UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF AN AUTOMATED GARDEN IRRIGATION SYSTEM

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

by

AHMAD HARIZ BIN HASHIM

B071410762

930728146151

FACULTY OF ENGINEERING TECHNOLOGY

DECLARATION

I hereby, declared this report entitled "Development of an Automated Garden Irrigation System" is the result of my own research except as cited in references.

Signature : ……

Author's Name : AHMAD HARIZ BIN HASHIM

Date : ……

APPROVAL

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

……

(Shamsul Fakhar Bin Abd Gani)

ABSTRAK

Sistem pengairan taman automatik untuk tumbuhan adalah satu sistem yang boleh digunakan untuk kebanyakan jenis tanaman tanah rendah dalam bidang pertanian. Tumpuan utama sistem adalah untuk membantu tukang kebun dari segi pengurusan masa, beban kerja dan kualiti tumbuhan mereka. Ini kerana disebabkan dunia bergerak ke hadapan, teknologi yang dapat menjimatkan masa dan tenaga menjadi produk yang sangat diperlukan. Sistem ini boleh digunakan untuk pelbagai jenis tanaman tanah rendah yang sesuai dengan cuaca di Malaysia. Sistem ini tidak mempunyai sistem kawalan iklim oleh kerana sistem ini tidak dibangunkan untuk tujuan seperti itu, ia tidak boleh digunakan untuk tanaman tanah tinggi. Kemudian, sistem ini dibina dalam satu pasu saiz sederhana. Walau bagaimanapun, walaupun dalam laporan ini pokok digunakan hanya untuk kawasan kecil kerana ia hanya satu prototaip, sistem ini juga dapat digunakan untuk kawasan perkebunan skala besar. Saiz dan reka bentuk sistem ini boleh dilaraskan kerana ia juga boleh digunakan sebagai mudah alih kerana saiznya kecil dan perisian boleh dilakukan dengan mudah. Sistem ini merangkumi 4 jenis parameter yang diperlukan oleh tumbuhan untuk tumbuh iaitu kelembapan, suhu, cahaya dan kelembapan tanah yang dikendalikan secara automatik oleh pengesan. Bacaan suhu dan kelembapan yang dikesan akan diproses oleh mikrokontroler Arduino Mega. Kemudian nilai yang dikesan akan dipaparkan pada LCD supaya pengguna dapat melihat nilai masa sebenar dengan mudah. Berdasarkan nilai yang dikesan pada pengesan kelembapan tanah, jika tanah di dapati kering, mikrokontroler akan mengaktifkan pam air untuk melakukan proses pengairan untuk memastikan tumbuhan mendapat nutrisi. Semasa kawasan persekitaran didapati gelap, cahaya akan menggantikan matahari kerana ia membolehkan tumbuhan dapat melakukan proses transpirasi mereka. Oleh itu, sistem pengairan taman automatik ini adalah sistem yang dapat mengurangkan campur tangan manusia dalam mengendalikan tumbuhan.

ABSTRACT

An automated garden irrigation system for plant is a system that can be used for most type of low ground plant in the agriculture field. The system main focus is to help the gardener in term of time management, workload and the quality of their plants. This is because as the world is moving forward, technology that can be able to conserve time and energy become a highly demand product. This system can be used for many different types of low ground plant that suit the weather in Malaysia. Since this system does not have climate control system as this system does not being developed for this kind of purpose, it cannot be used for high ground plantation. Then, this system is built in a one medium size vase. However, even in this report it only been used for a small area as it is only a prototype, this system also can be used for a large scale area of plantation. The size and design of this system is adjustable as it also can be use as portable since it is in a small size and the software can be done easily. This system covers 4 type of parameters that need for the plants growth which are humidity, temperature, light and soil moisture that being control automatically by the sensors. The detected of temperature and humidity value will be process by the Arduino Mega microcontroller, then the value will be display on the LCD so the user can see the real time value easily. Based on the detected value on soil moisture sensor, if the soil of the field is dry the microcontroller will activate the water pump to do the irrigation process to keep the plant get the nutrition. During the dark surrounding area, the light will replace the sun as the it allows the plant able to do their transpiration process. Therefore, this automated garden irrigation system able to reduce human intervention at the most possible in handling plants.

DEDICATION

To beloved mom, dad and my family.

ACKNOWLEDGEMENT

The success and final outcome of this project required a lot of guidance and assistance from many people and I am extremely fortunate to have got this all along the completion of my project work. Whatever I have done is only due to such guidance and assistance and I would not forget to thank them.

I respect and thank Sir Shamsul Fakhar, my supervisor for giving me an opportunity to do this project and providing some needed hardware which made me complete the project successfully. I am also extremely grateful to him for providing such a nice support and guidance though he had busy schedule managing the other project and student affairs.

I owe my profound gratitude to all lectures, who took keen guided on my project work till the completion of my project work by providing all the necessary information for developing a good system.

I would not forget to remember to my mom, dad and family for their unlisted encouragement and more over for their timely and financial support till the completion of my project work.

I am thankful to and fortunate enough to get constant encouragement, support and guidance from all my friend which helped me in troubleshooting and give an idea until I am able to successfully completing my project work.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

1.0 Introduction

In this chapter, the purpose of the project is about the Development of an Automated Garden Irrigation system using Arduino will be described generally. This chapter consists of project background, problem statement, objectives, scope of project, significant of project and thesis outline that define and give brief overview about the development of an automated garden irrigation system.

1.1 Background

Nowadays, the manual system is still being used by most of the gardener. This is because the lack of exposure about automatic garden system is not being implemented. If the gardener still doesn't move on to change their method of plantation. The quality of the crops would not be upgraded. The problem with the wastage of excessive water when watering the plant, plants die because of lack of nutrition its need, and the pest damaging the plant will be the frequent problems and questions that play in their mind that need to be solved by manual gardener.

Therefore, to face this problem is by purposing this automated garden irrigation system which is to eliminate the difficulties involved in the system by reducing human intervention at the most possible extent by using the aid of sensor. The project prototype is developing in a small scale, so that it will reduce the problem to find an area to cultivated plants with a limited space of places. In addition, all the process is

conduct automatically by the system which is involving from controlling the plants cares and all their needs.

The inputs of this system are sensed from the sensor. The list of the sensor that be used in this system are temperature, humidity, moisture and light. All the sensor will give an input data and then will be send the data to be read and controlled by the Arduino. From the input data of those sensors, the process of the output will be conducted automatically based on the required condition that being set from source code and being controlled all the time. In general, when there is area with dark surrounding, the light will turn on and supply the amount of light needed for the plant. Then, there are 3 sensors which are temperature, humidity and soil moisture are used to display the real time surrounding atmosphere and environment sequentially then the readings are being display at the LCD. Next, watering the plant is controlled by the soil moisture sensor that is set when to turn on the water pump from the source codes. This system will control the system in schedule to help the growth of the plant needs.

1.2 Problem Statements

Nowadays, the quality of the plants that cultivated manually is not to convincing. This is because, to cultivate the manual plantation it need large workforce to handle the plants. The age factor is the main cause that affect the human energy to do heavy work. Moreover, the crops that being planted in the field have more chance to be eaten by pests so that it will damage the plants and wasted their long precious time before the plants good to be harvest.

Some people love gardening and make it as part of their hobbies. However, as the world moving forward, everyone is busy to make money and there is a problem for them to follow the schedule to cares of their plants need. As humans need enough nutrition for their good health, plants also need enough nutrition to stay alive. The lack of nutrition will affect the growth of the plant. Thus, the plants will die because of low level of nutrition being supply as the plants also need more of our attention.

The knowledge about the plants care is a must for those who does gardening. The information about the plants temperature, humidity, light and watering

consumption also need to be known by them. The lack of knowledge about plants care will affect the growth of the plants. If there are low level amounts of water and light the plant may die, and if there are excessive water and light the plant may also die. So that, the amount of nutrition is need to be exact and optimal to plant to grow well.

1.3 Objectives

The purpose of the objectives is keep the project in the right path. The main objectives of this project are listed as below.

1. To study the effectiveness of growing the Butterfly Wings plants by using this automated system.

   For the first objective is to study about this system which is with the development of an automated garden irrigation it can give a better plantation result than the crops that be planted and cultivated on the field manually. From the result we can identify the effectiveness of this system.

2. To develop an automated system for cultivating plants to help modern gardeners.

   For the second objective it to determine whether this automated garden system will help the gardener in terms of their time. By using the input from the sensors, the Arduino will get the output result given from the sensor and control the system. This system will continuously be running as there is power being supply.

3. To analyse the controlled amount of water and light needed by plants in this system.

   For the last objective, the amount of water and light for the plant is being controlled and only the exact amount of nutrition that the plant need

will be supply to the plant to help for their growth to able the plants do their transpiration process.

1.4 Scope of Project

1. Focus on one plants
    - This project focus at Butterfly Wings Plants as main plants.

2. Small scale garden
    - This garden project prototype will be conduct in a small garden where it will only use one medium size vase.

3. Only for low ground plants
    - This project is for low ground plantation only, since there is no device used to adjust climate of surrounding area.

4. No pest prevention
    - There is no additional equipment to prevent pest from damaging plants.

5. No IoT (Internet of Things)
    - This project use Arduino board and doesn't use any module that will be conduct to send or receive data that involved in IoT.

1.5 Structure of Project

Chapter 1 consists of the overall overview about of the project. In this chapter, the problem statement will be stated. After that, the objective and scope will be defined by refer to the problem statement. The scope must be stated clearly in this chapter.

Chapter 2 consists of literature review about the existing system which is previous project research. The source of these researches has to be acceptable in the system format such as books, journals, articles and website that are licensed The enhancement of the existing system will be proposed. This chapter also will simply brief about the current system that will be developed.

Chapter 3 consists of research methodology that will be used in developing this project. This chapter will explain more about the device and equipment that will be used during developing process and consists of implementation and maintenance of the project. This chapter will explain about the steps of developing process and programming codes that have been used.

Chapter 4 is discussions about the result, the output from the project and the findings of the study which the result from the experiments that are presented in tables, figures, drawings and graphs.

Chapter 5 will summarize the outcomes of this experiment. The chapter also outlines several recommendations for further development and improvement on the design. Suggestions for future inventor are also provided within the chapter.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will focus more on research work related theories from the collected findings and resources from journal, book and website in order to discuss and summarize topic which contains the information gathered to gain knowledge and ideas. In this chapter it consists of automatic garden plantation, advantages automatic system plantation, lowland versus highland plantation, element need for plantation, hardware requirement, software requirement and related research. These findings will provide some in information needed to completing the project.

2.1 Automatic garden plantation

According to (Agrotechnomarket,. 2017) nowadays, in the field of agriculture farmers are facing many problems such as soil fertility and in watering their plants. It's because they don't have proper idea to create an agriculture innovation especially for the availability of the power. Even if it is available, they need a lot of time to water by hand or to pump water and wait until the field is properly watered, which compels them to stop doing other efforts which are also important for them, and thus they loss their precious time and other effort.

2.1.1 Advantages automatic system plantation

According to (Agrotechnomarket,. 2017) there is several advantages about the automatic water irrigation plantation system. One of the advantages is by reducing employee and cost, as the irrigation is not required to constantly monitor to check the progress of an irrigation which is the farmer is able to be away from the property. In addition, to reduce for the work force used to constantly check the progress down the bays being irrigated.

The second advantages are helping in the management if higher flow rates. Many farmers are looking to increase the irrigation flow rates by installing bigger channels and bay outlets. This will cause rates generally require an increase in employee as the time taken to irrigation is reduces thus requiring more frequent change over. To overcome this problem, automatic plant system irrigation allows for these higher flows to be managed without an increase in the amount of employees.

The third advantages are to get more accurate cut-off. In automatic plant irrigation system, it allows cut-off water at the appropriate point in the bay. This is usually more accurate that manual checking because human error can occur if the operator is too late or too early in making change of water flow.

Lastly, is also reduces runoff of water and nutrients. The automation can keep fertilizer on farm by effectively reducing run off from the property. Using automatic plant irrigation system produces smaller droplets, helping to preserve nutrients and reducing run of water. Retaining fertiliser on farm has both economic and environmental benefits.

2.1.2 Lowland versus highland plantation

There is a difference between lowland plantations with highland plantation. The difference between leaves and shoot affect the growing of the plants.

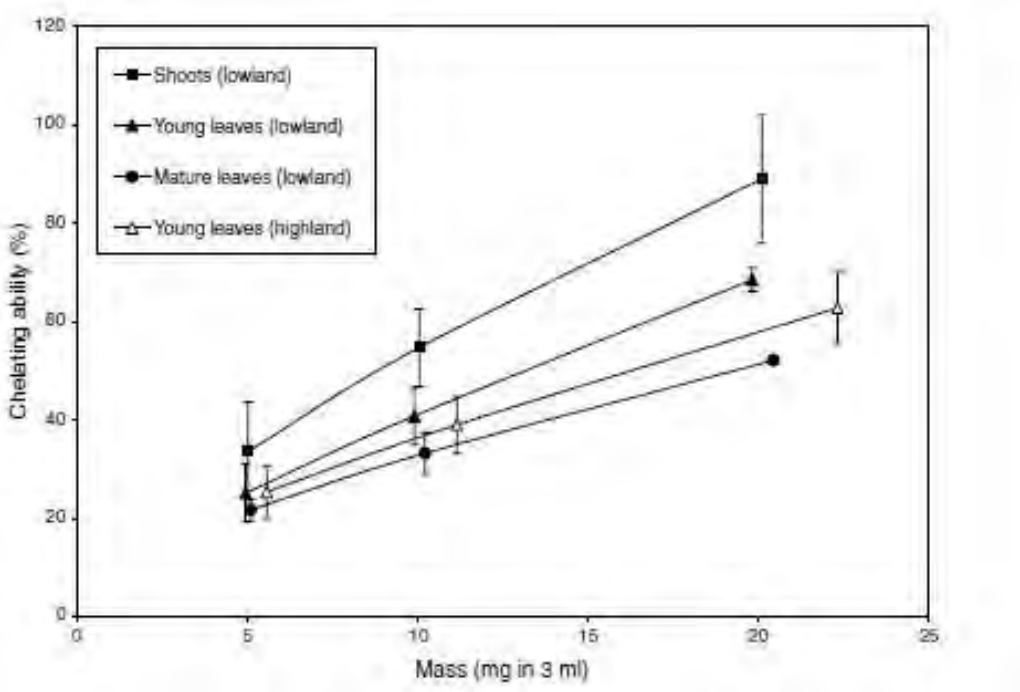

Figure 2.1 : Ferrous-ion chelating (FIC) ability of lowland leaves of different ages in comparison with highland leaves (fresh weight)

Table 2.1 : Total phenolic (TPC) and antioxidant activity of lowland and highland young leaves (fresh weight)

Location	TPC (mg GAE/100g)	Antioxidant activity (AOA)		
		DPPH free-radical scavenging		FRAP (mg GAE/g)
		IC_{50} (mg/ml)	AEAC (mg AA/100g)	
Lowland	7280 ± 126	0.030 ± 0.001	12817 ± 537	54.5 ± 2.8
Highland	7280 ± 1995	0.035 ± 0.010	11382 ± 3355	50.4 ± 12.9

According to Eric Chan *et al.,* (2006), growing plants in the lowland has numbers of advantages which is in terms of growth and yield. The plants in the highland have more shoots, but lower yield in terms of dry weight, than have those in lowland. Next, the leaves in the highlands are smaller and shoots at lowland develop faster than the highland. In terms of physical features, lowland plantation with more gentle terrains are easier to manage and harvesting can be mechanized without encountering environmental problems of soil erosion and slope failure. This would imply that lowland leaves are slightly more effective than highland leaves in sequestering 'free' metal ions, rendering them inactive in generating free radicals.

2.2 Automatic plantation system element

The element that consist for plantation is temperature, water, humidity and light are the major factor for plants growing. Therefore, this five element will be discussing briefly in this chapter section.

2.2.1 Temperature

Temperature changes that effect in plants are incredibly sensitive. This is also affected within the changes of one or two degree of temperature. It would cause the changes in term of development processes, plant architecture, plant reproduction and their immune response. In addition, the temperature also involved to the changes and adaptations to essential developmental process, such as germination, flowering, and reproduction (Keara *et al.,* 2013).

2.2.2 Water

Water is absorbed by the root system and lost through transpiring leaves. In mathematical calculation, the water lost per day by transpiration process from some plant is equal to twice is used for growth. During the dry season, the loss of water from the soil is quite common.

The evaporation of water from plants primarily through pores in their leaves. Up to 99% of the water absorbed by roots is lost via transpiration through plant leaves (Tracy *et al., 2004*).

2.2.3 Humidity

Humidity also takes control the moisture loss from the plant. Transpiration rates decrease proportionally to the amount of humidity in the air.

Relative humidity (RH) is the amount of water vapour that air could hold at a given temperature. A hydrated leaf would have a RH near 100% just as the atmosphere on a rainy day would have. The lower the RH, the less the moist the atmosphere that make the driving force of transpiration to high. The higher the RH, there is more moisture contains in the atmosphere, so that it will reducing the driving force for transpiration (Tracy *et al., 2004*).

2.2.4 Light

Light affect the growth of individual organs of entire plant in less direct ways. When a plant is grown in normal light and in the total darkness the striking effect can be observe at most. The requirement of light is depending of the plants.

Plants get energy form light through a process called photosynthesis. Without light, plant would not be able to produce the energy it need to grow. Plants that affected by shortage amount of light will affect the leaves to turn yellowish, leaves become small, stems will be spindly and lower leaves dry up (Heather *et al.,* 2015).

2.3 Hardware requirement

Hardware overview is analysis of the component that should be considered in building the Development of an automated garden irrigation system. The elements that were discussed in this section consist of Arduino Mega, light sensor, temperature and humidity sensor, moisture sensor, light bulb and water pump.

2.3.1.1 Arduino Mega

Arduino Mega is one of the platform for those who want to design a complex project using a simple microcontroller. The price is very convenient since it in low cost that make in affordable for those who is beginner. It comes in small size but it consists of more space for input and output pins so that it has more space and plenty of room to develop a project. In addition, it uses C/C++ language to be operated.