process of planning, creating, testing, and deploying the project.[5] The team has learned and applied a number of methodologies during different study projects. The choice of adopting development methodology depends on project nature, its size, the different requirements, and the time span. For this project, the team has discussed a couple of methodologies that can be adapted to run this project. Since this project is not considered as a large-scale project, the team has chosen to combine two well-known methodologies for the bachelor project.

We have decided to use a lean-agile combination of Scrum and Kanban. The reason for using both methodologies is that we have already used Scrum and Kanban in different projects and found that the combination would work well for this project. Doing a full scrum project fits better for larger projects as they should be more structured and iterative. However, combining these two methodologies could give several benefits such as having daily meetings. During the daily meetings, one could update the team with the status of the current task and discuss current challenges related to different tasks if it existed. The team has realized that as the ongoing project is more experimental, it is harder to estimate time for different tasks such as how much time can be spent on Image Processing. Similarly, estimating time for implementing Machine Learning algorithms and presenting results. Having the above reasons in mind, the group has decided to go with this combination of Scrum and Kanban in order to make the project successful.

### 2.1.1 Kanban Methodology

One of the most effective tools for lean working methodologies. Kanban offers several advantages to task planning and throughput for teams of all sizes.[6] By using Kanban, we can have a good way to form a backlog, we will make new tasks as they are needed to be solved. Another advantage of using Kanban is that the tasks would not be completely dependent on each other. Besides, it does not require a specific time frame for each task. So, it suits best for our project where the focus will be on inspecting the work and doing quality assurance of the work done by robots at Rebartek AS. ***The team wants a Kanban-inspired method with Trello as a Kanban Board.*** In addition to that, regular morning meetings such as stand-up meetings to discuss and show progress on each active task. Working on the project, Kanban consists of various building blocks that help the team to manage tasks and optimize the ongoing work.

### 2.1.2 Scrum Methodology

As a team, we know that Scrum is a framework for project management that emphasizes teamwork, accountability, and iterative progress toward a well-defined goal. Though Scrum is widely used for large-scale projects, managing our current project will also need to apply some Scrum features, so that the project could be coped up well in order to fulfill the requirements. [7]

### 2.1.3 Combination of both methodologies

As we know Scrum and Kanban as a flavor of Agile, where Scrum is best suited for products and development projects. Whereas Kanban is mainly best for production support. Many people use Scrumban – which combines the best features of both, and it is becoming prevalent nowadays. [8]

After having the first official meeting at Rebartek where we have discussed several issues including what their expectations are regarding the project work, the team chose to combine two methodologies since we believe that it would be a nice strategy in order to make a smooth workflow of the current project. However, choosing both have several reasons. One of the reasons is the use of **Trello** [9] as

our Kanban [10] inspired board. Trello provides an easy and comfortable interface to manage different tasks by defining different sub-boards on it (*project backlog*). Assigning responsibility to the team members is easy and effective to execute each task. Using Kanban features enables the group to set due dates on different set tasks and add attachments. In addition, adding customized fields, for example, a checklist, can help to track the progress of smaller elements of any ongoing tasks. Regarding the Bachelor Project, using a clean Trello as the Kanban board provides much flexibility in relation to performing different tasks. One can, for example, start a task without waiting or having a dependency on others' work. Also, one can choose a task from the defined backlog (in our case at Trello board) that provides effective progress towards solving the problems regarding the project.

The Scrum approach of the project management enables the team to prioritize the project work that matters most and can break it down into small manageable chunks. This strategy helps to keep the focus on the important parts instead of spending time on the other ones that are not required at the current stage. It also includes daily meetings and accountability of the project work. For example, it keeps a record of ongoing progress in an agile environment that can be helpful for the team to complete the project work effectively. However, combining these (Scrum, Kanban) methodologies together and picking the most suitable features for this project can boost the workflow and let the group focus on what is most needed rather than working on “Gold Plateauing” regarding the project.

## 2.2 Quality

The machine vision project is to check the quality of different welds. The program should be able to utilize image processing and machine learning in order to see if rebar has been welded good enough or not. Based on the rules from Rebartek AS, they have their own criteria for asserting the good quality of the weld. Their destructive test is applied on the welds. These welds should be able to pass a certain weight estimated at 300 kg. This is done by pulling the weld with a crane when it is secured to weigh. Using machine learning, we achieve at least an 80% accuracy rate when checking if the welds are good or bad. Besides, we should have more false negatives than false positives. We would rather call our system a good weld bad than calling it a bad weld good. If we call it a bad weld good in the machine learning part, it could break during transport or after putting it in a building.





## 2.3 Quality assurance

One of the most important key points regarding quality is good communication with the client and among the team. Good communication would ensure that quality is conformance to the requirements the client would have like accuracy rate, ongoing goals, and end product results. To make it easy, we have agreed on communicating in English with common simple vocabulary. Besides, documentation regarding guidelines and how the process has been taken is also crucial for both our project and Rebartek AS. We have been documenting the important incidents ongoing through testing and working with the main tasks such as image processing and paraphrasing the minutes of the status meetings, in addition to the code documentation. As a Scrum project, we have used Trello as a platform for implementing different tasks. In Trello, there are four main columns that show progress made in any task. These columns are ordered respectively as followed: To-Do-List, Work In Progress, Review, and Done. The review is an important way to ensure the quality as other members of the group could fill gaps in the task if they existed or fix some technical errors. So, the task is not moved into "Done" without being reviewed by at least one member in the group. This enhances the control over all the tasks in addition to the self-control of the divided task

With reference to Rebartek AS, we concluded that even if we are not able to finish the project as it was planned, they might continue where we left off. This increases the value of good documentation for us. Keeping this in mind, we decided to document our code in two steps. The first one is in-line documentation where we explain functions used from external libraries like OpenCV to let them quickly understand what these lines of code do and what they require. The second is more detailed documentation about all of our functions. This would show a brief overview of what they do, what parameters they require, and the data they return.

## 2.4 Project Management

### 2.4.1 Tasks and priorities

When defining the scope for the implementation stage, we first define what type of classes we want to create. In order to avoid working over each other, we split the scope into five different tasks with several subtasks based on the classes.

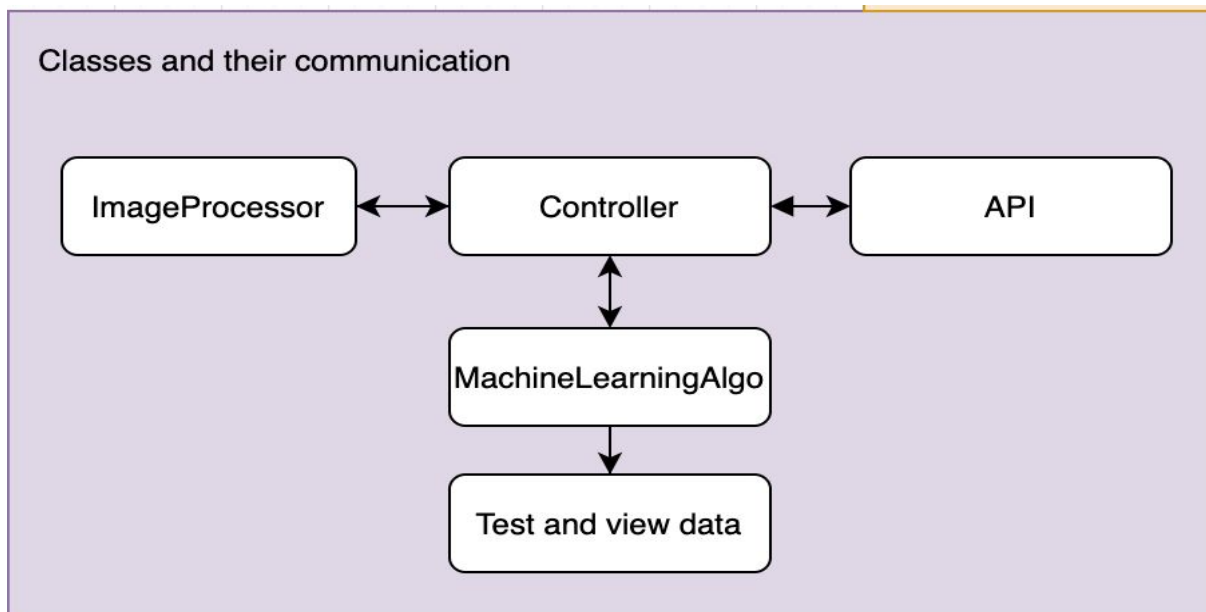


Figure [x] Implementation Scope

### 2.4.2 Plans and estimations

In this project, we plan to carry out what is known as a Test-Driven Development (TDD) for the implementation phase within the programming part of the product. This practice is a philosophy and practice that recommends building test units and executing tests before implementing the code or components in a system. [9]

This is seen as Agile testing practices, which help the team reach the different requirements of the system we are making. Carrying out a Test-Driven Development

mentally, the team will be able to ensure the quality of the programming that suits the requirements within the specifications that are stated in the Scope.

Using this approach, the team will be able to test the different aspects of the program with fast and automated testing procedures and eliminate most of the need for manual testing and debugging. This also ensures that the team is focused on the quality assurance of the system.

With Test-Driven Development, we write the test cases to have a baseline to look at before we start programming.

As we can see in the diagram below, the test cases will automatically fail, as the team has not made any of the code that the test can be carried out with.

The next step in this process is programming so that the code can meet and pass the different requirements within the test case.

If the test passes, the team will optimize and/or add more codes, before starting the test process again. If the implementation of the new code is optimized and fulfills the requirements within the test case, the team can carry on to form a new test case for other functionalities of the system.

If the test fails again, after writing the code with the goal to pass the code, the team will need to refactor it and start the process from the starting point in the model.

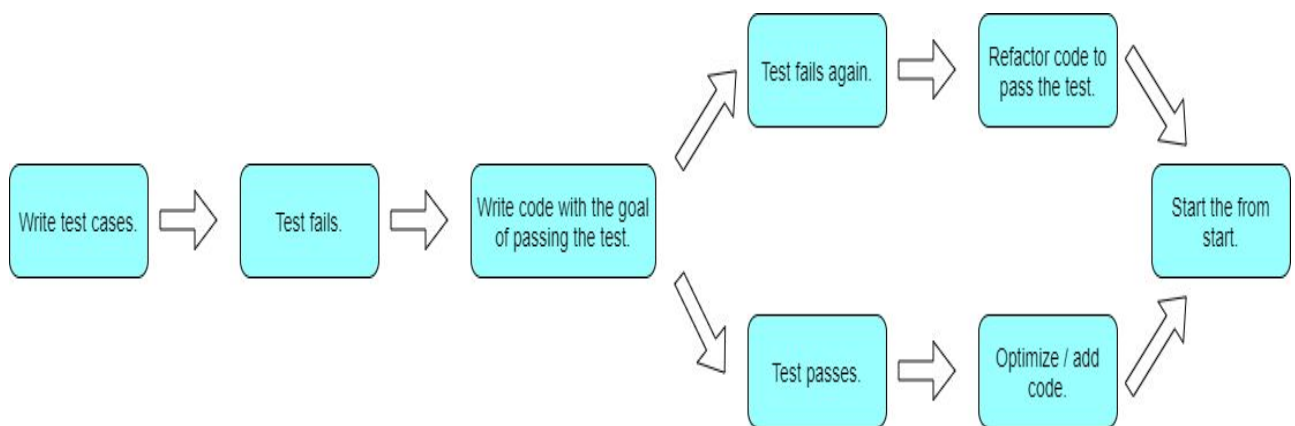


Figure [x] Test-Driven Development.

In addition to that, we have worked with Kanban-board dividing the work into different tasks within the board. Through communication with Rebartek AS, we could decide whether these tasks and parts of the work we have been developing, are within their scope or not. However, we have an excel calendar with different sheets. Each sheet has a functionality different from the others. All the sheets are mainly concerned with the time management of the tasks. Thus, each task has estimated time, re-estimated time, and actual time spent.

### 2.4.3 Project management tools

The group work involves some processes such as some basic planning, defining principles, so that everyone can band together, and enjoy the environment while working in the group. Since the group has been working on the project over the whole semester, it requires an understanding of how the project work can be done effectively and produce desirable results.

To do this, the group thinks that the project work can be broken down into small attainable tasks so that everyone in the group can focus on his part and complete the task independently and effectively. Also, what areas need to be researched prior to working on the task that will help to understand the work nature of the given tasks. Furthermore, the group work requires what skills needed to be tapped into for working on the project. In addition to this, assembling the group with a variety of skill sets as each person brings a different perspective and has a different viewpoint that is important to accomplish the task. Besides, we provide a positive but at the same time a bit of a challenging environment where everyone could boost his skills and learn new principles and ideas by having such a productive environment.

The group has specified some digital tools that could be used during the project work. These digital tools include communication medium, documenting, programming language, and how to control the work and keep a record of everything related to the project. The following are the tools that are used for supporting the project:

**Discord:** will be used as the main communication platform for sharing upcoming meetings and delays/absence. [10]

**Google Docs:** free text-editor with dynamic backups, and the possibility for more than one working on the same document at the time. [11]

**Google Drive:** will be used for organization files as a group. [12]

**Scrum / Kanban-board:** Trello

**Version control:** GitLab. [13]

**Programming language:** Python with a defined structure as a baseline.

## 2.5 Standards

Before starting we discussed what Rebartek expected from us and what they required from our system. They did not have any big and restricting requirements but they would like us to use python to make it easier for them to integrate it with their systems as they use python themselves. So since they preferred python and because they did not want to use Java, we decided to use python. For the speed of the system they wanted it to be quick, but we should not focus on the speed of the system as with the right hardware this can be improved. They also wished for around a 70% accuracy, they did not require us to get a 90% accuracy so we set it as a stretch goal for ourselves.

For the implementation of the project, it is important to plan ahead. With this, we mean a plan for how the system should run, how the code should be written and how we will write the documentation. After talking with Rebartek we concluded that even if we are not able to finish the project as long as they deem it worthwhile they might want to continue where we left off. This increases the value of good documentation for us. With this in mind, we decided to document our code in two steps. The first one is in-line documentation where we explain functions used from external libraries like OpenCV to let them quickly understand what these lines of code do and what they require. The second is more detailed documentation about all of our functions. This will focus on a brief overview of what they do, what parameters they require and the data they return.

We also wanted to make our system simple to use. Originally we wanted a more modular type of system. But after seeing how things were set up at Rebartek we decided to go a more object-oriented route. In retrospect continuing with the modular route would have been the better choice as we did not need the advantages of abstraction that comes with object-oriented programming. But, with this in mind, we split our code into three parts. The image processing, the Machine learning and the Controller class which will connect the other two classes. This was also in order to make it simpler for Rebartek to take over in case we are not able to finish. It also helps us keep control of what does what. So if we need to fine-tune the image processing we know that everything related to image manipulation is in the image processing class.

When deciding on how we want to code our project we thought of what we had learned throughout the years. What we landed on was that we wanted to make our code simple to read with comments that explained the more difficult lines. With this in mind for every unique change, we created a separate function. For example, we have a function for showing images, one for changing the color, one for light correction and one for checking how blurry the images are. This makes it simple to fine-tune specific parts and remove certain image manipulations if needed. We learned a lot during the project and realize we could have structured the code in a bit cleaner way. As mentioned earlier we could have used a more modular method instead of being so dependent on objects.

## 3. Running the project

At the beginning of the project, we had some challenges. The main challenges were how to gather the right information about the project scope, how to understand the complexity of different tasks, and how to prioritize different tasks and divide the workload into an even manner. Besides, estimating time for each task was also a challenge. That was not easy for the group to register the right time for each assignment and distribute the workload on a defined time plan.

### 3.1 Pre-implementation

Before starting with the project, we conducted some research about how we would set off and go forward in our project. The main point to start in our project is to search for the best method for implementing image processing. We have already agreed with the client to use Python as a programming language. But how would we use python for image processing? In the beginning, this phase was a little challenging, but after searching, we chose to use a library called OpenCV. However, the main purpose of the image processing class is to remove unnecessary noise in the background of the image in order to make it simpler for the Machine Learning algorithms to detect and evaluate the welding point. In addition to that, there are multiple methods for Machine Learning. Thus, we had to do deep research in order to implement the most suitable one for our project and to know some common concepts regarding Machine Learning such as Supervised and Unsupervised algorithms, False-positive and False-negative. After doing research and going through multiple methods for Machine learning, we chose to implement Keras with the availability of using algorithms from other methods.

## 3.2 Implementation

### 3.2.1 Controller class

The controller is the part of the system which connects everything together. The controller will ask the IP (Image processing) class to fine-tune the images, when it gets the images back it will then ask the ML (machine learning) class to check the quality of the weld. When it gets the quality result back it will then send it to the user who asked for the image to be checked.

To start out we made the controller after making the IP class. At first, we only tested the IP using one image, but when we got further we wanted to be able to manipulate multiple images. The best way for us to do this was to either create a function or start on the controller class. In order to save doing the same work, we decided to postpone the image processing and start working on the controller. With this implemented, we had one central place where we dealt with all the files. This way the IP class only needed to deal with the images as it was intended.

In early March, we got our second dataset. This dataset was very different from the first dataset we received so we had to make some adjustments. We also got some problems with the JSON file which included the name of the images as described above. Sometimes the images were under templates, while other times they were under scenes. Some images even missed the coordinates file leading to errors when trying to open them. With this in mind, we started adding exceptions and dealt with error handling. We also started running tests for every new dataset we got. One of these tests would check how many images had coordinates attached, how many were listed as templates or scenes and how many of the images in the JSON file actually had an image. Because of this, we were able to contact Rebartek quickly after getting a dataset to ask questions about the dataset. In one case the data in the JSON file was wrong and we were able to quickly get a new JSON file since we had written a test to verify the file.

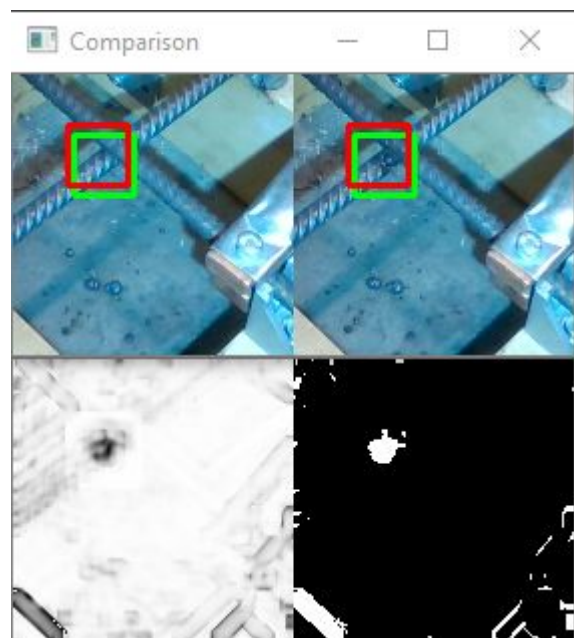
When we got the third dataset late march we no longer had a before and after image. So we now needed to make some more changes to our code in order to be able to handle single images. This was a simple change but up to this point, we had hardcoded all the folder paths in different areas of the code. To make this simpler we created a settings file that defined the folder paths. So now when we needed to change the dataset we just had to edit the path in a single location.



### 3.2.2 Image Processing class

The image processing class or IP class is the class responsible for cropping and manipulating images in a way that supports the ML class. In order to be able to properly manipulate and check different aspects of the images, we are using a library called OpenCV. This is a popular library for image processing that is able to handle comparison between images, color editing, and several other tools commonly found in graphical image editing software.

Our first step was to be able to automatically compare two images to find out where the welding was done. At first we had a success rate of about 30% but, after some experimenting to decrease the amount of noise we managed to get it up to 80%. The main contributor to this was blurring the before and after images before comparing them. The result can be seen in this image. The red square is the square from the comparison. It finds the correct welding spot based on how big the different white spots on the bottom right image are. Currently, if a white spot is below 170 pixels big and it is the biggest of those below 170px we assume it is the welding spot. After adding the rules about the sizes of the white spots we jumped up to about 95% accuracy on guessing where the welding spot is. This method does however only work when comparing a before and after image.



The green square is the expected welding spot. These coordinates are made during the welding process. The camera which is taking the images saves the coordinates in a file. This is a 3d matrix that was difficult to work with as we have to calculate the X and Y on a 2d canvas. We wanted to find a better way to calculate the coordinates but ended up drawing rectangles and guessing which multipliers to use. The coordinates are given using meters using scientific numbers like “-1.531004303728100702e-03”. If we draw a + sign in the middle of the image this would be 0.0015m to the left of the X-axis. These numbers are obviously way too small which leads us to multiply it. Currently on the dataset from the image above the

formula we use is:  $\text{middleX} + \text{cmX} * (\text{totalSizeOfImage} * 0.7) * 1.7$  where middleX is the center of the + sign and cmX is the coordinates mentioned above. We tried using the Z coordinates to get a more dynamic multiplier so that if the distance between the camera and the welding was not the same, we would not need to edit the multipliers again. But, we were not able to achieve this.

When we are only given one image we only mark out the expected welding spot and crop the image. We have also created functions for adjusting the lighting of every image in order to get as many similarities as possible. We are however waiting with this until we manage to get all the images through the machine learning algorithm. Together with this, we have also added a function that allows us to check how blurry the images are. This is currently not in use either but when we start fine-tuning images to increase the accuracy of the machine learning we will likely start using both of these functions.

### 3.2.3 Machine Learning

Machine learning is an application of artificial intelligence (AI) that offers systems the ability to automatically learn and improve from experience without being explicitly programmed. It focuses on the development of computer programs that can be used to access data and use it to learn for themselves.[14]

In our project, the Machine Learning segment is an important part because it would process around different images as our given datasets, would point out whether a welding joint at the rebar is good or not, and also predict the welding accuracy based on the processed images as an input. And make sure that whether the prediction accuracy fits in the required accuracy scale i.e. more than 90% on a specific bar.

Though there are several versions of Machine Learning (ML) algorithms available out there. However, to implement the right ML algorithm was a challenging task for us since we needed to find which algorithm could be fit for our needs regarding quality assurance of rebar joints based on given images. To do so, we started our research on ML algorithms and gathered information on different algorithms and techniques. After that shortlisted them according to the needs of the project and compared what is most suitable for the given scenario.

Furthermore, in the implementation phase of the Machine Learning (ML) algorithm, we applied the SKLearn ML library for python. The reason for using SKLearn through the Ensemble technique was having various algorithms support like the random forest, K-neighbours, and scientific libraries like NumPy and SciPy. We applied this algorithm for our project and tried to access the dataset through our controller class

(as discussed above). We were stuck at different stages: first getting required datasets through calling controller class. It was a challenging task since we had worked with the OpenCV library in our Image Processing class. So continuing with the same libraries was not possible for the ML algorithm. Another challenge was to deal with different datasets we got from time to time as these datasets were different from one to another (in a way to have pictures from different angles). After some time, we realized that the SKLearn algorithm would not be fitted for our project since we threw away much time to research on fixing different issues such as combining ML functionalities with our Controller part, fetching dataset as an array and dividing them properly into different models. Through the discussion in the group that we needed to look at another algorithm that could fit for the problems.

With doing more researching, we decided to move the project over to a deep learning technique. This is done using a deep learning algorithm called CNN (Convolutional neural network). CNN is used to analyze visual imagery that can handle images classification well. (15) For us, this seems to be a better approach to solve the case the client had given us.

## 4. Reflection

Along with this report, we have experienced many incidents, advantages and challenges. We have learned how to manage our project by dividing the tasks into the members of the team. We have also learned new techniques regarding using algorithms in both image processing and machine learning. Besides, we have done our best to document all the details around the project, especially those concerning coding. However, we did not hesitate anytime contacting our client at Rebartek AS to ensure a good quality of the product.

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## 6. Appendix

### Statement from Client

To whom it may concern.

I'm Felipe Delgado, Robotic Engineer at Rebartek AS, and on its behalf I declare that NAVA Tech Group has been working on a project for us, specifically, a system to detect Welding Quality through the use of Machine Learning.

The project has faced some difficulties along the process, but the group has been working thoroughly and the results look quite promising for us.

The group has been reporting every other week with the results of their work and I can say that they work in a really organized manner.

We're really excited about receiving the final results and the system as a whole to start using it in our development.

I wish the best for NAVA Tech group in their endeavors.

Thanks for all the effort that you have placed on this project.

### Self-evaluation:

#### **Ole Morten Ness:**

With this project, I had to put my earlier experiences and skills gained through the education course to a test. As this project contains technology and principles that's new to the team, we had a set of different challenges regarding the implementation part. In this project, I have been working closely with Ali to support him on the management and planning, such as keeping the Trello-board updated, and helping with filling excel-sheets we have used for the time-tracking and morning meeting logs.

I have also been the person with the main responsibility for the implementation of the Machine Learning part.

## **Muhammad Ali Amin**

In this project where I have studied several new things, I also learned about Project Management, working with real-world projects, collaborating with organization, inspecting owners' needs regarding their product and so on. In my point of view, this bachelor project is particularly designed to encourage the students to excel their skills as a group by working on both documentation as well as the practical implementation of what they chose as a project during that period. The course has given me the opportunity to express my feelings, thoughts based on the experience that I have gained so far. In addition to what work as a group or individual has been done, what are the learning outcomes for me through this project.

In the beginning, it was a bit difficult to understand how to handle this project work. There were many things which were new for me such as working around artificial intelligence and so on. Through this process, I got a chance to apply my earlier experience that I had gained during the studies and also enhance my learning skills for example, working on real-world projects, working on artificial intelligence part.

In this project, I have been responsible for managing the administrative part, setting up meetings, coordinating, management and planning. Also, worked around development part such as the Machine Learning part in order to fulfil the needs regarding our project results.

## **Abdulhalim Alhassan**

I have my best to employ all my skills in the project especially in reporting, researching and testing and I have learned new techniques in cooperation with my colleagues.

## **Odd-Andre Vatne**

During this project I have learned a lot of things. I mainly worked on the implementation of the image processing and Controller but helped out on the report writing and management decisions as a group. It was interesting and challenging to learn and work with image processing and machine learning for the first time and I can see it will be helpful for me in the future.