LONDON METROPOLITAN UNIVERSITY

Islington college
(इस्लिङ्टन कलेज)

Module Code & Module Title

CS6PO5 Final Year Project

Assessment Weightage & Type

Final Year Project Proposal (5%)

Agriculture Monitoring system with automated Irrigation and Water tank system

Year and Semester

2019-20 Autumn, Year Long

College ID: NP01NT4A170104

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Submission Date: 22th November 2019

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1. Introduction

As the technological revolution continues, every aspect is leaning towards the technology to make the maximum use of it. Farmers are also slowly adopting technology in agriculture field. As the necessary goal to trend up in agriculture continues, the use of Agriculture Monitoring system with automated Irrigation system can be a very great option to adopt to. The monitoring and automation system can be implemented in agriculture sector to gain efficiency and simplicity by reducing the cost and resources and utilizing the technology for the better. (Vineela et al., 2018)

1.1. Problem statement

Agriculture is the most important occupation of the world. In the country like Nepal, about 80 percentage of people are involved in agriculture and the major source of country's economy comes from it, but still agriculture industry is facing many problems as people are unaware about the new technologies that costs them less than the traditional method. Some of the major problems faced by farmers because of lack of technological use are:

i. Wastage of water.
ii. Unscientific and Ineffective agriculture method resulting in waste of human resource and money.
iii. Decrease in crop production because of lack of monitoring system. (Sarkar et al., 2018)

1.2. Project as a solution

Use of Agriculture Monitoring system with automated Irrigation system provides the user-friendly interface to monitor the agriculture and automated irrigation in lower cost, that makes field cultivation process much simpler and efficient. Some of the major solution to the problems that the project provides are:

i. Utilizes the water, power consumption and manpower.
ii. Monitors the environment and keeps the record and analyses it.
iii. Monitoring and controlling from remote distance.
iv. Increases the crop production because of applied scientific technological measures. (Sukumar et al., 2018)

2. Aims and Objectives

2.1. Aims

The main aim of this project is to eradicate the problems of the traditional agriculture methods and interduce a cost and work efficient technology to manage and automate the various aspects of the agriculture in a productive, efficient and scientific manner.

2.2. Objective

The objectives of the project are:

- To use the IOT devices (Arduino Uno, jumper wires and sensors) to build a prototype project of Agriculture monitoring and automated irrigation system.
- Research about the IOT and its implications.
- To have extensive knowledge on programming concept and hardware.
- To determine the application areas of the project.
- To manage different aspects of the agriculture.
- To automate the irrigation and water tank system.
- To analyze the data sent by the sensors to generate a simple and meaningful information.

3. Expected Outcomes and deliverables

The expected outcome of the project would be a prototype IOT devices which is made up of motors, sensor and other various electronic components which is connected to the Arduino that acts as the brain of all the hardware used. Multiple Arduino are used to control the different aspects of the system. The system automates the irrigation system as per the data sent by the moister sensor. It also measures and regulates the water level in the tank. The system alerts the user if the water level is low. The sensors also monitor the crops by keeping track of temperature, moister, and growth of the plants. The collected data from the sensors is collected and analyzed by the Arduino and sent to the user's device through the use of API where a person can monitor and read the information in simple format. The water tank, irrigation and monitoring system use different Arduinos, so the data are sent separately and then later it is combined to display it as a single system. The information is displayed is timely updated and stored for the future purpose. The information is displayed on the basis of various categories like temperature, humidity, time and so on. The system also allows a user to access the data remotely via website. All the functionality and guide will be well explained in the documentation (report) which also acts as a manual to properly understand the developed system.

The project is targeted to aid the agriculture sector. It is targeted to the farmers and business sector who are willing to do the agriculture in a scientific way through the use of technology. The project is mostly useful in a scientific and systematic environment. The project can also be useful to the agriculture researchers as the displayed information helps to provide information based on various categories.

4. Project risks, threats and contingency plans

4.1. Risk and Threats

- The major risk is the lack of network and/or power. In the absence of network, the IOT device will not be able to communicate with the user resulting in lack of timely updates. This will be even bigger problem if a user is trying to monitor the system remotely from a distant place. The lack of power will cause even bigger problems as IOT device will not be able to function.
- Technical failure is another big threat as the sensors could get easily damaged.
- The lack of knowledge is another main problem as people either do not know about IOT devices or they do not care. People blindly follow traditional path just because they think change is hard.
- Physical security is another major concern as adversaries, or any other person may cause harm to the devices and sensors. This will result in the damage or malfunctioning of the system.
- The system is most effective in the scenarios in closed and scientific environment. It is not very effective in the places where the farmers totally rely on rain water for agriculture.

4.2. Contingency plan

- A backup power source like invertor, generator or use of solar panels would be a great option to fight against the lack of power. And a backup network source would be great against network failure scenarios.
- The use of redundant sensors could eliminate the problem of a sensor failure.
- Awareness and training program for the farmers is a great solution to eradicate the misconception and lack of knowledge problem.
- The agricultural area should be made secure from physical threats by covering the area with fetch, to avoid the physical threats.
- The proposed system is mainly targeted to the environment like green house, or secure scientific environment.

5. Methodology

5.1. Considered Methodologies

5.1.1. Waterfall methodology

It is a type of methodology where all the phrases of a development process are divided into separate and the result of a phrase acts as the start point for the next phrase sequentially. In this methodology all the requirements are gathered at first then the tasks are divided into different sequential phrases. (Charvat, 2003)

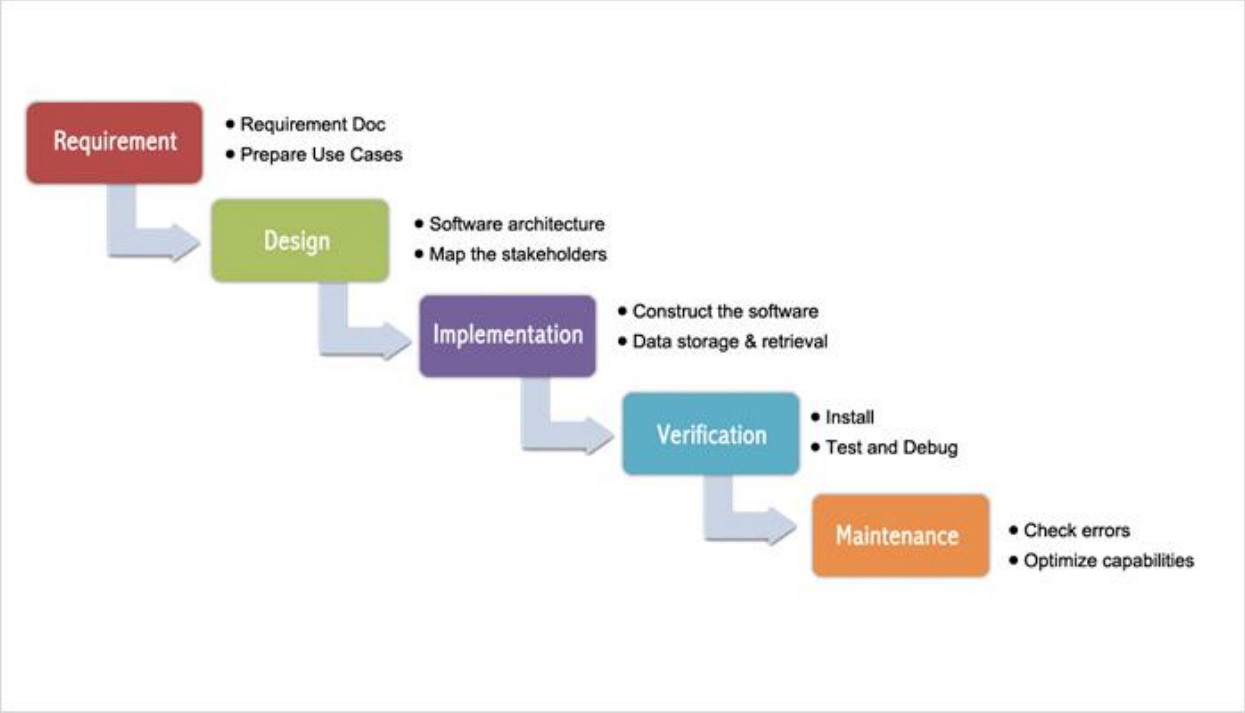

Figure 1 Waterfall Methodology. (Mobile App Daily, 2019)

5.1.2. Agile Methodology

It is a type of methodology where the requirement and the solution of it evolve through the collective action of teams and the client. The task is broken down into several phrases and continuous improvement and iteration is done by interacting with the stakeholders. The divided portions are called sprints. (Charvat, 2003)

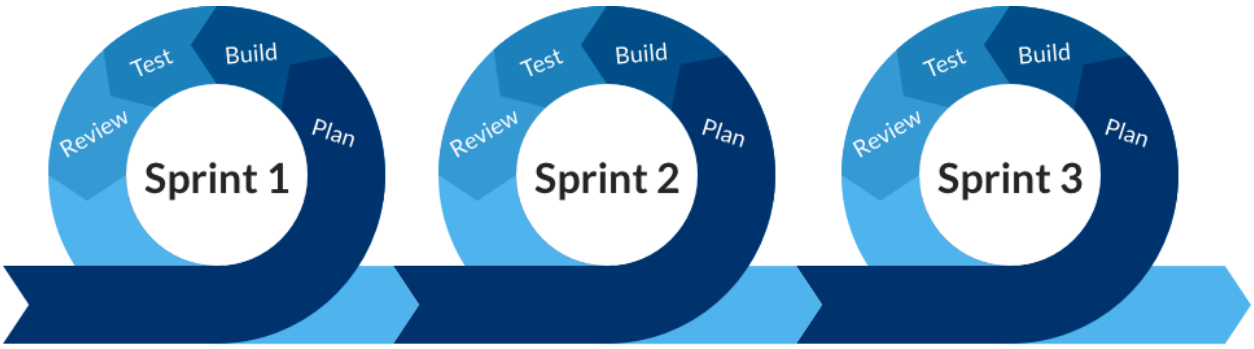

Figure 2 Agile Methodology. (Littlefield, 2019)

5.1.3. Prototype Methodology

It is the type of methodology in which the initial requirement is collected, successive prototypes are produced with added features and improvements and the process is repeated until the product that satisfy the client is produced. (Charvat, 2003) There are four types of prototype methodologies and they are:

- Rapid throwaway prototype.
- Evolutionary prototype.
- Incremental prototype.
- Extreme prototype.

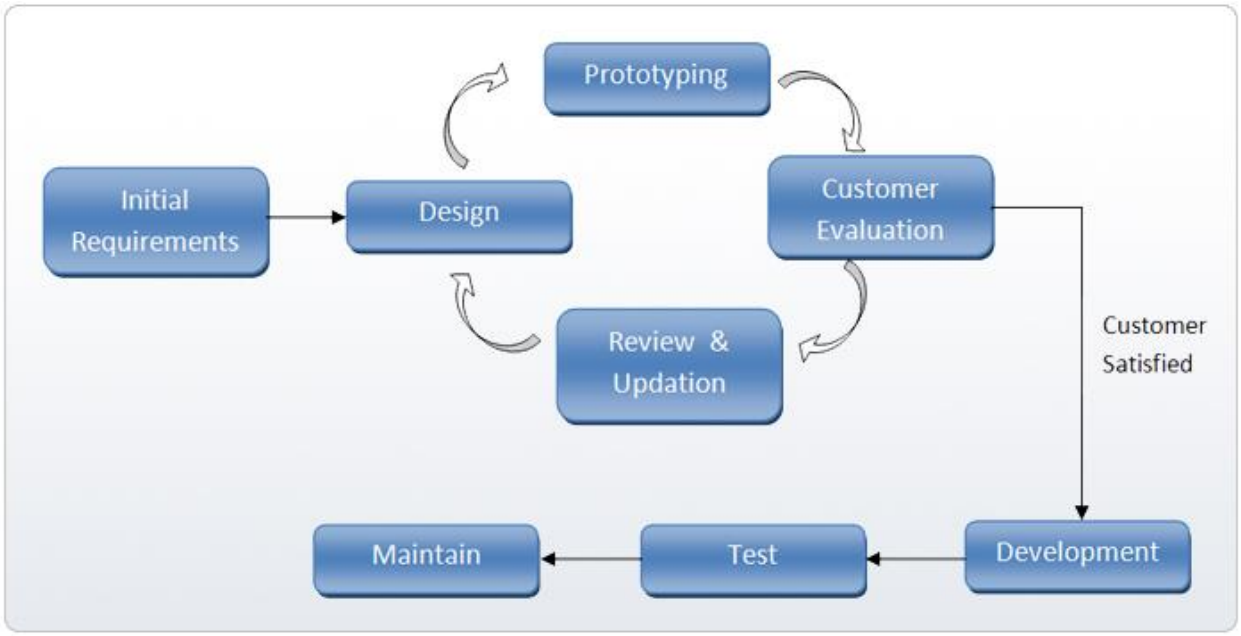

Figure 3 Prototype Methodology. (Littlefield, 2019)

5.2. Selected Methodology

5.2.1. Evolutionary Prototyping

The methodology followed for the system is Evolutionary Prototype methodology as changes are common and necessary part of the system. After The new features could be added, or an old feature could be removed to make the project more practical, efficient, and market ready. Innovations are the common in IOT system and with new ideas comes new changes, this provides the system to be flexible. Design, testing and improvement is what makes the innovation and changes possible which will eventually be able to satisfy the customer. The prototype can be changed multiple times as the requirement of the client might change overtime. The evolutionary prototype methodology also welcomes the criticism from the internal and external supervision in context of this system. (Haan & Diaz, 2002)

The advantages and dis-advantages of evolutionary prototyping are:

Advantages	Disadvantage
Ensures client's satisfaction and comfort.	Costly and time consuming.
New requirements are welcomed.	Documentation with the development can be frustrating as the product is continuously changing.
Flexibility in term of design.	Frequent changes and high maintenance cost.
Most needed functionalities are integrated first.	The customer might lose interest if first prototype does not satisfy their expectation.

6. Resource Requirement

There are various hardware and software tools needed for the completion of the project.

6.1. Hardware

The hardware that are required are:

Computer	A laptop or a desktop computer is required to program the Arduino and document the necessary information about the project. It is also required to build the database and carry out the research work. A computer with proper internet connection is mandatory.
Arduino Uno	It is the small sized, single board computer that provides various functionalities such as browsing internet, performing computational tasks and so on. It can be programed using Arduino programming language and Arduino Software (IDE). (Blum, 2013) In the project Arduino acts as the brain as it will be programmed to control and instruct all the sensors and analyze the data. Multiple Arduino will be used in the project. (Halfacree, 2018)
Sensors	It helps to generate the data based on the environment it is exposed to. As this is an IOT project there are various sensors that will be used in the project. The sensors that will be used in the project are: Temperature sensor, Humidity sensor, Soil Moisture sensor, Water level

	sensor, Color sensor, and IR sensor. (Yuvaraju & Priyanga, 2018)
Other devices required	For making, controlling, and monitoring the system various other devices are required, they are: Computer, Motor, automatic motor controller, and Mobile.
Other hardware required	Other hardware that are required are: A/D converter, led lights, memory card, wires, a proper Internet connection and a good environment to make and run system.

6.2. Software

The software requirements are:

C/C++	C/C++ is the programming language that will be used for programming the project.
HTML	HTML will be used to develop the webpage that displays all the necessary information that are sent by the sensors through the API.
Documentation Software	Various software is required for the process of documentation. Some of them are: Microsoft word, snipping tool, designing tools (Visio, draw.io), simulation software and so on.

7. Work breakdown structure

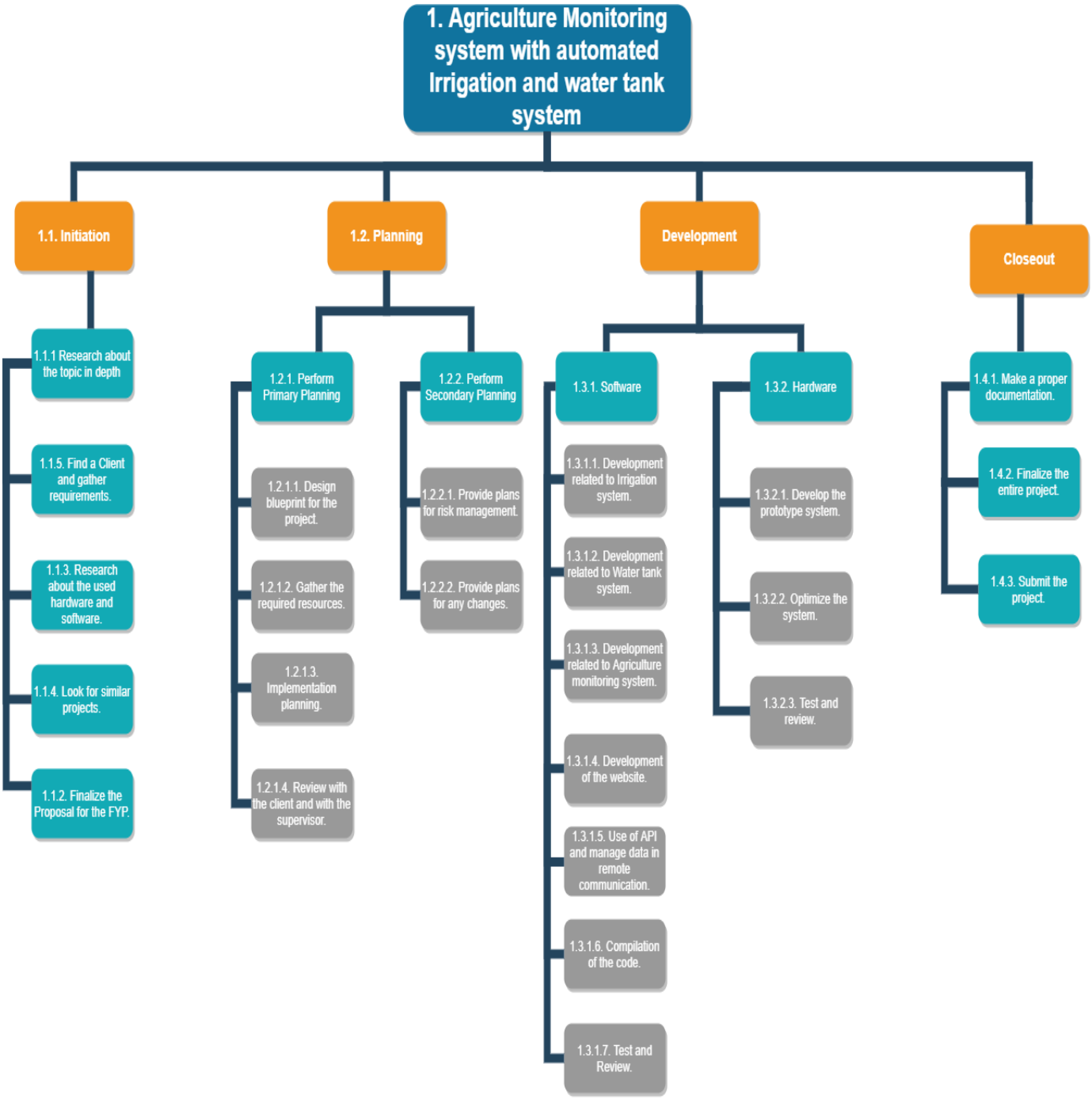

Figure 4 Work breakdown structure.

The project is initiated with the research work about the topic, finalization of the client and client's requirement, gathering information of the hardware and software used, research

about the similar topics to get the proper understanding about the topic, and lastly, proposal finalization for the project. This make take up to 30 days. The Initiation consists of the steps which provides detail knowledge about the topic to start working on the project.

Then the planning for the project is carried out to make the blueprint of a proposed project. The planning may take up to 20-25 days. Planning is divided into two portions i.e. Primary planning and the secondary planning. Primary planning helps to build the blueprint of design and implementation of the project. The review with the client and supervisor is done throughout the project. The secondary planning focuses on the risk management and plans if any major changes occurs in the proposed system.

Development is the most valuable part of the work breakdown structure. It focuses on the development of the main system as per the planning. This may take up to 80 days. The development is divided into two sections i.e. Software and Hardware. Software portion of the development focuses on the coding section to build the Irrigation, water tank and agriculture monitoring system, it also includes coding related to API and finally the compilation and testing. The hardware portion focuses on designing and managing Arduino and sensors and building the prototype so that it can be implemented in real life. The development is reviewed by the client at the end and if the client is not satisfied, necessary changes are made.

Finally, the closeout. The closeout portion consists of documentation of the development, finalizing, recheck and submission of the project. This may take up to 40-45 days. The documentation will consist of detailed explanation, scope, and everything about the system.

8. Milestones

- ✓ **Milestone 1:** Topic Finalization.

  Topic finalization is the first milestone that was achieved. The milestone helps to focus on a project.

- ✓ **Milestone 2:** Client Finalization.

  The finalization of the client is the important milestone as the project is based on the requirement of the client. The changes are made based on the requirement of the client.

- ✓ **Milestone 3:** Proposal Submission.

  The final proposal submission will give the idea of how the entire project is going to be. This highlights the main aspects of the final projects. It also identifies the initial requirement of the project.

- ✓ **Milestone 4:** Completion of Interim report.

  After the submission of the proposal the interim report is started. It is heavily based on the proposal and explains the topic in more detail. The interim report is major part of the report.

- ✓ **Milestone 5:** Complete development related to irrigation system.

  This is the completion of development of the first portion of the project, the first unit of the development automates the irrigation system.

- ✓ **Milestone 6:** Complete development related to water tank system.

  This is the completion of development of the second portion of the project, the second unit of the development automates the water tank system.

- ✓ **Milestone 7:** Complete development related to monitoring system.

This is the completion of development of the final IOT system which is responsible for the development of the monitoring system of the agriculture.

- ✓ **Milestone 8:** Complete development related to website and API.

  The milestone helps to achieve the development of the display system for the project which helps user to control and monitor the project remotely.

- ✓ **Milestone 9:** Finalize Development.

  All the development processes are finalized based on the review and requirement of the client. Every unit is tested and reviewed until this point.

- ✓ **Milestone 10:** Complete Testing.

  The final testing of the developed unit is completed in this milestone. The development is completed from this point.

- ✓ **Milestone 11:** Complete the documentation.

  The documentation of the project is completed which is the most important part of the project. The documentation is ready for submission.

- ✓ **Milestone 12:** Submit the project.

  The project is reviewed for the final time and submitted to the RTE.

9. Project Gantt Chart

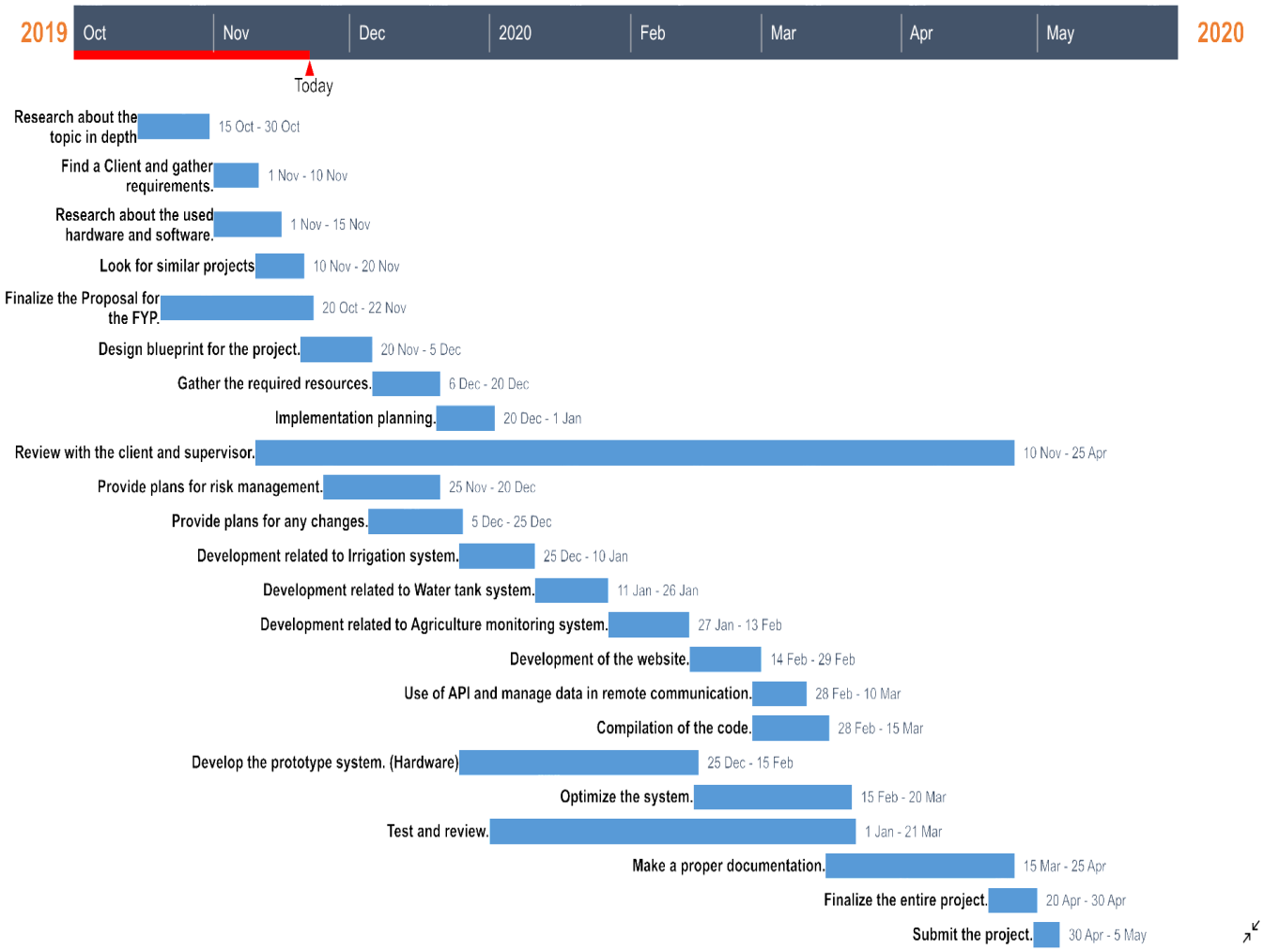

Figure 5 Gantt Chart.

Gantt chart is the representation of the tasks that are completed or the tasks that are to be completed in a timeline format. It represents when and for how long the processes are carried out. It is represented in a horizontal manner. In the above Gantt chart the work breakdown structure is divided classified based on time. There are also various milestones set throughout the time duration which is shown in the milestone section above. The total time for the completion of the project from the beginning is approximately 6.5 months. The timeline starts from the date when the topic was selected and ends with the submission of the project.

10. Conclusion

The agriculture monitoring with automated irrigation and water tank system will be an effective and efficient method in an environment where farmers want to utilize their limited water resource. The project is mainly targeted to the closed environment where people want a scientific and efficient way of farming through the use of technology. The system can remotely monitor the farm and automate the irrigation and water tank to utilize the water resource. The project will be based on a evolutionary prototype methodology and it is targeted to the people of agriculture industry who are willing to do the farming through the use of technology and in an systematic way. The time for the completion of the project is 6.5 months approximately from the start date and it is achieved by breaking down the project into the smaller tasks.

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12. Appendix

12.1. Similar Projects

12.1.1. Project 1

Project Name: IoT BASED SMART AGRICULTURE MONITORING FRAMEWORK WITH AUTOMATION

Publisher: I-manager's journal on embedded system

Author: S. KUMAR REDDY MALLIDI

URL: https://www.researchgate.net/publication/326686850_IoT_BASED_SMART_AGRICULTURE_MONITORING_FRAMEWORK_WITH_AUTOMATION

12.1.2. Project 2

Project Name: IOT Based Monitoring System in Smart Agriculture

Publisher: IEEE

Authors: S. R. Prathibha ; Anupama Hongal ; M. P. Jyothi

URL: https://ieeexplore.ieee.org/document/8081906

12.1.3. Project 3

Project Name: IoT Based Smart Agriculture Monitoring and Irrigation System Using Raspberry Pi Kit

Publisher: International Journal of Engineering Development and Research

Author: P. Nandhini, V. Kalpana, J. Sikkandhar Batcha

URL: https://www.ijedr.org/papers/IJEDR1802151.pdf

12.1.4. Project 4

Project Name: IoT Based Crop Field Monitoring and Irrigation Automation System

Publisher: IJISET - International Journal of Innovative Science, Engineering & Technology

Author: Erastus Ogunti

URL: http://ijiset.com/vol6/v6s3/IJISET_V6_I3_17.pdf

12.1.5. Project 5

Project Name: IOT based irrigation scheduling for smart farming

Publisher: Krishisewa

Author: Akram Ahmed

URL: https://www.krishisewa.com/articles/miscellaneous/1018-use-of-iot-based-irrigation-scheduling-for-smart-farming.html

12.2. Requirement from clients

12.2.1. Client 1: Krishi Sansthan

1. **The system should be able to automate the water tank:**

   The system should turn of the water supply when the water level is full and provide alert when the water level is too low. The system should keep track of water level and display it.

2. **The System should be able to automate the Irrigation system:**

   The plants are categorized according to the amount of water they need to grow, so the irrigation must me customizable to adjust the water level that is required by the plant. After the irrigation process is customized according to the requirement of the plant, the moister sensor should sense the moister level and automate the irrigation if the water requirement level falls below threshold level. The moister level should be displayed to the user and a message should be sent at the starting and completion of the irrigation process.

3. **The agriculture monitoring System:**

   The system should be able to monitor the plant and provide various information such as temperature, humidity, color, and camera. The data collected from the monitoring system should be displayed in graph for the ease of understanding.

4. **Storing:**

   All the data should be stored so that it can be accessed in the future. The stored data helps to reflect the growth and requirement of the plant. It can be helpful to understand the changes and water requirement in various seasons.

5. **Display:**

   The above-mentioned information should be displayed in android application so that it can be accessed easily from anywhere. The interface should be clean and simple for the ease of understanding the given information. The user should also be able to access the database (data that are being stored.) through the application.

6. **Reliable:**

   The system should run properly even if a sensor does not work. Redundant sensors can be a good solution to it.

7. **Accessibility:**

   The monitoring system should be accessible from a remote place through internet. The alert message should also be forwarded via email.

12.2.2. Client 2: Gautam Nursery

1. **The system should be able to automate the water tank:**

   The system should turn of the water supply when the water level is full and provide alert when the water level is too low. The system should keep track of water level and display it.

2. **The System should be able to automate the Irrigation system:**

   The plants are categorized according to the amount of water they need to grow, so the irrigation must me customizable to adjust the water level that is required by the plant. After the irrigation process is customized according to the requirement of the plant, the moister sensor should sense the moister level and automate the irrigation if the water requirement level falls below threshold level. The moister level should be

displayed to the user and a message should be sent at the starting and completion of the irrigation process.

3. **The agriculture monitoring System:**

   The system should be able to monitor the plant and provide various information such as temperature, humidity, color, and camera. The data collected from the monitoring system should be displayed in graph for the ease of understanding.

4. **Storing:**

   All the data should be stored so that it can be accessed in the future. The stored data helps to reflect the growth and requirement of the plant. It can be helpful to understand the changes and water requirement in various seasons.

5. **Display:**

   The above-mentioned information should be displayed in a website so that it can be accessed easily anywhere from a computer. The interface should be clean and simple for the ease of understanding the given information. The user should also be able to access the database (data that are being stored.) through the application.

6. **Reliable:**

   The system should run properly even if a sensor does not work. Redundant sensors can be a good solution to it.

7. **Accessibility:**

   The monitoring system should be accessible from a remote place through internet. The alert message should also be forwarded via email.

13. Circuit Diagram

13.1. Circuit Diagram of Circuit Diagram

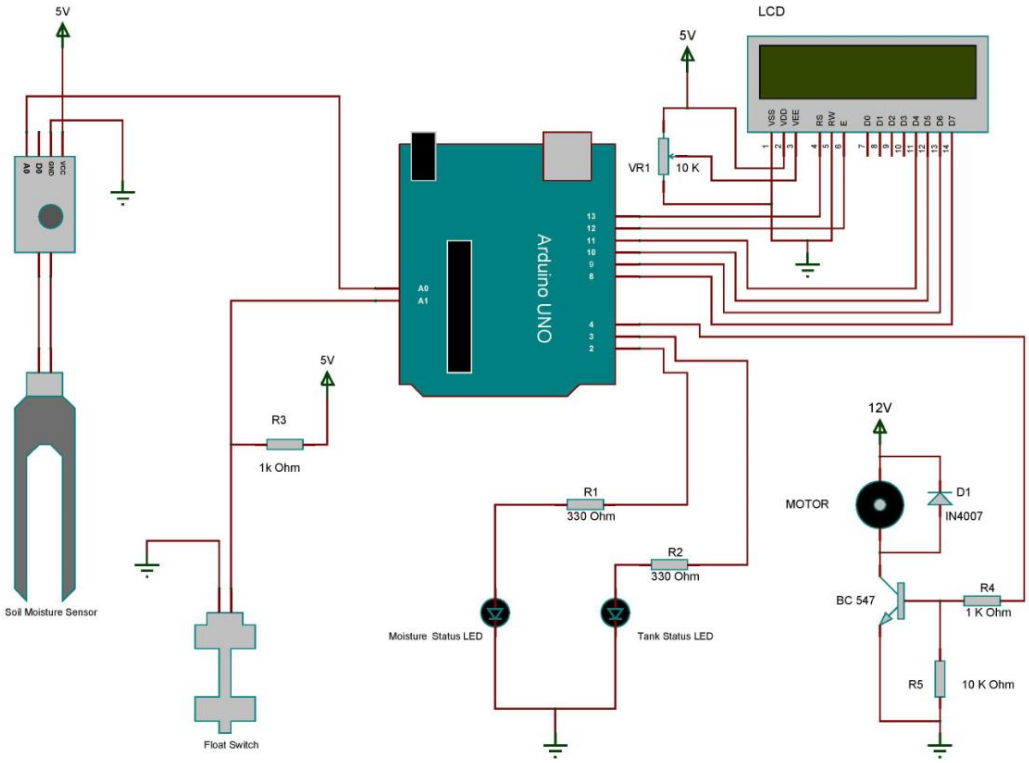

Figure 6 Circuit Diagram of Irrigation System.

13.2. Circuit Diagram of the Water tank System.

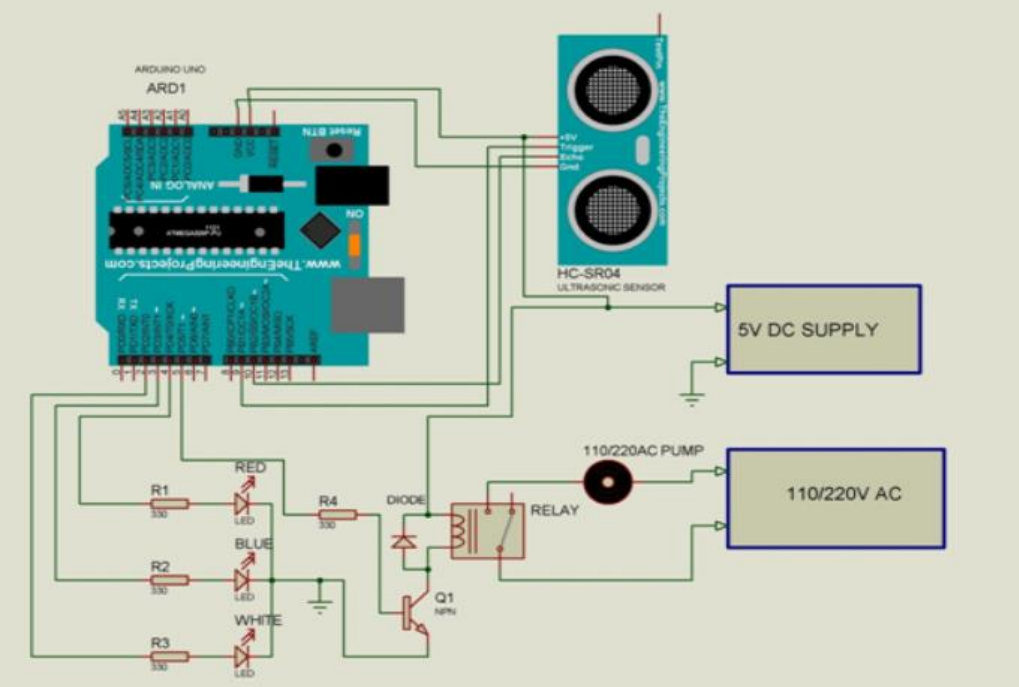

Figure 7 Circuit Diagram of the Water tank System.

13.3. Circuit Diagram of monitoring system.

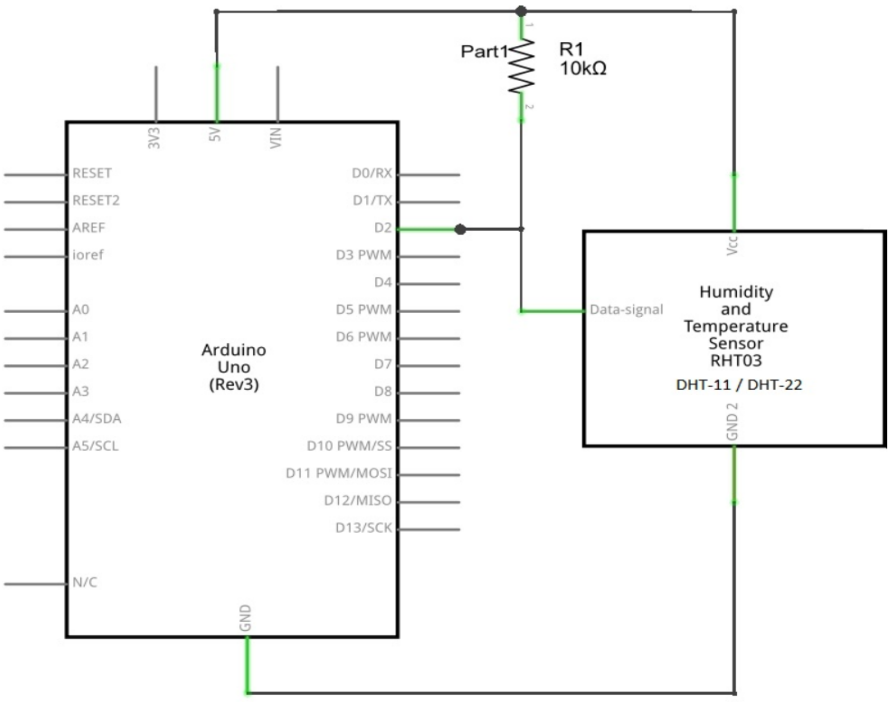

Figure 8 Circuit Diagram of the monitoring system.