UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AUTOMATIC PLANT MANAGEMENT SYSTEM FOR HORTICULTURE USING ANDROID

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer System) with Honours.

by

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DECLARATION

I hereby, declared this report entitled "Automatic Plant Monitoring System for Horticulture using Android" is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer system) with Honours. The member of the supervisory is as follow:

……

(Project Supervisor)

ABSTRAK

Sistem pengawasan tumbuhan automatik untuk hortikultur adalah sistem untuk memantau tumbuhan hortikultur seperti strawberi di persekitaran tanah rendah. Malaysia tinggal di rantau khatulistiwa yang panas dan lembap sepanjang tahun. Iklim Malaysia tidak sesuai untuk tumbuhan tanah tinggi kerana Malaysia mempunyai haba yang berlebihan. Projek ini dibina untuk memantau tumbuhan tanah tinggi dalam bekas yang tertutup seperti rumah hijau. Projek ini secara automatik boleh memantau keperluan asas tumbuhan seperti suhu, kelembapan, cahaya dan air. Kelembapan dan suhu diukur dengan menggunakan sensor DHT22, kelembapan tanah diukur dengan menggunakan sensor lembapan tanah dan cahaya diukur dengan menggunakan sensor LDR. Semua nilai yang diukur dikawal oleh Raspberry Pi dan hantar ke pelayan web di dalam Raspberry Pi. Sistem pemantauan akan dipamerkan pada aplikasi Android. Nilai untuk suhu dan kelembapan dipaparkan pada aplikasi. Di samping itu, pangkalan data mengemas kini tindakan dari sensor dan ia menghantar nilai kepada komponen output. Sistem ini mempunyai fungsi automatik dan fungsi manual. Apabila sistem berada dalam manual, pengguna boleh menghidupkan dan mematikan alat peltier, pembuat kabus, pam air dan lampu. Projek ini sesuai untuk pekebun kecil kerana boleh ditempatkan di rumah atau di luar rumah. Ia adalah merupakan satu kemudahan kepada tukang kebun kerana ia ringan dan kecil.

ABSTRACT

Automatic plant monitoring system for horticulture is a system to monitor a horticulture plant such as strawberries in the low ground environment. Malaysia lives in an equatorial region that is hot and humid throughout the year. Malaysia climate is not suitable to grow high ground plant due to its excessive heat. This project is built to monitor the high ground plant in a closed container like a greenhouse. This project can automatically monitor the basic need of the plant like temperature, humidity, light, and water. The humidity and temperature are measured by using the DHT22 sensor, the moisture of the soil is measured by using soil moisture sensor and light are measured by using LDR sensor. All the measured value is controlled by the Raspberry Pi and send to the web server inside the Raspberry Pi. The monitoring system is being display on the Android application. The value for temperature and humidity are display on the application. In addition, the database updates the action from the sensors and it sends the value to output components. This system has automatic function and manual function. When the system is in manual, the user can easily turn on and turn off the Peltier, mist maker, light and water pump. This project is suitable for a small-scale gardener because it can be placed either in a house or outside the house. It is convenience to the gardener because it is lightweight and small.

DEDICATION

To my beloved parents and me.

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First and foremost, I am grateful to the God for the good health and well-being that were necessary to complete this project.

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CHAPTER 1
INTRODUCTION

This chapter consists of project background, problem statement, objectives, the scope of project and thesis outline that give a brief overview of automation system and scheduling management system for the high ground plant on the low ground using Android.

1.1 Background

Malaysia is located in the equatorial region which has a tropical rainforest climate. It is hot and humid throughout the year. Generally, the rainfall in Malaysia is 250 centimeters (98 in) and temperature of 27 °C (80.6 °F) a year (Abd Aziz, 2015). Furthermore, El Nino effect is exposed to Malaysia. It reduced rainfall in the dry season. Due to this weather, the high ground plant is difficult to grow on the low ground especially in Malaysia. The high ground plant needs an optimum temperature about 15 °C to 26 °C to live (Kubota and Kroggel, 2015). Malaysia rates in humidity is an average of 80% (Weather and Climate, 2016). The high ground plant needs 80 % of humidity so that it can grow healthily (Sulaiman and Ramachandran, 2014).

Change of climates can easily damage the plants. High ground plants have their own requirement to live. They cannot withstand the extreme change of climate like Malaysia. Greenhouse or also being called as glasshouse is used to grow plants that need to be required regulated climate conditions. A greenhouse becomes a heat trap during warm weather and the plants freeze to death if the temperature drops to

low. Some farmers used this greenhouse to grow high-value crops. Building a greenhouse is expensive. The farmers need to bear with the loss of profit when the crops damage due to climate changes. Hence, in order to overcome the problem automation system and scheduling management system are used in the greenhouse. By using this system, farmers can easily manage their greenhouse even though the weather is erratic. This project is mainly focused on a small-scale gardening so everyone can experience planting a high ground plant in their backyard.

The greenhouse is used to control the basic need for the growth of the plant such as temperature, humidity, light, and water. All of the basic need of the plant will be measured by using sensors. All the measured values will be controlled by Raspberry Pi and send to the server to be displayed on Android application. If the measured value is different from the requirement, the system will automatically trigger and take action to the plant. Plant need sufficient environmental element for them to yield a healthy and high-quality crop. The purpose of this project is to make an automatic system that is able in maintaining the growth of the Highland plantation in all condition.

1.2 Problem statement

The high ground is hardly growing on low ground in Malaysia due to hot and humid climate. The average temperature in Malaysia is 27 °C (Abd Aziz, 2015). It is hard for a low ground plant such as strawberry, raspberry, and tomato to live in Malaysia because the optimum temperature for the high ground plant is about 15 °C to 26 °C (Kubota and Kroggel, 2015). Furthermore, strawberries are very sensitive to dry climate. It needs 80% of humidity to make it grow healthily (Sulaiman and Ramachandran, 2014). If the humidity is high it will lead to the growth of bacteria while if the humidity is low it can cause the disease to the plant such as allergies. Next, strawberry needs to be water regularly. They need an average of 1 to 2 inches of water weekly. If the plant is over water, it can lead to fungal infections and cause the root to rot. Strawberries need at least 6 hours of full sun or 6 – 10 hours of light a

day to grow (*Strawberries*, 2010). Too much exposure to the sun or heat will harm new plants and stunt their growth.

The demand for the high ground plant is high especially for strawberries because it is widely used in industry. The crop production for this plant is quite low because strawberry can live on high ground. In Malaysia, strawberry plantation majorly is done in Cameron Highland. Malaysia exports more strawberries from other countries due to its high demand. Because of that strawberry categorized as expensive fruit in Malaysia. In the era of technology, the majority of the people lives a busy lifestyle. Thus, they don't have time to take care of their garden. With the aid of the system, they can take care of their garden automatically. Furthermore, even the small-scale gardener can experience the farming of high ground plant in the low ground.

1.3 Objectives

I. To study the suitable environmental element for the high ground plant that fit on the low ground environment.
II. To analyze the functionality of the system in order to monitor and maintain the growth of the high ground plant on the low ground.
III. To develop a system using Android application to monitor and create an appropriate environment for the high ground plant.

The first objective of this project is to study the suitable environmental element for the high ground plant that fit on the low ground environment. This is to decide the suitable environmental element for the high ground plant and it needs to be adjustable on the low ground environment.

For the second objective, the functionality of the system will be analyzed in order to monitor and maintain the growth of the high ground plant. Raspberry Pi is used for this project to control all the sensors and link it to the Android. The user can

analyze and monitor the temperature, light, humidity and watering schedule of the plant through the system.

For the third objective, an Android application is developed to monitor and create an appropriate environment for the high ground plant. The users are able to monitor and create the environment by using their own smartphone.

1.4 Scope of Project

The scope of this project is to monitor the high ground plant on low ground by using the Android platform. The horticulture plant that is being chosen to be monitor is strawberry. Studies show that strawberries can fight cancer and bad cholesterol that can lead to heart diseases. Furthermore, strawberry is a high demand crop due to widely used in industry.

This project is divided into two part that is hardware development and software development. In hardware development, Raspberry Pi will control all the sensors that will measure all the required values and send to the server. The software developed in this project is Android. From the server, all the measured values will display on the smartphone. Farmers can easily monitor their garden with just a single click.

This project will control the moisture of the soil, temperature of surrounding and amount of light produced. For moisture of the soil, soil moisture sensor is used. The soil moisture sensor will detect the moisture of the soil. Strawberry plant needs an average of 1 to 2 inches of water. If the soil around the plant is moist about 2 inches deep, it means it obtains enough water. If the soil dries out, the mist will turn on and moisture the plant. For the temperature of the surrounding, the temperature sensor is used. The optimum temperature for the high ground plant is 15 – 26 °C(Kubota and Kroggel, 2015). If the temperature in the greenhouse exceeds 20 °C, Peltier will automatically turn on. All plants need sufficient amount of light to live. The light sensor is used to detect the presence of light.

1.5 Significance of study

In an equatorial region like Malaysia, its climate is hot and humid throughout the year. So, it is hard to grow a high ground plant in this climate. Furthermore, the high ground plant is high in demand in the market. This project is not only for big farmers. Small-scale farmers also can take part and grow the Highland plantation. The new system in the greenhouse can help ease the farmer with the automation system that requires less human power. In addition, raising the high ground plant in a hot climate area will attract more people in doing the home gardening. This system will improve the quality of the crop production as it is being monitored and managed automatically.

1.6 Structure of report

Chapter 1 explains about the strawberries that are a high ground plant that hardly grows on the low ground due to the difference in climate. In this chapter also discuss the greenhouse that is used to plant the horticulture plant. In addition, in this chapter also discussed problem statements, objectives, the scope of project and significance of the study.

Chapter 2 study on a literature review by comparing former project that is related to this project. In this part, research about the Highland plantation and greenhouse are conducted and the result of the research are presented. Compare and contrast through the research being done to make an affordable greenhouse project. Further to this, basic of raspberry pi, sensors, and Android are explained in this chapter.

In chapter 3, the systems of study methods on hardware development and software development are done in this chapter. The hardware development consists of the construction of the project and the workflow on how the system function. On software development, Raspberry Pi is used to control the sensor and its measured value is presented on the Android.

In chapter 4 the results are analyzed from both hardware and software development. Results analysis are in the form of figure and discussion.

Chapter 5 is the conclusion of the project and future improvements recommendation.

CHAPTER 2
LITERATURE REVIEW

In this chapter, it focusses on the literature review on theoretical ideas implement in this project. The information of the project is gathering in order to complete the whole project. There is some discussion of the related research about the previous project that is related to this project.

2.1 Horticulture

Horticulture is defined as both art and science. The originality of horticulture from the middle age is the practice of growing kitchen gardens that contain herbs, ornamental plant, vegetables and fruits for the lord's mansion. In today's era, horticulture includes the culture of vegetables, herbs, fruits, ornamental plant and another high-value plant. Horticulture is a contrast from agriculture, horticulture comes with small-scale gardening and it is generally in the enclosed garden while agriculture deals with large-scale gardening with a wide range of crop cultivation. For example, in Western European countries they depend on the high level of machinery used in a large-scale area of land. By using the machinery, the production process uses less manpower (Adams C.R., Bamford K.M and Early M.P., 2008). Horticulture is tending towards the domestic aspect of cultivation. It is practice in a small-scale area, so it is less expensive than agriculture.

Table 2. 1: Agriculture vs Horticulture

(Source<(http://www.differencebetween.info/difference-between-agriculture-and-horticulture)

	Agriculture	Horticulture
Scale of operation	Large scale	Small scale
Budgeting	Usually agriculture costs more than horticulture	Horticulture is normally less expensive
Activities	Irrigation, cattle farming, rearing, etc.	Garden cultivation, growing fruits and vegetables domestically, maintenance of such a garden, etc.
Subsidies	Agriculture is boosted by subsidies by various governments	Subsidies are not as frequent as they may be in agriculture
Occupation vs. hobby	Agriculture is mainly taken up as occupation by people	Horticulture is opted for occupation as well as leisure
Output/yield	Agriculture yields a higher output	Less output, as compared to agriculture

Mainly, in horticulture, there are only four types of study that is Pomology (fruit culture), Olericulture (vegetable culture), Floriculture (culture in the ornamental crop) and Post Harvest Technology (management of produce after harvest). The scope of horticulture has been expanded over the years. It consists of other plants like tea, coffee, bamboo, mushroom and etc. Strawberries are under pomology that is fruit culture. Strawberries are a garden cultivation fruit. It is suitable to plant in the home garden. A relatively small amount of space in the backyard garden is required to grow the strawberry. Usually, a backyard plant garden is specialized in plants that are high in demand and can be container grown to save

space. In addition, container growing saves water and time. Gardeners that live in the rural area can make a good income by doing the backyard plant garden and focus on wholesale plant sales around their district.

Figure 2. 1:backyard garden

(source< http://www.colinalexander.info/files/pdfs/horti2008.pdf)

2.2 Highland Plantation

Malaysia observes as tropical weather without tremendously high temperature. Malaysia is located in the equatorial region, so its climate is hot and humid throughout the year. The average temperature ranges from 20 °C to 30 °C. The average rainfall in Peninsular Malaysia is 2500 mm and 5080 for East Malaysia (Abd Aziz, 2015). Even though majority area in Malaysia have hot climate but there is still a highland area that has cold climates such as Cameron Highland and Genting Highland in Pahang. The average temperature in Cameron Highland is 18 °C. The temperature can climb up to 25 °C during the day and it also can plunge as low as 9 °C during the night (*Weather and Climate, 2016*).

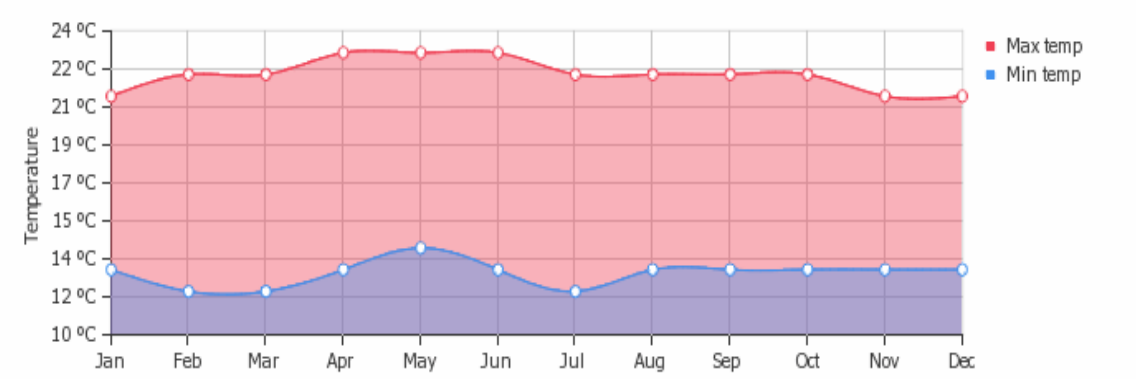

Figure 2. 2: Average minimum and maximum temperature in Cameron Highland

(source: https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,Cameron-Highlands,Malaysia<2016)

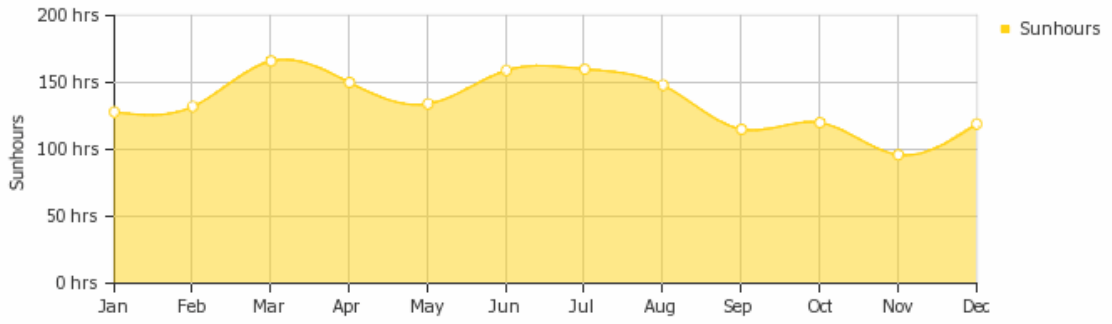

Figure 2. 3: Average monthly hours of sunshine in Cameron Highland

(source: https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,Cameron-Highlands,Malaysia <2016)

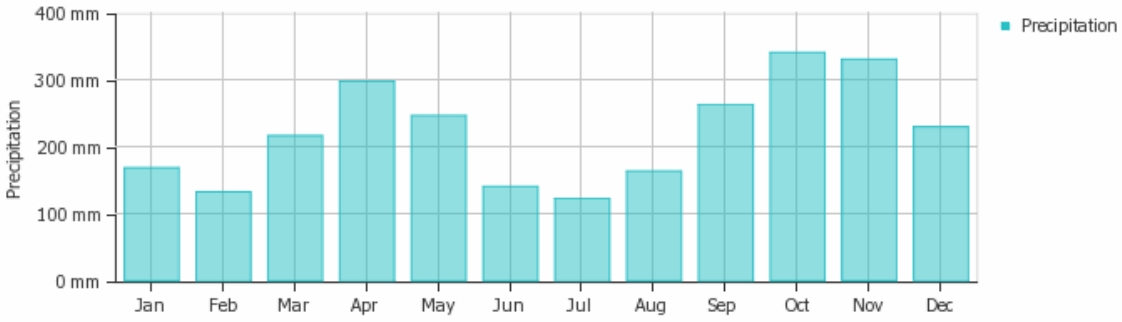

Figure 2. 4: Average rainfall precipitation in Cameron Highland

(source: https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,Cameron-Highlands,Malaysia <2016)

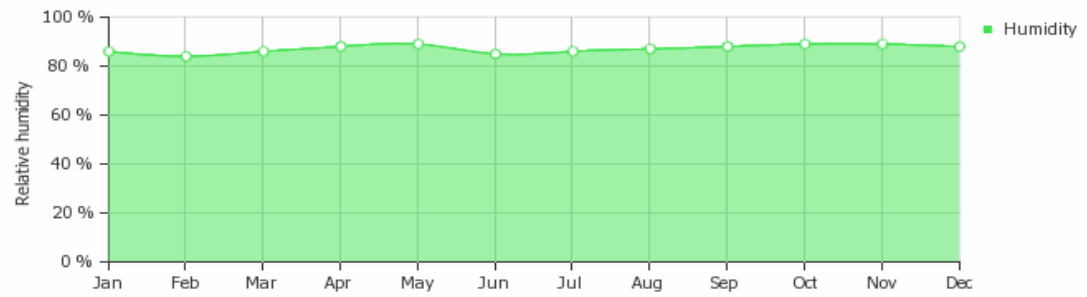

Figure 2. 5: Average humidity in Cameron Highland

(source: https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,Cameron-Highlands,Malaysia <2016)

The plant that lives in Cameron Highland is considered rare and hard to see on the low ground in Malaysia. It contains plant that only can live in cold climate. Some of the examples for the cold climate plantation that can be found in Cameron Highlands are strawberries, persimmon, tea, roses, daisies, lavender, grapefruit, and vegetables. Tea plantation in Cameron Highland is one of the largest tea producers in Malaysia. Other than that. Cameron Highland is also the center of strawberry production in Malaysia. The temperature and humidity needed for the plant in the cold climate region and hot climate region are different. The temperature in Cameron Highland is an ideal temperature for the cultivation of strawberry. Strawberries are easy to grow if they meet their basic requirements. With the optimum temperature in Cameron Highland can lead to the development of strong roots and take up required nutrients for the strawberries to produce lots of flowers and fruits.

In Cameron Highland, all of its plants grow in a container like a greenhouse. The container filter all the rain and sunlight. Cold climate plant needs an average of 1 – 2 inches of water. They required less water than another plant. The excess water can lead fungal infections and rot of roots. Furthermore, cold climate plant cannot survive in hot climate condition and it is tending to die when they expose to hot climate. Strawberry plant does not need direct sunlight, but they also do not grow well in full shade. So, it still needs some source of sunlight to make process photosynthesis to maintain the health of the plant.