CHAPTER 1
INTRODUCTION

1.1 Background

Agriculture is critical in developing countries like Indonesia because it contributes to improving the quality of human resources and also serves as a means of ensuring social and political stability, both are necessary progress to implement[4]. Indonesia is a country with a population of over one billion people that rely on rice as their staple food. As a result, agriculture should be enhanced and modernized, particularly in terms of technology, to enable higher and more significant increases in agricultural yields.

Agriculture technology continues to advance, resulting in the creation of perfect growing conditions for crops. The scarcity of agricultural land and the unpredictable nature of weather conditions have aided in the development of greenhouse agriculture. A greenhouse, in which plants are cultivated, is a modified structure to meet their specific demands. With rapid technological advancement of agriculture, conventional greenhouse technology has been phased out in favor of the construction of a greenhouse fitted with a smart farm system.

This smart greenhouse is equipped with the Internet of Things-based automation system (IoT). The Internet of Things is a technology that enables the connection of objects and the movement of data via a network[5]. In a greenhouse, numerous major variables are managed, including temperature, humidity, soil moisture, and light intensity.

Celery is a significant agricultural commodity in Indonesia. Celery is a leaf vegetable that has a variety of uses, including being a culinary complement and possessing medicinal properties. Celery plants are also rich in vitamin A, vitamin C, iron, and other minerals. Celery contains 130 IU of vitamin A, 0.03 mg of B vitamins, 0.9 g of protein, 0.1 g of fat, 4 g of carbohydrate, 0.9 g of fiber, 50 mg of calcium, 1 mg of iron, 0.005 mg of riboflavin, 0.003 mg of thiamine, 0.4 mg of nicotinamide, 15 mg of ascorbic acid, and 95 ml of water per 100 g of raw material[6].

Celery plants are popular in Indonesia. Almost everyone consumes this veggie. Celery plants need about 25-28 days to mature after planting. To boost the production of celery farming, a smart farm system with drip irrigation is developed to operate automatically in response to variations in the celery plant soil water content. The goal is to increase celery production which offers farmers the appropriate planting phase for excellent harvests and possibilities to preserve celery quality on the market. A greenhouse is one of the facilities used to carry out proper planting. The greenhouse is a building that enables celery to be planted optimally in a more controlled environment while minimizing undesirable environmental variables. The researchers have conducted several studies on greenhouse usage, including real-time monitoring and management of greenhouse systems based on smart farming systems, as well as self-sufficiency in exploiting the environment[7].

The Internet of Things (IoT) may be the key to operate celery nurseries. A Raspberry Pi 3B+ is used, along with a variety of extra sensors, including the DHT-22 humidity and temperature sensors, the YL-69 soil moisture sensor, the BH1750 light intensity sensor, the ADC ADS1115, and relays. The sensor will collect data on the room temperature and humidity, soil moisture, light intensity, and water availability in case of irrigation. If the available water supply is insufficient, an automated approach based on the dataset may be employed to perform the watering procedure. The data will subsequently be stored in a database, allowing for immediate monitoring via the internet.

The author's objective in this thesis is to create an environment conducive to the mentioned plant development criteria. Finally, the author constructs a smart farm with the use of a sensor-assisted automated system to assist farmers and the home sector with plant growing techniques. This instrument will be constructed in a greenhouse and will include soil moisture sensors, room temperature and humidity sensors, light intensity sensors, relays, water pumps, and a Raspberry Pi 3B+ acting as the device's brain.

1.2 Problem Identification

Celery production, as one of the edible and medicinal plants, increases marginally. This can result in a shortage of accessible supply if it is not proportionate to market demand. One of these issues is a result of a lack of comprehensive knowledge and understanding. Farmers have significant challenges in identifying superior seeds that have an effect on the quality and quantity of celery. Celery market demand, however, remains outstanding due to its use in home and medicinal cooking. At the moment, there are no criteria for developing projections that have an effect on the farmer's surroundings.

1.3 Objectives

The research in this thesis has the following objectives:

1. Capable of designing an IoT device for automation in smart farm.
2. Capable of designing a prediction model that can provide smart farm.
3. Capable of designing a tool that can provide watering as needed in smart farm.
4. Capable of designing a tool that can monitor the room temperature, room humidity, light intensity, and soil moisture of the smart farm in real time.
5. Capable of developing an optimal celery seeding period growth prediction model in the farmers surrounding.

1.4 Scope of Work

The limitations of the problems carried out in the study are as follows:

1. The IoT device used is Raspberry Pi 3B+.
2. The programming language used on the device is the Python programming language version 3.7.3.
3. Type of database used is MySQL Database.
4. The image of celery growth is not used as an attribute for predictive modelling.
5. Machine learning used is random forest algorithm using decision tree.
6. Parameters measured using DHT22 sensor for room temperature and humidity, BH1750 sensor for light intensity, and YL-69 sensor for soil moisture.
7. Quality of Service determines the quality of data collecting depending on delay and throughput characteristics.
8. The celery growth dataset covers variables collected in the Buah Batu region in December 2021.
9. The Raspberry Pi was used for data retrieval and storage, while the celery prediction models were run on a laptop.

10. The research did not discuss network security

1.5 Research Method

The methodology for the preparation of this thesis is as follows:

1. Literature study

   At this stage, the author looks for material, references related to the undergraduate thesis and also conducts a survey for smart farm.

2. Literature Review

   At this stage, the author analyses problems based on the sources and also the results of observations that are within the problem boundary.

3. System Testing

   At this stage, the author conducts a system test of the tool to find out the results of the design of the smart farm automation system.

4. Conclusions and Suggestions

   At this stage, the author processes the results of the conclusions of the research tested based on predetermined parameters and some supporting suggestions based on the deficiencies contained in this undergraduate thesis.

1.6 Undergraduate Thesis Structure

The rest of this thesis is organized as follows:

- Chapter II BASIC CONCEPT
  This chapter discusses the theory, parameters to be used, an explanation of the sensors, tools and platforms used to support this final project.

- Chapter III PROPOSED CELERY GROWTH MODEL AND SYSTEM
  This chapter discusses the overall system model and system design that will be used in this final project.

- Chapter IV RESULTS AND ANALYSIS
  This chapter contains the results of quality of service and analysis from testing the smart farm automation system that has been created, testing the web database that has been created, and the results of data modeling.

- Chapter V CONCLUSION AND SUGGESTION
  This chapter contains the conclusion taken from this thesis and accommodate the suggested idea use for future research in the same field of interest.