UNIVERSITI TEKNIKAL MALAYSIA MELAKA

WEB-BASED AUTOMATIC MONITORING AND SCHEDULING MANAGEMENT OF HIGHLAND PLANTATION ON LOW GROUND

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

by

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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 pemantauan dan pengurusan berjadual automatik bagi tumbuhan adalah sebuah sistem yang difokuskan untuk tanaman tanah tinggi yang ditanam di kawasan tanah rendah. Tanaman tanah tinggi memerlukan perhatian lebih terhadap suhu dan kelembapan. Ini kerana, cuaca panas yang dialami oleh sebahagian besar kawasan di Malaysia boleh merosakkan tumbuhan iklim sejuk. Sistem ini mempunyai konsep sama seperti rumah hijau dalam membantu pekebun untuk memerhati dan mengendalikan tumbuhan daripada perubahan iklim melampau. Namun, sistem ini lebih sesuai untuk pekebun kecil kerana saiznya yang kecil dan mudah diletakkan di dalam rumah. Saiz dan reka bentuk yang fleksibel memudahkan ia diletakkan dimana-mana dan perubahan pada perisian boleh dilakukan pada bila-bila masa. Selain itu, terdapat empat elemen utama yang akan dipantau dan dikendalikan secara automatik oleh sistem ini iaitu suhu, kelembapan, air dan cahaya. Seterusnya, nilai-nilai yang diukur oleh sensor akan dikawal oleh Raspberry Pi dan dihubungkan kepada sesawang sesawang di dalam Raspberry Pi. Kemudian, proses pemantauan dilakukan melalui laman sesawang dimana graf-graf yang menunjukkan perubahan suhu dan kelembapan dari semasa ke semasa dipaparkan dan juga paparan pangkalan data bagi suhu serta kelembapan. Tumbuhan disiram sebanyak dua kali sehari berdasarkan jadual siraman tumbuhan yang ditetapkan secara automatik. Kehadiran cahaya melalui lampu khas untuk tumbuhan menggantikan cahaya matahari membolehkan tumbuhan diletakkan di kawasan kurang cahaya. Di samping itu, sistem ini mempunyai mod manual yang membolehkan pengguna untuk menutup dan membuka pam air, alat sejuk (peltier), penghasil kabus bila-bila masa. Hal ini kerana pemerhatian manusia lebih baik daripada sistem automatik. Oleh itu, sistem pemantauan dan pengurusan berjadual automatik ini adalah sistem yang tidak memerlukan banyak tenaga kerja manusia dalam mengendalikan tumbuhan dan juga membolehkan tanaman tanah tinggi ditanam di mana-mana tempat.

ABSTRACT

An automatic monitoring and scheduling management system for plant is a system that is mainly for highland plantation to be planted on low ground. The highland plantations require more attention especially on temperature and humidity. This is because the hot climate condition experienced in most part of Malaysia can easily damage cold climate plants. This system which has similar concept with greenhouse helps farmer to observe and handle plants from extreme climatic conditions. However, this system is more suitable for small scale gardener due to the small size and it is suitable to be placed inside the house. The size and design are flexible as it can be moved anywhere and settings on the software can be done at any time. Moreover, there are four effective environment elements that will be monitored and handled automatically by the system which are temperature, humidity, water and light. The temperature readings and percentages of relative humidity are measured using temperature and humidity sensor. The measured values will be controlled by Raspberry Pi and linked to the web server inside the Raspberry Pi. Then, the monitoring process can be done through website. From the website, graphs showing changes in temperature and humidity over time can be viewed easily. Moreover, databases of temperature and humidity are also displayed in the website. Based on the watering schedule, the plant will be watered twice a day. The presence of a growing light that replaces sunlight allows the plant to get sufficient amount of light to grow well even if it is placed in a dark area. Most importantly, this system also have manual mode on the website for the user. The manual mode allows user to on and off water pump, cooler (peltier), mist maker at any time. This is because human observations are better than the automatic system when observing the condition of plants. Hence, this automatic monitoring and scheduling management system is a system that requires less human energy in handling plants and also allow highland plantation to be planted at any place.

DEDICATION

To mom, dad and me.

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Countless appreciation and inmost thanks for the help and support are extended to the following persons who have contributed in making this project possible.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

This chapter consists of project background, problem statement, objectives, scope of project, significance of project and thesis outline that define and give brief overview about an automatic monitoring and scheduling management system for highland plantation at low ground using web based.

1.1 Background

Regularly, greenhouse is widely used in all countries as it is very useful to protect plants from the effect of environment that frequently changed. In four season countries, the greenhouse protects plants from freezing temperature especially during winter season. Other than that, greenhouse is somehow useful to protect plants from extremely hot summers. The change of climatic conditions can easily damage the plants. This is because each plant has its own characteristics on where and how it can grow very well. Most of the farmers plant high value crops in greenhouse to protect from extreme climatic conditions. However, the cost of greenhouse method is quite high. This is because high loss of profit whenever the high value crops damage due to climate changes every year.

Therefore, this automatic monitoring and scheduling management system that has similar concept with greenhouse would help farmer or gardener to observe and handle highland plantation on hot climate areas especially in Malaysia. This system is not mainly for large farmer or gardener but it is more suitable for people who prefer small scale farming. This is to allow small scale farmer experiencing planting highland plantation in small quantity at the backyard or even in their house.

The idea to protect the plantation is same like greenhouse but it is easier as it operates automatically and cheaper as it is for small quantity of plants. The purpose of this system is to monitor and manage temperature, water, light and humidity for the plant. This monitoring and control processes will be done automatically and continuously. Therefore, less human monitoring is required.

The inputs of this system are the temperature reading, light intensity and percentage of humidity. All the inputs will be measured using sensors and the measured values will be controlled by Raspberry Pi. Then, it will be linked to web servers that installed in the Raspberry Pi. The output will be displayed on the web. If the measured values are not the same with the expected values, actions will be taken automatically. For instance, if temperature of surrounding exceeds the normal range such as too hot or too cold, the system will activate peltier to reduce the temperature back to normal. The light will be used to replace sunlight in order for the plant receives enough amount of light. The watering schedule will be set on server and can be monitored from website. When it is time to water the plant, dripping irrigation system will be activated. Other than that, humidity of surrounding will be measured using humidity sensor. Mist maker will be activated whenever the humidity percentage below the normal value. This invention system is able to maintain the growth of the highland plantation under control all the time.

1.2 Problem Statements

As most of the places in Malaysia experiencing hot climates every year except for Cameron Highlands and Genting Highlands, it is quite difficult to plant strawberry, tea plantation and others on low ground. This is because they are usually suitable to be planted on cold climate area. Cold climate plantation which also known as highland plantation demands specific range of temperature around 10°C-20°C with percentage of humidity about 60%-80% (Sulaiman *et a*l., 2014). Higher percentage of humidity will lead to growth of bacteria whereas less percentage of humidity can cause disease to the plant such as allergies.

Nowadays, Malaysia is facing hot and dry climate. Plant that grows in hot climates requires very different temperature and humidity from plant that grows in cold climates (Sulaiman *et a*l., 2014). Low amount of humidity which means dry environment can cause damage to younger leaves and also to the leaf tips. This causes the plant to grow unsuccessfully. Furthermore, more attention is required to manage the plantation manually so that the plant will always be in good condition. Frequent observation needs to be done time by time causing more human energies are needed. In addition, these crops are very costly in market as they normally being exported from other countries especially countries that are experiencing cold climate. Therefore, this project will help small scale farmer experiences the cultivation of highland plantation on low ground in a simple way as the system is in automatic mode.

1.3 Objectives

Basically, objectives will explain the outcomes that need to be achieved at the end of the project. The purpose of objectives is to keep the project in the right path and well defined. The main objectives of this project are listed as below:

1. To study the effective environment elements needed to make highland plantations suitable for low ground.
2. To develop a system that automatically monitor and manage highland plantation on low ground using web based system through Raspberry Pi.
3. To analyze the functionality of the system on observing the temperature, water, light and humidity of the plantation.

For the first objective, this project is to survey the effective environment elements for the growth of highland plantation on low ground. This is to find the important things that need to be concerned on and identify whether highland plantation can grow well on low ground or not.

For the second objective, an automatic system will be developed in order to monitor and manage highland plantation on low ground. Raspberry Pi will control all the measured values from sensors and linked to server. The output will be displayed on the website. The owner/user gets to observe the plant conditions in real-time from the website easily. The system will automatically manage the plant based on the aspects given.

For the third objective, the system's operation will be evaluated by discovering some aspects of the plantation. The system will observe and manage the plantation's temperature, light and humidity including watering the plant on the specific time.

1.4 Scope of Project

The scope of this project is to develop an automatic system that will monitor and manage strawberry plant on low ground by using Raspberry Pi through web based. Moreover, strawberry is one of the various kinds of highland plantation that has been chosen to be monitored and handled by using the system automatically. Strawberry that has a nice taste and rich in nutrition is widely grown all over the world (Qingchun *et al.*, 2012). Normally, the system will monitor and control four important aspects of the plant which are surrounding temperature, watering schedule, light and also humidity. The strawberry plant will be located in a closed area to ensure the temperature of surrounding is even. Other than that, it is also to prevent the rain from damaging the plants.

The optimum temperature of strawberry plant is between 16°C - 20°C (Treethidtaphat *et al.*, 2015). Temperature sensor is able to measure the temperature of the surrounding continuously as it will update on the server from time to time. Moreover, few actions must be done by the system automatically in order to ensure the measured temperature is in optimum state. Then, too much light exposed towards the strawberry plant causing the leaves to dry. The light sensor will analyze the presence of the light automatically. For instance, the light will be switched on when

the area is dark. In addition, watering schedule twice a day (morning and evening) will be activated by server and display on the website to ensure the strawberry plant gets enough amount of water every single day. Besides, humidity will be checked for every 3 minutes to ensure the surrounding of the plant having enough humidity. The humidity will not be checked in every second as gap of 3 minutes is the most suitable time to observe when there are any changes on the humidity after action has been done.

Furthermore, this project can be divided into two main parts, hardware and software. The hardware part in this project involves Raspberry Pi and sensors whereas the software part of this project is web based. Firstly, all the values required will be measured using sensors that controlled by Raspberry Pi. Then, it will link to servers before displaying the measured values in the website (interface). When the measured values displayed on the website is not in the green (safe) range, actions will be done automatically. The system will checked on the temperature and humidity of the plantation for every 3 minutes and the measured values displayed on the website will be refreshed automatically.

1.5 Significance of study

Highland plantation can be very interesting to be in low ground not only for big farmers but also small scale farmer. This is because highland plantation is potentially high in demand in the market. In hot climate area, it is somehow difficult to grow highland plantation that requires different amount of temperature, water, light and humidity. This new system will ease the farmer as it requires less human energy due to an automatic system. Hence, it allows the cultivation of cold climate plants in hot climate area can be experienced by farmer, gardener and also people who enjoy small scale farming. With this system, better production and quality of plant produced as the monitoring and managing processes are done continuously.

1.6 Structure of Report

This report consist of three chapters that literally discussing the idea and concept of the project, all activities in achieving the final product. The explanation of each chapter will be in paragraph as following:

Chapter 1 briefly describes about greenhouse and highland plantation that is quite hard to be planted on low ground due to the difference in climate conditions. Then, problem statements, objectives, scope of this project are also presented in this chapter.

Chapter 2 discuss on literature review, comparing previous project that relates to this project. This chapter review on concept of greenhouse that can be implemented in this project in simpler and cheaper way. In addition, this chapter includes the concept and fundamental of Raspberry Pi, sensors and web based.

Chapter 3 concerns more on the methodology of the project from the beginning till the end. The methodology consists of hardware development and software development. The hardware development includes the design and architecture of the automatic monitoring and managing system for highland plantation on low ground and sensors. On the other hand, in the software development, the measured values from the sensor that controlled by Raspberry Pi will be displayed on the website through server.

Chapter 4 focuses on analyzing the result from both hardware and software development. The results will be in form of figure and discussion.

Chapter 5 will be the summary of the project including conclusion and recommendation for future improvements.

CHAPTER 2
LITERATURE REVIEW

This chapter will focus more on research work and related theories via few resources from journal, book and websites in order to gain further knowledge and understanding about highland plantation, greenhouse, automatic versus manual system for plantation, elements to consider in the automatic system for plantation, hardware requirements, software requirements and also related research. In this report, some studies and information from related research will be very useful to compare and find the most convenient to be used in the project.

2.1 Highland Plantation

The highland plantation probably can be also known as cold climate plants. This is because these plants cultivate well in cold climate conditions. However, Malaysia is experiencing hot climate throughout the years making these kinds of plant hard to survive in the country. In Malaysia, there are two cold climate areas which are Cameron Highlands and Genting Highlands in Pahang. Cameron Highlands is located on Titiwangsa Range at about 1500 metres above sea-level (CameronHiglands, 2015). Cameron Highlands is the place where most of the highland plantations are planted in Malaysia.

In 2014, the ideal temperature in Cameron Highland was 20°C with humidity level 50%-60% (Sulaiman *et a*l., 2014). Every year, the warmest month on average in Cameron Highlands is May whereas the coolest month on average is January. However, October is known as the wettest month while July is the driest month in

Cameron Highlands. (Cameron Highlands, 2015). Thus, this environment is suitable to plant varieties of cold climate plantations.

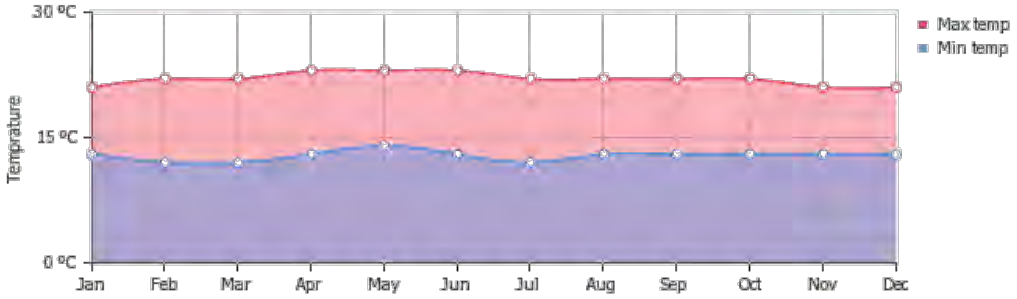

Figure 2.1: Average Minimum and Maximum Temperature over the Year of 2015 (Source: < https://weather-and-climate.com/average-monthly-min-max-Temperature, Cameron-Highlands, Malaysia> 2015)

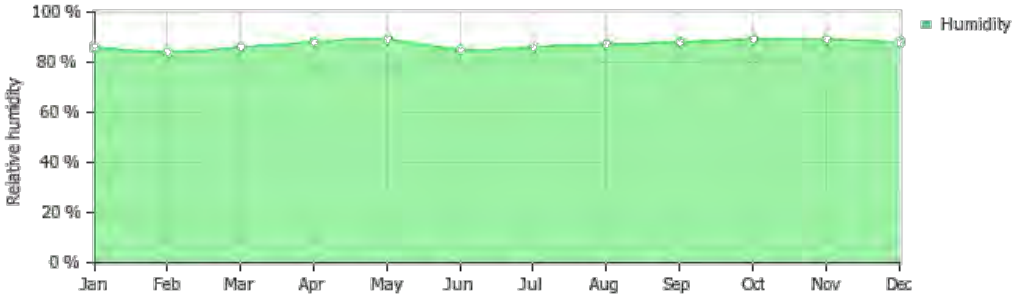

Figure 2.2: Average Humidity in Cameron Highlands over the Year 2015

(Source: < https://weather-and-climate.com/average-monthly-Humidity-perc, Cameron-Highlands, Malaysia> 2015)

Figure 2.1 and 2.2 shows that Cameron Highlands is a suitable place for cold climate plantations as the optimum temperature is around 20° C and the percentage of humidity is more than 80%RH.

Few examples of cold climate plantations that can be found in Cameron Highlands are strawberry, tea, variety of flowers and also vegetables. Many varieties of flowers such as daisies, roses and chrysanthemums flourish in this habitat (Sulaiman *et a*l., 2014). Other than tea plantations, Cameron Highlands is known as the center of strawberry production in Malaysia. The cold climates allow the cultivation of strawberry throughout the year. Strawberry plantations can grow easily but difficult to grow well. An ideal temperature for strawberry growing allows the

strawberry plantations to generate strong roots and receive enough nutrients to produce lots of flowers and fruits.

Figure 2.3: Plantations in Cameron Highlands
(Source <http://www.cameronhighland.com/> 04/03/2015)

According to Sulaiman *et a*l. (2014), plantation that cultivates in cold climate areas requires diverse temperature and humidity that different with plant that grows in hot climates. Cold climates plants possibly might not produce a strong harvest in hot climates. Some plants cannot adapt with hot climates and tend to die when experiencing hot weather as different plantations have different characteristics. Cold climate plantations desire high level of humidity with low level of temperature. The cultivation of these plantations works well within high humidity and low temperature.

All plants demand light for growth and development. Light is known as a necessary factor in maintaining healthy plants. However, some plants do not require direct sunlight like strawberry plants. This is because these plants are independent of light. They inhale oxygen and exhale carbon dioxide like animals; this does not mean that these plantations grow only in dark. The strawberry plantations need to be shaded especially in hot climates to reduce stress on the plants as well as keeping the plant from drying out in the heat (Wei Yeap *et al.*, 2009).