CHAPTER 1
INTRODUCTION

1.1 Background

People coexist with almost everything digital that surrounds us in the Industrial Age 4.0. Nowadays, technology has become an important factor in daily life. Technology even now can be applied to any sector. Technology was not created solely for manufacturing; it has now advanced to the world of agriculture. Technology can play a role in the agricultural sector, particularly in horticulture, which has an impact on the community today. Agriculture is becoming increasingly popular in Indonesia, and as digital technology advances, farmers in Indonesia have more opportunities to practice agriculture for maximum results [1].

One of the biggest agricultural areas in Indonesia is West Java Province. West Java is one of Indonesia's most important agricultural areas. West Java, in particular, is one of Indonesia's leading producers of vegetables such as red spinach, mustard, lettuce, and spinach. According to data from the Central Bureau of Statistics and the Ministry of Agriculture, West Java is one of the major agricultural provinces, with 31,371 tons in 2020, 28,987 tons in 2019, and 29,809 tons in 2018. According to this data, the revenue from red spinach in West Java ranges from 1,000 to 3,000 tons. Several factors contribute to this fluctuation, including weather sensitivity, limited resources, the effect of fertilizers, and climate change. Maintaining the commodity price stability of spinach requires the supply of high-quality red spinach, minimizing the shortage of factors with the help of industrial products 4.0 to open opportunities to maintain the availability of spinach supply in terms of quantity and quality so that people can enjoy it at stable prices. The specific parameter observed for analysis was soil moisture as a growth-related factor for growing spinach.

Agricultural technology is constantly improving, creating ideal growing conditions for plants. Scarcity of agricultural land and unpredictable weather conditions fueled in the development of greenhouse agriculture. A greenhouse for growing plants is a modified structure designed to meet those specific requirements. Through the rapid advancement of agricultural technology, traditional greenhouse

technology has been phased out in favor of building greenhouses equipped with smart farm systems. This smart greenhouse has an Internet of Things-based automation system (IoT). The Internet of Things is a technology that connects objects and allows data to flow across networks [5].

There are several types of spinach, including snapper spinach, thorn spinach, and red spinach. Red spinach (Alternanthera amoena Voss) is a spinach variety with a distinct feature: the plant is red. This type of spinach is known as a highly nutritious vegetable because it contains protein, vitamin A, vitamin C, and mineral salts that the body requires. The stem color can be any other color, such as green, red, yellow, or a combination of these [1]. According to data released by the Central Statistics Agency (BPS), spinach production results vary, and the lack of popularity of red spinach has resulted in less intensive cultivation and marketing, despite the fact that red spinach is beneficial to the human body as an antioxidant.

The Internet of Things (IoT) could be the key to successfully running red spinach nurseries. The Raspberry Pi 3B+ supports additional sensors such as the DHT-22 humidity and temperature sensor, the YL-69 soil moisture sensor, the BH1750 light intensity sensor, the ADS1115 ADC, and relays. During irrigation, the sensor collects data on room temperature and humidity, soil moisture, light intensity, and water availability. If the available water supply is insufficient, the irrigation process can be performed using an automated method based on the dataset. The information is then stored in a database, allowing for real-time monitoring via the internet.

Based on the problems listed above, the solution can be implemented by searching for datasets and prediction models that are ideal for red spinach in order to produce quality red spinach while also meeting market demand, and the categories are included in the Livestock Monitoring category, as well as data storage based on the device used. As a result, the researchers carried out a study titled "IoT-BASED SMART FARMING WITH MACHINE LEARNING FOR RED SPINACH." In the system, IoT will save data to the MySQL database and then send data to Firebase, after which the researcher will access the data via a query that generates a collection of data that will be processed by Machine Learning and produced an ideal prediction model for red spinach.

1.2 Problem Identification

In this section there are several identification problems, as follows:

1. Red spinach plants continue to be volatile.
2. The uncertainty of red spinach production for three years may result in a reduction in red spinach supply in the face of future higher demand.
3. Farmers are frequently concerned about information and technology illiteracy.
4. It is difficult to select the preferred red spinach seeds in the quantity that corresponds to the quality.
5. The results of a fluctuating supply of high-quality red spinach, requiring responses to market demands supported by suggestions from farmers who claim that red spinach is still supported by a fair market. Red spinach is a popular cooking ingredient in both homes and businesses.
6. A reasonable, comprehensive, and systematic reference to growing red amaranth linked to the data set appears to be unavailable at this time.
7. This developed method, in this case, it will serve as a useful foundation for farmers to calculate the appropriate number of red spinach plants to produce products that do not reduce market costs.

1.3 Objectives

For its purposes and benefits, itself as:

1. Capable in accomplishing the qualified Quality of Service.
2. Machine learning performance relation worth for the ideal dataset and classification model knn result.
3. Proficient in implementing the whole system on IoT
4. Adept in implementing MySQL databases by collaborating with IoT, as well as at the machine learning development stage to compile datasets and red spinach growth models to be analyzed during the seeding period.
5. Competent to generate an optimal red spinach growth model for the farmer as input for the best red spinach crop within the forthcoming.

1.4 Scope of the Work

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

1. The red spinach growth dataset contains four parameters which will be stored in variable form gathered from April - May in the Buah Batu region
2. The network quality measurement that is affected in data collection is determined by QoS based on delay and throughput parameters.
3. Confusion matrix and classification report is used as the machine learning observation parameter to determine the model's quality.
4. Network security of data transmission between systems is not discussed
5. The Python libraries will be used are NumPy, Pandas, Matplotlib, Seaborn, and Scikit-learn.
6. The machine learning technique used is guided learning specify by the classification approach
7. The image of red spinach growth was not used as a predictive modeling attribute.
8. This system will be focused on creating a dataset that matches the growth of the defined plant's research.
9. The IoT platform used is the Raspberry Pi 3B+ model
10. The data collection and storage realization is carried out on the Raspberry Pi, while the red spinach prediction model is implemented on a laptop.
11. The programming language that will be used to build systems and create classification knn models is Python version 3.
12. The type of database used is one of the RDBMS products MySQL database.
13. The parameters to be measured are greenhouse temperature and humidity using the DHT22 sensor, light intensity using the GY302-BH1750 sensor, and soil moisture using the YL-69 sensor.

1.5 Research Method

This thesis is divided into six works packages as follows:

1. Literature Study

   Knowledge review to formulate datasets and prediction models with IoT mechanism, MySQL database, and machine learning procedures with guided learning from credible references such as articles, books, journals,

or conference papers published by credible publications and governments.

2. Model System

   Arranging designs systematically for the prediction model datasets from the data collection phase in IoT, data storage in MySQL database, and data modeling with machine learning procedures of Python-based corresponds to literature review.

3. Application, Device, Tools and Library Preparation

   Ensure that the sensor collects data from the research object. Make sure the Raspberry Pi is able to store data and send it to the MySQL database for full data storage. Satisfy Jupyter Notebook as code executing media and its dependable libraries installed on the laptop to construct the model.

4. Dataset Preparation

   Collects the raw data from MySQL database adding with manual parameter measurement attributes and their corresponding values also labels manually in Microsoft Excel downloaded from MySQL database.

5. The Red Spinach Growth Model Analysis

   The prediction model formulated in the Jupyter Notebook takes the specified data set and determines the model using machine learning procedures.

6. Performance Metric Analysis

   Analyze service quality as it relates to throughput and delay for data transmission. Also, classification reports and confusion matrix based on cases, accuracy, and precision values to achieve the ideal model.

1.6 Bachelor Thesis Organization

The rest of this thesis is organized as follows:

- CHAPTER 2 BASIC CONCEPT

  This chapter contains an explanation of the basic theory of the related system concept.

- CHAPTER 3 THE PROPOSED RED SPINACH GROWTH MODEL AND SYSTEM

  This chapter contains the illustration of the algorithm, concept implementation, and flowchart diagram of the designed integrated system.

- CHAPTER 4 PERFORMANCE EVALUATION

  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 5 CONCLUSIONS

  This chapter contains the conclusion taken from this thesis and accommodates the suggested idea use for future research in the same field of interest.