Smart Mango – A Smart System for Mango Plantation Management

TMP-23-309

Project Proposal Report

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8th May 2023

IoT-Based Smart Watering System

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DECLARATION

I declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

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Ms. Hansika Mahaadikara- Supervisor Date

8/5/23 8/5/23

Ms. Shashika Lokuliyana – Co-Supervisor Date

ACKOWLEDGEMENT

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ABSTRACT

Since it is essential to ensuring global water and food security, proper irrigation system has garnered a lot of attention. For the efficient use of water in agricultural industry and to increase crop production, a smart irrigation system is used. As a result, irrigation has less of a negative environmental impact and there is less of a strain on water supplies. This project will identify the gaps in the irrigation methods and examine how they affect crop quality, productivity, and water usage. It has been demonstrated that using soil moisture sensors, temperature sensors, and humidity sensors to gain data and by analyzing them through a machine learning model, the water need to be released to the agriculture field can be determined. Therefore, it can save water while preserving crop growth and quality. The information about the soil moisture level and the water scarcity will be provided real time through the web interface.

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1. INTRODUCTION

A country like Sri Lanka, where the economy is built primarily on agriculture and the weather conditions are isotropic, needs to quickly improve its food production technology to meet the constantly rising demand for food. Despite this, we are still unable to fully utilize our farming resources.

Moreover, we constantly pollute the ecosystem and misuse a variety of farming components. The primary causes are a dearth of information and a lack of water in land reservoirs. A lot of land is steadily encroaching in the areas of unirrigated land as a result of the continual removal of water from the ground.

Due to unintentional water usage, which results in substantial wastage and a reduction in the soil's fertility, this is also due to another very important cause. To help farms save time and money while also improving their quality of life, we are developing an automated method. For changing irrigation applications-based temperature, humidity, and soil conditions, smart irrigation systems are a developing technology.

Most of the smart irrigation systems present in the market are expensive and cannot be afford by the small-scale mango farmers. This system is made using qualified and sensors with reasonable prices. Therefore, this system can be provided with a reasonable price. The machine learning model used in the system can be used to accurately provide the amount of water needed to the plantation.

The usage of this system will reduce many tasks that are divided among the employees, and it will help the managers to manage the farm activities efficiently and effectively.

1.1 Background Literature

There has been lack of research on the use of smart watering systems for Sri Lankan mango farms, despite these systems have been extensively explored for a variety of crops. Mangos are a significant fruit crop in Sri Lanka, because of the problems with water shortages and unreliable rainfall cycles, which can have a severe effect on both productivity and quality.

The potential advantages of smart watering systems for mango production have been highlighted in a number of studies. Research by Rahman et al. (2020) on a smart irrigation system for mango plantations in India found that the technology enhanced yield by 33% while reducing water use by 40%. Similar results were found in research by Rezaei et al. (2020) on a smart irrigation system for pomegranate plantations in Iran. The technology boosted fruit quality while reducing water use by 30%.

A study by Karunarathna et al. (2021), has discovered that the water needs of mango trees in Sri Lanka varied depending on the soil type, climate, and age of the tree, demonstrating the necessity for site-specific irrigation management systems. While smart watering systems have the potential to increase the yield and efficiency of water use in mango plantations, more research is required to address implementation issues and limitations as well as to determine the best technologies and approaches for Sri Lanka's unique agro-ecological conditions.

In locations with water scarcity and unpredictable weather, smart watering systems are a viable way to maximize water use in agricultural productivity. These systems combine multiple technologies, including sensors, controls, and communication networks, to offer real-time irrigation management monitoring and decision-making capabilities.

The potential advantages of smart watering systems for crop productivity, effective water usage, and farm profitability have been shown in a number of studies. Aghighi et al. (2018) discovered, for instance, that when compared to conventional irrigation techniques, a smart irrigation system for tomato production reduced water use by 35% and boosted yield by 26%. Similar to this, Mekonnen et al. (2020) claimed a 30% reduction in water use and a 14% increase in output compared to conventional irrigation in a trial of a smart irrigation system for maize cultivation in Ethiopia.

Smart irrigation system adoption still faces obstacles and restrictions, despite the potential advantages. One significant obstacle for small-scale farmers is the high initial investment cost for the technology. The demand for technical competence and the intricacy of the technology might also make it difficult to adopt and maintain the systems.

1.2 Research Gap

Despite the potential benefits of smart watering systems for mango orchards in Sri Lanka, further research is still needed to determine the precise requirements and most effective ways to implement such systems. Despite studies on intelligent watering systems for other crops and in other countries, there is still a need for studies that focus on the unique characteristics of mango plantations in Sri Lanka, such as soil type, climate, and irrigation patterns. A lack of studies that could provide farmers with relevant information about the economic potential of implementing smart watering systems in Sri Lankan mango orchards is another issue. Further research is needed on the machine learning based smart watering systems, particularly for cost and availability for small-scale farms. By closing these knowledge gaps, Sri Lankan mango farming could become more efficient and productive while simultaneously promoting sustainable water use practices.

2. RESEARCH PROBLEM

The dearth of research on the unique water needs of the various mango types grown in the nation represents one possible research gap in the field of smart watering systems for mango plantations in Sri Lanka. There has been research on the water demands of mango trees generally, however due to variances in climatic conditions, soil types, and other factors, different mango cultivars produced in Sri Lanka may have varying water needs. Therefore, research is required to establish the ideal water needs for the various mango varieties cultivated in Sri Lanka and to create intelligent watering systems that can adjust to these needs. This could entail running field tests to determine the water needs of various mango varieties, creating sensors that can track the moisture content of the soil in real-time, and using machine learning algorithms to optimize irrigation schedules based on the unique requirements of each mango variety.

3. OBJECTIVES

3.1 Main Objectives

- To implement a smart water management system that provide water to the plantation at the correct time and the correct amount.

The main objective of the system is to implement a smart water management system that provide water based on data input by different types of sensors and analyze it through a machine learning model. The amount of data analyzed through the machine learning model is distributed to the farmland through the pipelines. The real time data can be obtained through the website. This will help the users of the system to control and manage remotely. This will make the management functions easier, and the operation cost of the field will be reduced. The maximum yield can be obtained by using a smart irrigation system. The wastage of many resources such as water, energy, labor force, time, and money.

3.2 Sub Objectives

- To minimize the wastage of water
- To make the management functions easy
- To increase the yield of the mango plantation
- Use less workforce and save energy.
- To increase the efficiency of the workers.

4. METHODOLOGY

Raspberry Pi, soil moisture sensor, temperature and humidity sensor, a relay switch, an Ethernet shield/GSM module, an AC motor are used as the hardware components. The sensing portion, the management portion, the transmission portion, and the output portion are the system's four main components. The Raspberry Pi was used to create the management device. The data to the system is obtained from the temperature, humidity, and soil sensor installed in the mango plantation. The data obtained from the sensors are send to the cloud server using the GSM module. The data obtained is analyzed through a machine learning model. This model will predict the irrigation data needed for the plantation. The water needed to the plantation will be released through the pipelines. The system can be used in semi-automated and fully automated mode. The system can be shut down during the rainy season. The management and the authorized workers can access the website and can control the system remotely. The data of the mango plantation can be obtained real time through the website. A report of the water usage will be given at the end of a specific time period according to the requirement of the management.

4.1 System Diagram

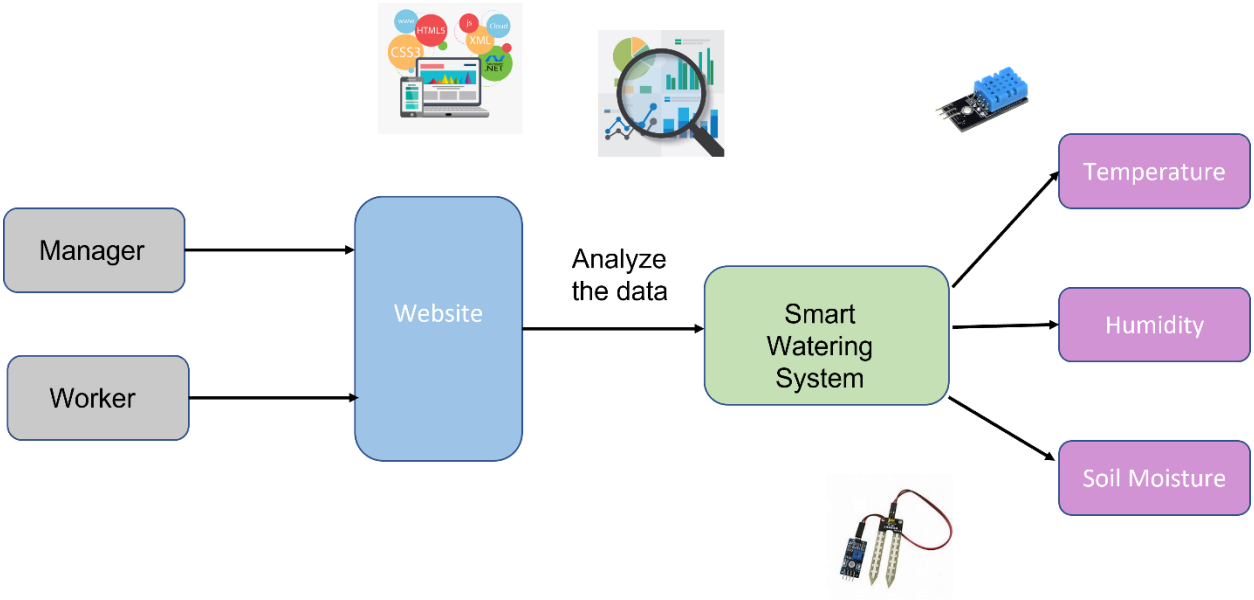

Figure 4.1 System Diagram

4.2 Work Breakdown Structure

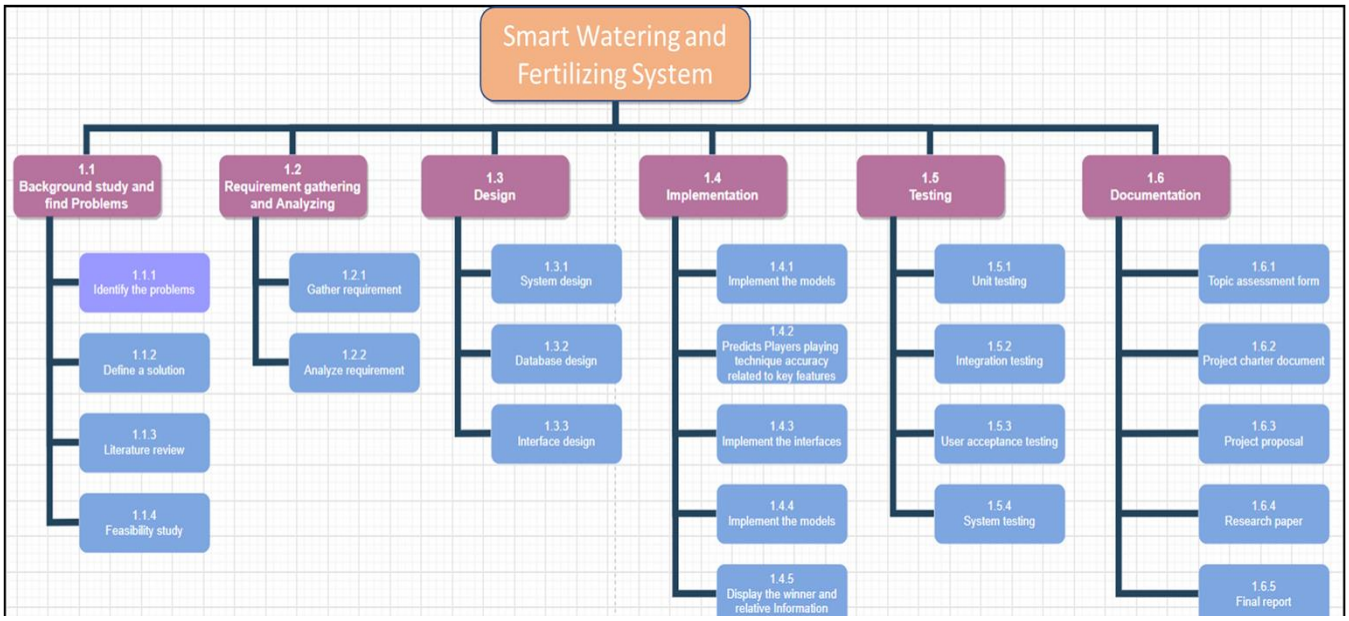

Figure 4.2 Work Breakdown Structure

4.3 Gantt Chart

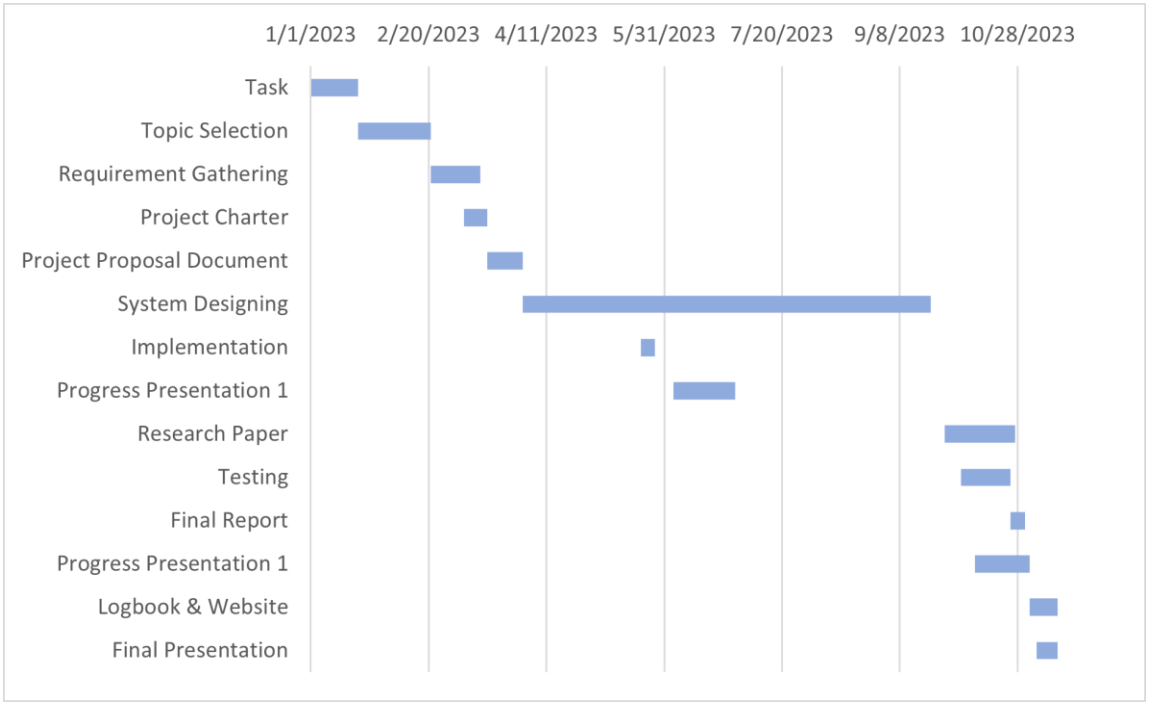

Figure 4.3 Gantt Chart

5. BUDGET AND BUDGET JUSTIFICATION

Item	Quantity	Unit Price	Total Price
Raspberry Pi	1	19200	19200
Relay Switch	1	420	420
Servo Motor	1	900	900
Soil Moisture Sensor	1	210	210
Temperature and Humidity Sensor	1	490	490
Total Amount			21220

Table 1 Budget Table

6. CONCLUSION

The research examines the advantages and drawbacks of the currently used methodologies in order to develop a smart water management system. Using the data provided by the sensors as input, the machine learning model will be used to predict the quantity of water needed for the plantation and to distribute it via the pipeline. One of the activities that requires the most water is agriculture. The system uses sensor data to calculate how much water should be applied to the soil, avoiding over- or under-irrigation, which may be detrimental to crops. To follow the procedure, farm owners can use the website. This study has shown how the Internet of Things and automation might significantly improve agriculture. The device offers a workable solution to the problems associated with the present manual and tiresome irrigation strategy by enabling efficient utilization of water resources.

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