Software Development Plan

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1. Product Description

A raspberry pi module gets data values from sensors that measure CO_2, humidity and temperature. The measured data are then transmitted and stored in a cloud database where they can be accessed for graphically display in the user interface. The product also has a function for machine learning. The algorithm which the machine learning function uses can from the gathered data decide the quality of the room, in form of a message “good” or “bad” quality.

2. Team description

2.1 Project Knowledge Requirements

Project Process Section	**Knowledge Requirements**
software development plan	- Team experience. - Customer support.
System specification planning	- Basic hardware and IO programming. - The product’s functionalities. - Customer requirements.
Software structure design	- Basic experience with software and GUI. - Experience with C#. - Object oriented programming. - Database structure and SQL. - Experience with Python - Concept of IoT. - Customer understanding.
Implementation	- Experience with debugging. - Experience with working in a team, under pressure. - Experience with web development. - Function oriented programming.
Software testing	- Creative software usage. - Experience with debugging
Publishing and post-launch support	- Customer support.

Table 1: Overview of knowledge requirements.

2.2 Team members and rolles.

Throughout the organisation of the project, the members has been assigned main responsibilities/rolles, and has a general responsibility to follow up the progression of the other team members. This is done so that other team members can take part of and learn all the main responsibilities assign to other team members. Though the person responsible for their section of the system will have the final authority over the code.

Member	Øyvind Brakstad	Ole J. Oksum	Lars C. Wessel
Main Responsibility	*System Engineer* *Web designer* *Service designer* *Database designer*	*System Engineer.* *Product Owner.* *Machine learning.* *UX Designer.*	*System Engineer* *Scrum Master* *UX Designer* *QA tester*
Strengths and experiences	*Experienced in SQL*	*Experienced in Python*	*--*
Programming Languages: Little, medium or good knowledge	*C# - Good* *Lua - Little* *Python - Medium* *JavaScript - Little* *SQL - Good*	*JavaScript - Good* *Lua - Medium* *C - Little* *C# - Good* *Python - Good* *SQL - Medium*	*C# - Medium* *C++ - Little* *Python - Medium* *SQL - Medium*

Table 2: Overview of team members and experiences.

3. Software Process Model Description

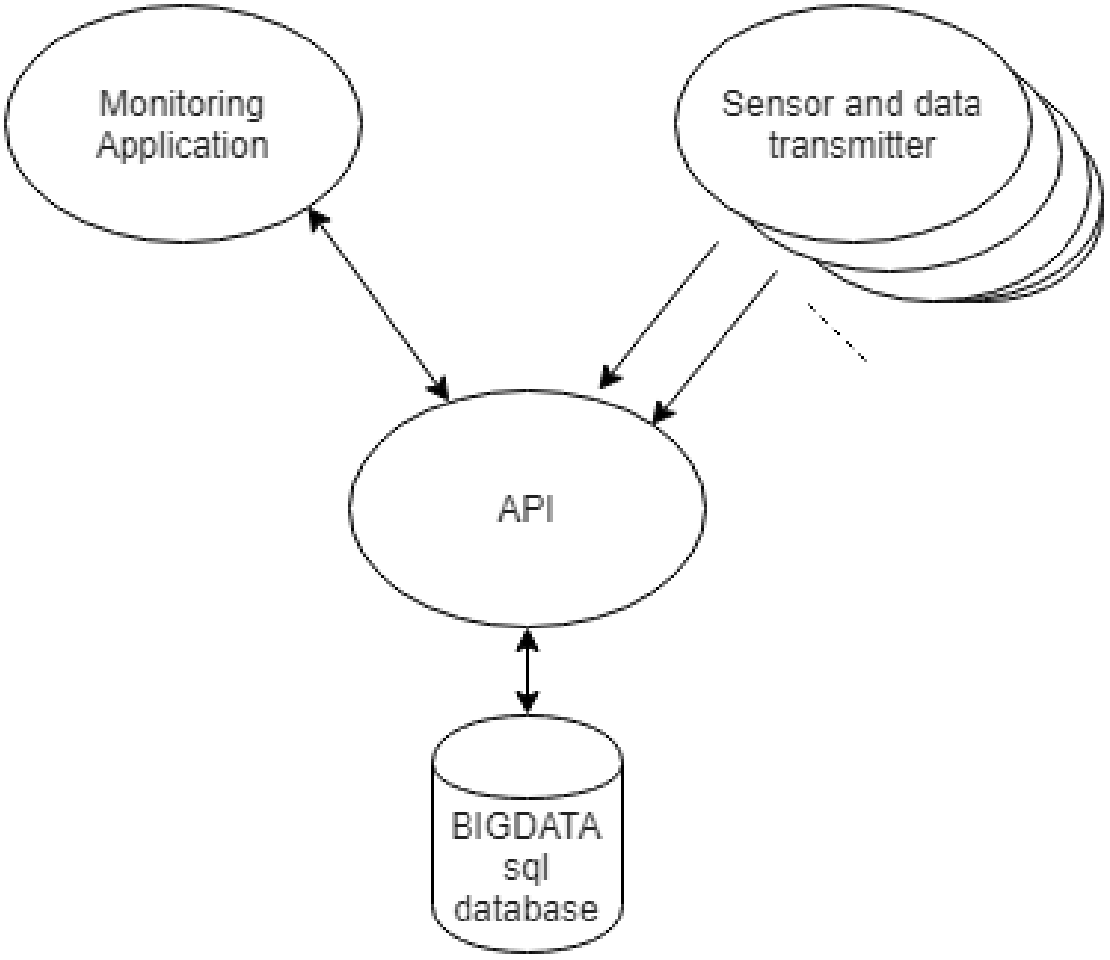
The product that is to be materialize is of a limited scope, and the team that shall realize it is small and transparent. From this it has been more appropriate to use an agile process model instead of an more stiff plan driven model. The Team has from this insight has chosen scrum as the process model for structuring the development of the software. This model those not demand an comprehensive documentation of the software at the beginning of the development process, because much of the details comes to light as the work with the software program progresses. The project scope and the team's size facilitates for that each member of the team has capability to have good overview of the project through good communication with the other team members. This is realized with short daily informal meeting where progression is communicated to the team's other members. All meeting activity is lead and organize by a scrum master, who has an facilitation rolle in the team.

Units of the product is chosen for completion from a document called the product backlog, the prioritizing of what units that shall be completed is decided by the product owner (here by the team in sprint planning meetings). The sprints last 14 to 30 days and lets each team member try all of the scrum-roles, with rotation at the beginning of each sprint. The sprint breaks up the product into units who can be completed and tested at each ended iteration. The team and the product owner is summoned after each iteration to a sprint review meeting where the unit that has been completed is discussed. There is later before next sprint planning meeting also held a sprint retrospective meeting. This just for the teams members to evaluate the sprint process itself.

4. Project Definition

The project is called Air Quality. The system that is to be developed shall get a large amount of data from the sensors, and display this data graphically. The machine learning algorithm will then use the latest stored data to predict whether the quality of the room is “good” or “bad”. Planning, designing and creating this system is done as a single team effort.

The system takes use of modules that measures temperature, CO2 and humidity. This data is then sent to a server implemented with the restful api service. Thereafter the data is used by the windows application installed on the monitoring computer for processing. Below in picture 1 is a simplified overview of how this system operates.



Picture 1: Simple system overview

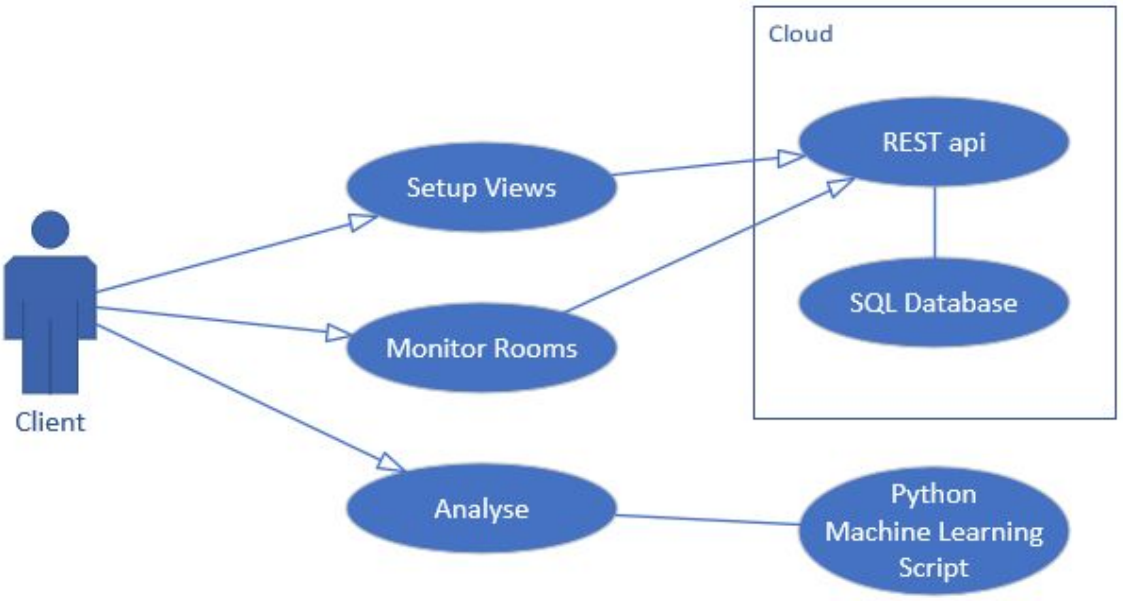
The computer application use a machine learning algorithm for validating the air quality. There are many benefits to gain by implementing this system in both large and small facilities. Air quality has been proven to affect work efficiency, focus and the general mood of any person. Due to this, facilities all over the world go to great lengths to improve their ventilation system.
But how would you know that all rooms are well ventilated at all times?

Usually, modern day ventilation systems come with some sort of regulation control for this, but is this regulation sufficient ?

What sets the air quality system apart from others is that it takes into consideration more aspects of air quality, and processes these factors to give a more robust answer regarding the air quality of the workspace. The combination of these factors are often ignored in modern day standard ventilation systems with possible appalling consequences for working condition.

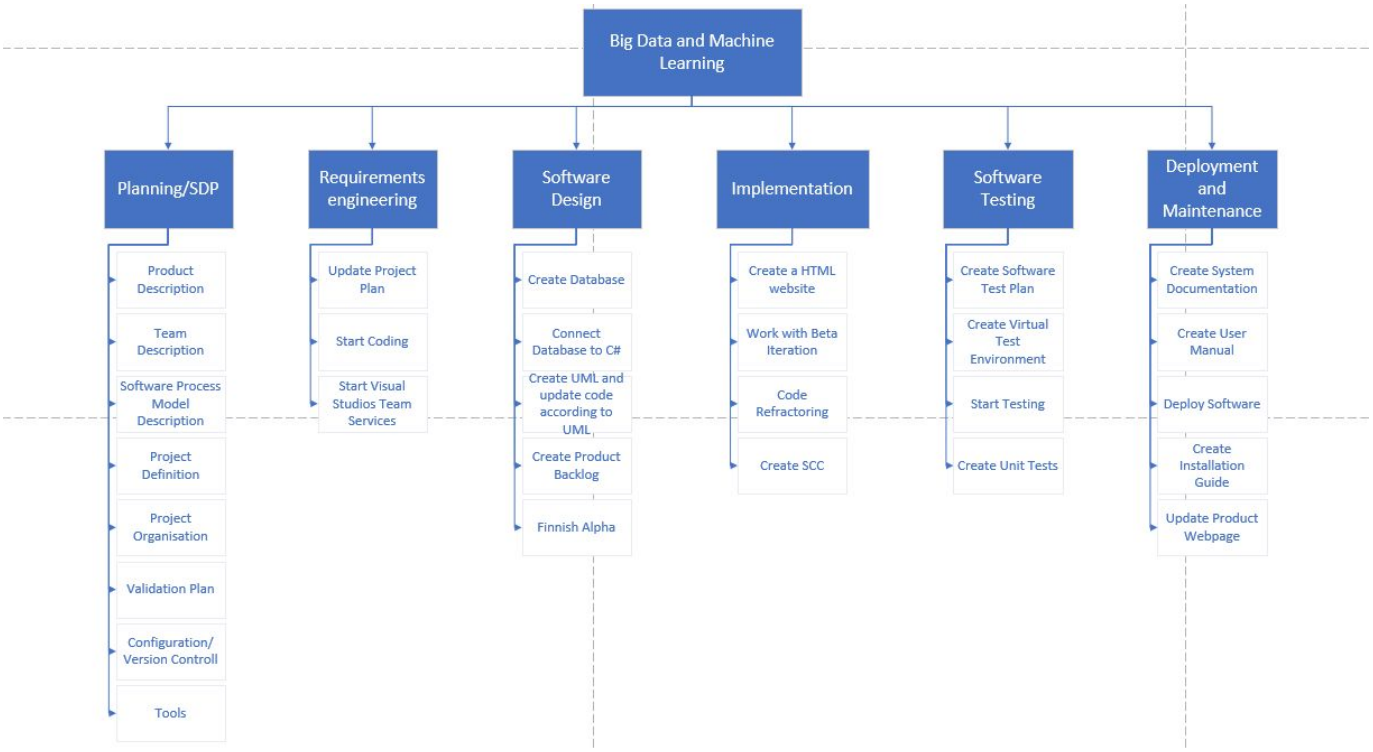
An example for illustrating the later might be a basement room in a workplace where the cold air is breezing through the ventilation system, and the ventilation system might respond to this by decreasing the fan power gain. This again causing the room to stabilize on a comfortable temperature.
But in a vertical ventilation tube (particular those that are installed for basement sectors in a facility) there might be a high threshold for a fan to dilute out all the heavy carbon dioxide molecules in an effective manner. In a situation like this there could be a minimum CO2 concentration trapped in all basement sectors at any time. This could very easily cause the workers in the basement section to be tired and unfocused for most of their working hours.

This system is meant for large facilities like office buildings, schools, hospitals and other large buildings with daily human activities. The system provides those who are responsible (like those working in PR departments) with a overview of measurement levels and algorithmic analysis of air quality.



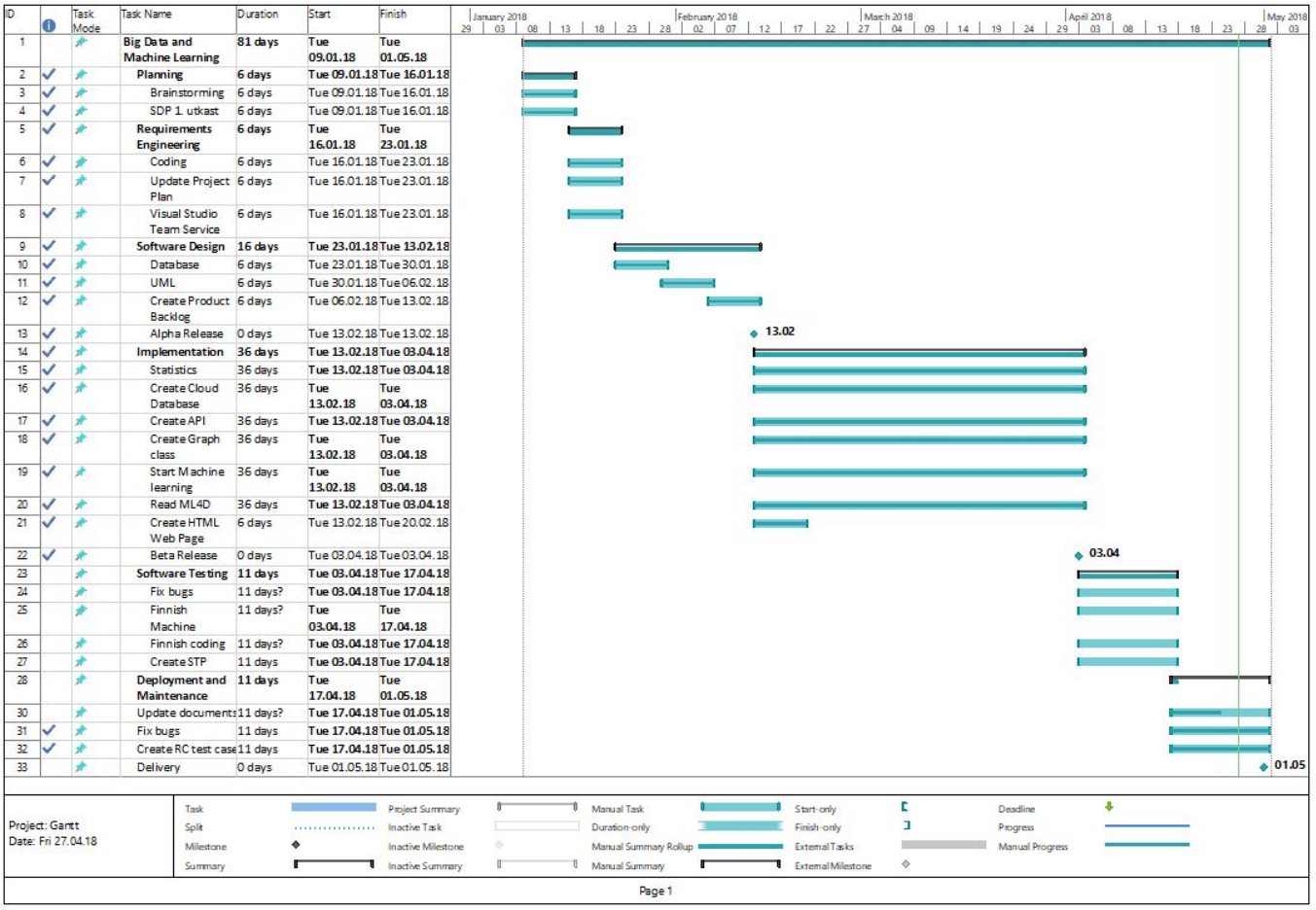
Picture 2: Overview of the Use Case.

5. Project plan organization



Picture 3: Work breakdown sheet.

The project is divided into five phases (six is shown over in the WBS), planning, requirement and design (have been merged), implementation, testing and deployment. Under the planning phase the team shall make an SDP, and activate the VSTS. With the requirement and design phase the team shall specify the non-functional/functional requirements, create E/R and UML-diagrams. These specifications shall be integrated into the SRD document, in addition to this the team will start working on the alpha release. In the implementation phase the team will start programing for the betha release, and structuring this work through the use of VSTS. In the next phase a program test plan shall be developed, and the program shall be tested according to this plan. In the last phase the system documentation shall be updated from what the system should have been to what it have become, user manuals must also be created in this phase.

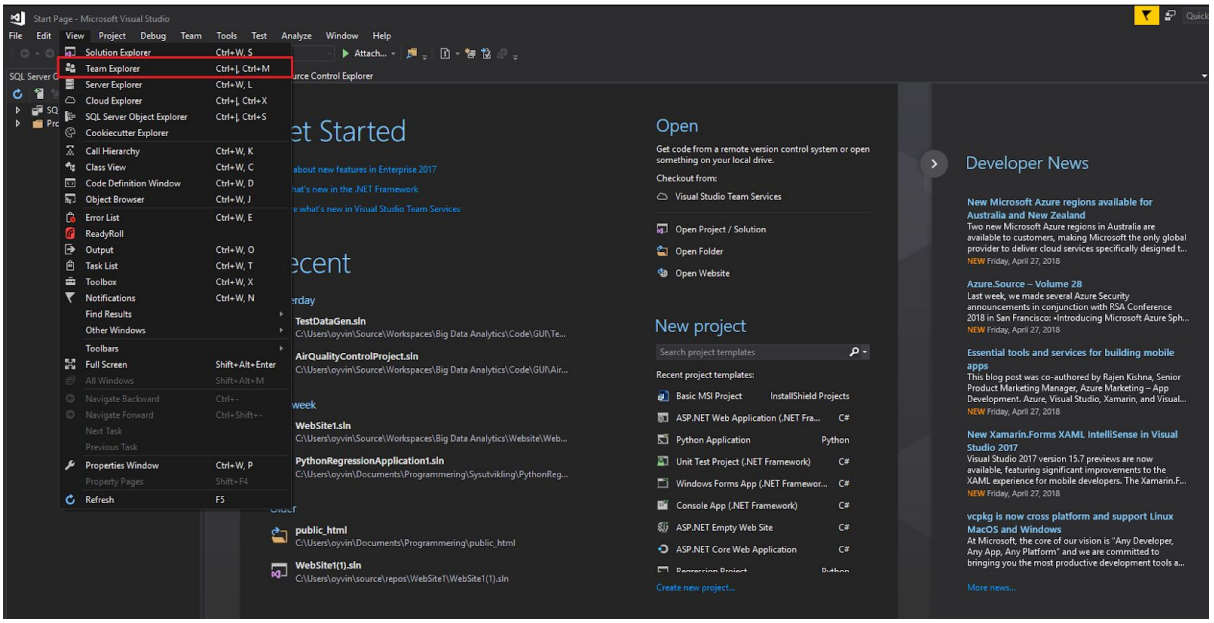


Picture 4: Gantt diagram of the project.

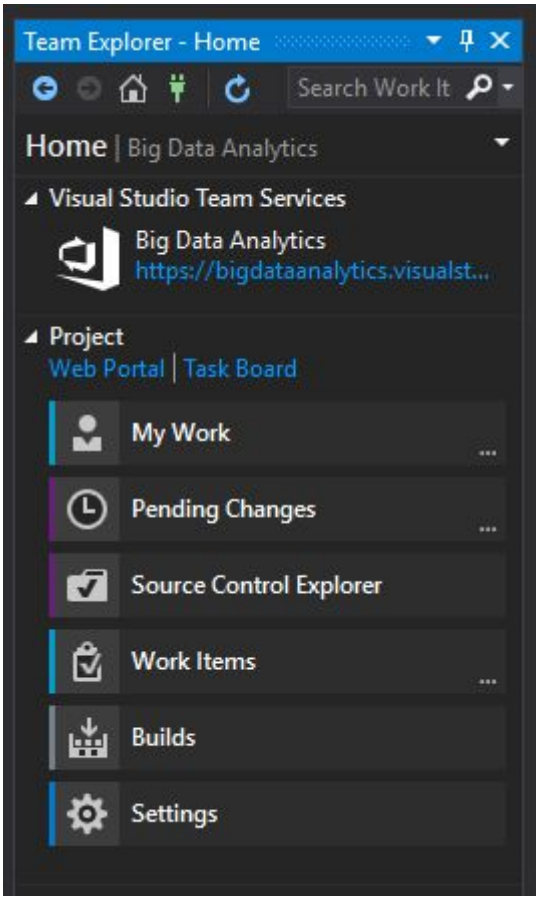
7. Configuration- / Version Control

For version-control Visual Studio team Services is used. This program is free to use for up to 5 users, and no installation is required because the program domain is placed on the cloud to Visual Studio`s homepage. This connection happens through Visual Studio`s Environment. Before a one can use VSTS the user needs to register a user account. This can be done here:https://www.visualstudio.com. Link to the teams project page is to be found here: https://bigdataanalytics.visualstudio.com/Big%20Data%20Analytics/Big%20Data%20Analytics%20Team

In Visual Studio you can find the team explorer option under views, as illustrated in picture 5. Thereafter you must connect (if visual studio are opened from VSTS as described earlier there is an automatically connection) to the team service by clicking at the green connection icon as seen at the top in picture 6.



Picture 5: VSTS in VS



Picture 6: VSTS in VS

Inside Visual Studio under Team explorer and thereafter Source control one can find the folder structure that have been created for the project. Here it also can be added additional folders. If the a new folder has been added, it can be loaded up to the cloud by right clicking over the project, and chose “check in pending changes”. After this is done one must click “check in” under Team explorer.

The first thing one has to do when adding new code in to the software is to make sure that one has the newest version of the code. This can be done be right clicking over the project in source control and activate “Get latest version”. After this is done the user need to click on “check out for edit…” also to be found by rightclikking on the project under source control. By doing the later one prevents that anyone else are changing the code while one are working on it. The downlocking of the program for other users are confirm by blue padlocks in front of the icons in Solution Explorer. After the changes to the code has been added one must load up these changes to the cloud. These is done by clicking on “check in” under Team explorer and pending changes. The new version of code will thereafter be achieved under the folder structure in the cloud, as the latest of many versions of the code. If two team members have been changing the same code VSTS will try to merge this two versions. If a satisfactory result cannot be obtained, the user is asked to take the decision.

The folder structure that have been loaded up to VSTS can be found by clicking on Code under the toolbar. Here is an well-presented overview of the code-versions from the software-programs that the team uses, like Visual Studio and Microsoft SQL Server Management Studio. If a later “check in” of the code should be infected with bugs beyond repair, from here an earlier code can be recovered.

Under work in the toolbar is the page where the project sprints are organized. Here we find the project-backlog where units are added and prioritized. By clicking on one of these units a addisjon operator will show up in front of the unit. One can add task`s under each unit by clicking on these operators. Here one can also assign different task`s to specific member of the team, specify time before completion and decide a priority to the work. Under board (also under work) one can see the task`s of the units that have been chosen from the backlog for the current sprint. Here one can follow the progression to the different members of the team, while the tasks that are a part of the sprint goes through the 3 stages of approved, to do and done.

8. Project tools

Tools	**Usage**
Visual Studio 2017	Used for programming C#, and creating the UI.
Anaconda Spyder	Used for programming the machine learning algorithm using Python 2.7.
Visual Studio Team Services	Organization of workload, and continuously updating the documentation. VSTS is also used to implement Scrum.
OneDrive	Storing all documentation, reports and miscellaneous project documents.
Google Docs	Real time editing and writing reports and documents.
Microsoft Office 365, Visio 2016 og Project 2016	Planning documents and long time storage of finished project documentations.
Discord	Used for communications, and organising scrum meetings online.
Erwing database modeler	Planning and creating a database structure.
Microsoft SQL server Management Studio 2016	Creating and validating databases.
Restlet Client (Google Chrome Extension)	For continuous testing and validation of REST api functionalities.

Table 3: Overview of the software used during the project.