CHAPTER I
INTRODUCTION

1.1 Background

The Dragon fruit, also known as Pitaya in English, comes from several types of cactus belonging to the Hylocereus and Selenicereus groups. The origin of this fruit is found in Mexico, Central America and South America, but now it is also widely grown in many Asian countries such as Taiwan, Vietnam, the Philippines, Indonesia and Malaysia. In Indonesia, demand for dragon fruit continues to increase from year to year, with productivity reaching around 24 to 30 tons/hectare (Maulida & Farah, 2018). In 2014, the Banyuwangi Agriculture Service noted that Banyuwangi Regency, which is one of the national dragon fruit production centers, had a harvest area of around 678.80 hectares with a harvest of 24.5 tonnes/ha. Total dragon fruit production reached 16,630.60 tons. The hope is that this production amount will be sufficient to meet domestic consumption needs, thereby reducing dependence on dragon fruit imports from Thailand and Vietnam.

Dragon fruit is popular with many people because of its unique shape, sweet taste, fiber content, vitamins and minerals which are good for health. According to Wibawa (2012), one way to manage dragon fruit after harvest is to check the quality and ripening of the harvested dragon fruit products. Checking and controlling the ripeness of dragon fruit is very important in managing dragon fruit products. Consider the quality of fruit ripeness as perceived directly by consumers as the most important quality indicator.

The process of determining the ripeness of dragon fruit using the classical method encounters many obstacles due to the subjective nature of selection or lack of scientific understanding in selecting ripe dragon fruit, which causes the selection of dragon fruit to be less accurate. The manual method commonly used to determine the ripeness of dragon fruit is checking based on its appearance and checking by touch. This method is considered ineffective if used to classify the ripeness of dragon fruit in large quantities. Apart from that, this manual method has several weaknesses, including the need for more energy to carry out sorting, human consistency in choosing ripe dragon fruit, because humans also feel tired, this can also be caused by other factors such as decreased vision, etc. that the human eye cannot be used as a benchmark

to determine the level of ripeness of dragon fruit. Therefore, by utilizing information technology, researchers have created a system for determining dragon fruit ripening using the Naïve Bayes method to make it easier to determine dragon fruit ripening.

To develop the research above, it is necessary to develop further research so that the researchers propose "Development of a System Based on Naive Bayes Method for Ripening Level Identification in Dragon Fruit (Hylocereus spp.)". In this research, several stages were carried out, including the development of Red Green Blue (RGB) and texture feature extraction using GLCM on dragon fruit object images. Apart from that, the Naïve Bayes method was applied to determine the accuracy of the dragon fruit ripeness results.

Red Green Blue (RGB) is a color model used in digital image processing. It represents colors as a combination of red, green, and blue light. RGB is commonly used in image segmentation and feature extraction, including for fruit images such as dragon fruit (Hakim, Kristanto, & Shodiq, 2020) . Grey Level Co-occurrence Matrix (GLCM) is a method used for texture feature extraction in digital image processing. It analyzes the spatial relationship between pixels in an image to extract texture features such as contrast, homogeneity, and energy. GLCM has been used in various studies for fruit image analysis, including for dragon fruit (Husdi, 2020). Therefore, to extract texture features from a dragon fruit image using GLCM, the image needs to be converted to grayscale first. Then, GLCM can be applied to the grayscale image to extract texture features such as contrast, homogeneity, and energy. These features can be used for further analysis, such as classification or identification of the fruit's ripening level (Husdi, 2020).

Naïve Bayes is a classification method that can be used for fruit sorting based on RGB color features extracted from fruit images (Manik & Saragih, 2017). The method involves extracting color features from the RGB image and then using Naïve Bayes to classify the fruit based on these features. The accuracy of this method can be high, with one study reporting an accuracy of 90.5% for fruit sorting using a perceptron system (Manik & Saragih, 2017). Other studies have used Naïve Bayes for fruit classification and identification, including for identifying different types of apples based on color features, and for classifying the skin color of a digital image (Adika , Suartana, & N, 2022). The Naïve Bayes Classifier method has been widely used in research on text mining. Some of the advantages of the Naïve Bayes Classifier include

a simple algorithm but has high accuracy (Ariadi, Dio and Fithriasari, & Kartika, 2016).

1.2 Problem Statement

Based on the above foundation, the problem with sorting red dragon fruit is that it is still done manually, resulting in inconsistent sorting and not meeting the fruit quality standard (WIBOWO., 2022). Sorting and grading are post-harvest processes that affect the quality of dragon fruit (Baskara, 2021). Some other problems related to determining the quality of dragon fruit include the selection of harvest time and post-harvest sorting and grading (Baskara, 2021). Dragon fruit is a perishable product that requires special handling such as washing, sorting, and grading to maintain its freshness (Aritaga, Moh. Rajiv Rohman, & Sumarlan, 2022). The use of image processing and neural network techniques can help farmers sort dragon fruit more quickly and efficiently (Baskara, 2021). The perishability of dragon fruit is also a challenge in marketing, and farmers need a fast marketing system to sell their products (Adiyanto, 2011), this study aims to overcome obstacles in determining the ripening of dragon fruit using information technology and Naïve Bayes classification methods. Therefore, the formulation of the problem that arises in this study is as follows:

- How to develop a Red Green Blue (RGB) image that can be used to assist in determining the ripening of dragon fruit using the Naïve Bayes method?
- How is the Naïve Bayes Classifier method applied to classify the ripening level of dragon fruit based on image extracts and texture characteristics?
- How can the development of a system based on the Naïve Bayes method help improve the efficiency and accuracy of verification and control of dragon fruit ripeness?

The formulation of this problem includes aspects of image development, extraction of texture characteristics, use of classification methods, comparison with classical methods and performance evaluation. This study aims to overcome obstacles in determining the ripening of dragon fruit through a more efficient and accurate calculation method.

1.3 Objectives

The goal of the project "Development of a system based on the Naive Bayes method to determine the ripening of dragon fruit (Hylocereus spp.)" is to develop a system that can help determine the ripening of dragon fruit (Hylocereus spp.) using the Naive Bayes method. Naïve Bayes method. This project aims to improve the efficiency and accuracy of the dragon fruit ripeness process which is usually done manually. Therefore, this project has several main objectives, including:

- Develop a dragon fruit ripening determination system: Build an information technology-based system using the Naïve Bayes method to Classify the ripening level of dragon fruit.
- Identify the level of accuracy in the application of the Naïve Bayes method: Knowing the level of accuracy in determining the ripening of dragon fruit compared to the manual identification method subjectively.
- Provides functionalities that facilitate increased productivity and overall quality of dragon fruit with a system determining dragon fruit ripening.

1.4 Scope

1. Project
    - Dragon fruit image data collection:

    The system will receive dragon fruit image data that can be obtained through photographic equipment or cameras. This image will be used as input for the analysis process. There are several datasets available for dragon fruit images, including a custom dataset of 100 images with 25 green, 25 green-red, 25 yellow-red, 25 red dragon fruit.

    - Image feature extraction:

    The system will develop methods to extract important features from dragon fruit images, including texture features using the Gray Level Co-occurrence Matrix (GLCM) and color specifications using red green (RGB). The Gray Level Co-occurrence Matrix (GLCM) is a statistical method that can be used to extract texture features from images. It calculates the frequency of pairs of pixel values at a given offset and direction in an image. RGB is a color model that represents colors using combinations of red, green, and blue light. To

extract color features from dragon fruit images, the RGB values of each pixel can be analyzed

- Ripening modeling with Naïve Bayes:

The Naïve Bayes method will be applied to model the ripening rate of dragon fruit based on extracted feature data. The process will involve training Naïve Bayes models using known dragon fruit ripening data. The process of determining the level of ripening of dragon fruit is conventional and there are many obstacles too. The determination is usually by paying attention to the color of the fruit, which changes as it matures

2. User
    - Dragon fruit growers and cultivators:

They will be the end users of the system under development. They will use this system to evaluate the ripening of the dragon fruit after harvest.

- Agricultural researchers and scientists:

They can use this research to develop methods and technologies related to dragon fruit management, as well as measure the effectiveness of the Naïve Bayes method in classifying ripe dragon fruit.

3. Sistem
    - User interface:

These systems can include an intuitive user interface, allowing dragon fruit growers and cultivators to upload dragon fruit images, receive ripening assessment results, and receive recommendations regarding harvesting or management.

1.5 Significance

The expected benefits of this study are:

1. For writers
    - Can increase knowledge and experience in developing a dragon fruit ripening identification system. The project to develop a dragon fruit ripeness identification system offers a valuable opportunity to improve knowledge and gain practical experience. These efforts allow individuals to learn the ins and outs of this innovative technology, thereby making progress in the field of agricultural science.

- Added reference to the use of the Naïve Bayes method. The addition of these references provides a solid foundation for the data analysis approach we use in this research and strengthens our theoretical foundation. By integrating the Naïve Bayes method into our analytical framework, we can understand and interpret the data we examine more deeply, allowing us produce more accurate and meaningful results.

2. For society

It can help farmers and consumers easily determine the ripening level of dragon fruit. This system can have a big positive impact on agriculture and the dragon fruit cultivation industry, helping farmers and producers optimize harvest yields, fruit quality and production process efficiency. Therefore, developing a system for determining dragon fruit ripeness can help increase productivity and industrial profits. This also increases the supply of quality dragon fruit on the market.

1.6 Summary

The project "Developing a system based on the Naive Bayes method to determine the ripeness of dragon fruit (Hylocereus spp.)", aims to solve challenges related to assessing the ripeness of dragon fruit (Hylocereus spp.) long, a popular and nutritious fruit grown in many different countries, including Indonesia. Manual methods currently used to assess ripening levels tend to be inconsistent and do not meet quality standards. The project takes advantage of information technology, using the Naïve Bayes classification method to automate and improve the accuracy of determining the ripeness of dragon fruit.

The research includes several main objectives, including the development of a system that uses dragon fruit image data for analysis. Through image feature extraction techniques such as RGB color parameters and texture features using GLCM, the system will provide a more accurate assessment of the ripeness of dragon fruit. The Naïve Bayes method will be employed to model ripeness levels based on these extracted features, offering a more consistent and precise approach. The system's user interface will be designed to facilitate ease of use for dragon fruit growers and cultivators, enabling them to upload images for ripening assessments and receive valuable recommendations for harvest and management decisions.

The significance of this project extends beyond its academic and technological merits.. It has the potential to enhance knowledge and experience in developing fruit ripening identification systems, particularly using the Naïve Bayes method. Moreover, it offers a practical solution that can benefit both farmers and consumers, as it simplifies the process of determining the ripeness of dragon fruit, contributing to a more efficient and accurate fruit production and distribution process.