LoRa Greenhouse Project

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1. Background Description

A research report of McKinsey&Company done in 2017, states that 40% of Danish working hours could be automated by current technologies. While automation will bring substantial improvements in prosperity, the transition will also face challenges (McKinsey&Company, 2018), but since Danish society has a high level of trust in the public institutions, Denmark is well positioned to become one of the world's leaders in digital front runners (Alfter, 2020).

In april 2020, Nordic Harvest announced the establishment of one of the largest vertical farms in Europe. The project offers a sustainable food system with local production and offers high quality experience, as the world population is growing and the global challenges concerning sustainability are rising (Anon., 2020).

“Vertical farming helps Denmark to reduce CO2 emissions per unit of agricultural crop produced, and thus we at Nordic Harvest help agriculture with the green transition that is highly needed when Denmark has to deliver a 70% reduction in greenhouse gases in 2030,” says Anders Riemann, CEO and founder of Nordic Harvest (Anon., 2020).

A greenhouse automated monitor system works towards the same goals as vertical farming but on a smaller scale. A greenhouse offers great protection from adverse weather conditions ensuring optimal conditions for growth with little physical labour involved, due to its wireless sensors connected to the Internet of Things.

From the large variety of sensors, the most common for greenhouse automation are the outdoor sensors for temperature control, in close relation with the indoor sensors for humidity monitoring and CO2 emissions. A volumetric water sensor replaces the manual work of irrigation, being able to monitor irrigation controls.

Greenhouse A/S are expanding their product range, with a product for automatic greenhouse control system, that will collect sensor statistics for optimizing plant growth which at the same time will give the gardener responsible an overview, as well as the opportunity to adjust parameters for regulation. This will cut down on labour and resources cost.

Regulation of light, heat, CO2, water, humidity, and nutrition are the main parameters to improve plant growth and the yield of the plants. Understanding these factors and regulating them will help to increase knowledge about plants growth and their development (dti, 2021) (Bitesize, 2021) (oregonstate., 2021).

2. Problem Statement

1. Main problem

How can the system optimize the growth of plants while saving resources?

1) How can the working labour hours be reduced with automated technologies?
2) How can the particular plant get the ideal amount of nutrients and water?
3) How can the data be gathered and sorted into useful intel?
4) For which types of plants is the system better suited for?
5) How to set up the tools to find the “optimal” conditions for the plants?
6) How can the improvement of a particular plant’s life be measured?
7) Which are the particular specifications of a plant’s life that should be prioritized?
8) How error prone should the solution be?
9) Where is the best placement for equipment to survey the greenhouse?
10) How can the system measure the plant’s life cycle?

3. Definition of purpose

The focus of the project report is to create a sustainable solution for an automated greenhouse through the use of wireless sensors connected to the Internet of Things.

4. Delimitation

The system's sensors can only be used around Horsens and Århus.
The system sensors are limited to four options: light (on/off), temperature, humidity, CO_2, PIR and the LoRaWAN transceiver.
The system can only send and receive signals every 5 minutes.
The system will only have a single servo motor.
The client application will only be available on Android OS.

5. Methodology

The use case driven software development process UP and documentation in UML will be used to analyze and design the solution to be developed. To deal with unpredictability and deliver high quality software the team will use the iterative agile framework SCRUM.

It has been estimated that the team will fit 5 sprints within the timeframe of the project, where each sprint will have the duration of 3 days. Each sprint the team will have a workload of 264 hours, 24 hours per member. The estimation includes the SCRUM events - daily scrum stand up meetings, sprint planning, sprint review and sprint retrospective. Each Sprint will start by prioritizing the backlog followed by sprint planning where Work Breakdown structure will be performed. Planning poker will be used for estimation of tasks. The team will be using the online tool Planning Poker Online.

For the management of sprints and product backlog Jira will be used. The software will also be used to track the team's progress. A burndown chart will be generated at the end of each Sprint. The columns in Jira for the sprint are structured according to the definition of DONE.

Git will be used as a version control system. The team has agreed on the following naming convention for creation of branches **Jira-id-description-of-jira-task.**

6. Time schedule

In order to fulfill the requirements of the project and meet deadlines, the team has set up the following milestones throughout the project.

Phase	Calendar days	Development stage
Inception	22-Sep	Project Initiation
	29-Sep	Poject description and user stories
	04-Oct 23:59	Inception Deadline
	06-Oct	Feedback on Inception
Elaboration	13-Oct	1st Sprint
	18-Oct - 24-Oct	AutumnBreak
	27-Oct	1st Sprint
	03-Nov	1st Sprint
	10-Nov	2nd Sprint
	15-Nov 23:59	Elaboration Deadline
Construction	17-Nov	2nd Sprint
	24-Nov	2nd Sprint
	01-Dec	3rd Sprint
	06-Dec 23:59	Construction Deadline
	06-Dec	3rd Sprint
	07-Dec	3rd Sprint
	08-Dec	4th Sprint
	09-Dec	4th Sprint
	10-Dec	4th Sprint
Transition	13-Dec	5th Sprint
	14-Dec	5th Sprint
	15-Dec	5th Sprint
	16-Dec	Final Review
	17-Dec 13:00	Hand In

7. Risk assessment

Risks	Likelihood (1-5)	Severity (1-5)	Product of L&S	Identifiers	Preventive	Mitigating	Responsible
Hardware issues	1	2	2	The hardware does not behave like it should	Make sure there is a cloud service for backup, being aware of the correct way of using and storing equipment	Get a backup as soon as possible, buying/asking for a replacement from the supervisor.	Florina
Someone gets sick	4	3	12	Person is calling sick	Take care of yourself	Give notice and what´s wrong	Florina
Lose internet	3	3	3	Unstable connection	Make sure there is some sort of device that can handle data	Do assignment that can be done offline	Kristoffer
Team gets a member short	1	2	2	Team member not showing up, underperforming	Talk with each other to prevent problems	Talk as a group and evaluate what went wrong	Florina
Miscommunication	3	4	12	Angry tone, miscommunication	Make sure you stick to the Scrum rules and notify the team every time when needed	Talk as a group and fix the problem	Tamas

Severe conflict between team members	3	3	9	Words used, behaviour and language	Always have a good conflict	Involve other members (Responsible Person) or supervisor in worst case	Sommer
Lack of participation ("Couch potato")	3	4	12	A team member does not participate and contributes to the work done	Group contract clauses	Members not participating on meetings/ Not delivering parts of the project	Sommer
If interfaces are not functional	3	5	15	The test cases for the interface are not functional	Start with defining mock-up data and communication between sub-groups.	Use of mockup data for the responses.	Daniel
Losing project artifacts (Documents, data, diagrams etc.)	1	5	5	Bad backup strategy	Version control, Backups	System shutdown	Viggo
Not using git correctly	3	4	12	Merge conflicts during pool requests	Follow git guidelines & solve conflicts before making a pull request. Master is protected	Attend the workshop by Viggo	Viggo

8. Sources of Information

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