UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AUTO WATERING SYSTEM USING ARDUINO

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Computer Engineering Technology (Computer Systems)(Hons.)

by

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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's Degree in Computer Engineering Technology (Computer Systems) (Hons.). The member of the supervisory is as follow:

……

(Dr. Abd Kadir)

ABSTRAK

Tanaman memerlukan sumber air yang mencukupi untuk menjadi sihat dan subur. Jumlah lebihan air dan jumlah kurang air yang dibekalkan kepada tumbuhan boleh menyebabkan tumbuhan layu dan mati. Penyelidikan yang lepas telah memberi tumpuan kepada kaedah bagaimana untuk menyiram air tanaman pada masa yang sesuai dengan jumlah air yang betul. Kajian ini tertumpu kepada bagaimana untuk membangunkan sistem penyiraman automatik menggunakan Arduino supaya tumbuhan disiram pada masa yang sesuai dengan jumlah yang betul. Sistem berasaskan rumah adalah untuk memudahkan manusia dalam menyiram tumbuhan tanpa melibatkan mana-mana tenaga manusia. Untuk membangunkan sistem automatik sepenuhnya yang secara pintar mengukur kelembapan tanah, pendekatan yang berbeza daripada kaedah yang digunakan dalam bidang berbeza telah dikaji semula. Sistem yang paling sesuai telah dipilih untuk menjadi sumber idea dan bimbingan. Idea sendiri dicadangkan untuk meningkatkan pendekatan sistem yang sedia ada. Komponen akhir dan bahan-bahan yang diperlukan untuk menyokong sistem penyiraman automatik yang cekap telah didapati dengan menganalisis dan menguji prototaip. Sistem penyiraman auto tumbuhan menggunakan Arduino adalah satu sistem yang memudahkan manusia dalam menyiram tumbuhan.

ABSTRACT

Plants need sufficient water resources to be healthy and fertile. Excess amount of water and less amount of water supplied to plant may cause the plant to wither and die. Past research has focused on the method on how to watering the plant water on the right time with the right amount of water. This research focussed on how to develop an auto watering system using Arduino that watering plant at the right time with the right amount. This home based system is to facilitate human in watering plant without involving any manpower. To develop a fully automated system that intelligently measures the soil moisture, different approaches of methods used in varying fields were reviewed. The most suitable system had been selected to be a source of ideas and guidance. An own idea proposed to improve the approaches of existing systems. The final components and materials needed to support an efficient auto watering system was obtained by analyzing and testing the prototypes. A plant auto watering system using Arduino is a system that facilitates human in watering the plant.

DEDICATION

To my beloved parents,

Mohd Shah Bin Rasul

&

Juwita Binti Abdul Halim

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ADC	-	Analog-To-Digital Converter
ALCA	-	Associated Landscape Contractors Of America
DAC	-	Digital-To- Analog Converter
DAP	-	Maximum Allowed Depletion
DC	-	Direct Current
IDE	-	Integrated Development Environment
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
GND	-	Ground
LED	-	Light Emitted Diode
LDR	-	Light Dependent Resistor
MST	-	Malaysian Standard Time
NASA	-	National Aeronautics And Space Administration
NC	-	Normally Closed
NO	-	Normally Open
PCB	-	Printed Circuit Board
PIC	-	Programmable Interface Controller
PWM	-	Pulse-Width Modulation
RFID	-	Radio-Frequency Identification
RTC	-	Real Time Clock
SRAM	-	Static Random-Access Memory
TDT	-	Time Domain Instruction
TDR	-	Time Domain Reflectometery
USB	-	Universal Serial Bus

CHAPTER 1
INTRODUCTION

In this chapter, simple explanation about the study is explained. The project background presented the main ideas of the thesis. All related information on the study is presented.

1.1 Project Backgound

Plants are a pleasing home decor for those longing for greener interior, it can be a creative decorating ideas for homes too. Besides, growing plants in indoor spaces naturally help purify the air human breath and also acts as little oxygen supplier which is beneficial to human being. It is proven in a study by NASA and the Associated Landscape Contractors of America (ALCA) (Johnson, 1989).

However, most people faced problem in keeping their plant healthy and alive. According to some research, people often tend to forget to nurture their plant(s), between daily activities (Sanberg, 2012). The plant need to be watered with an adequate amount to keep them fertile. The previous research said that, the principal environmental requirements for plant growth include adequate space for root and canopy development, sufficient light, water, oxygen, carbon dioxide, and mineral elements, and temperature suitable for essential physiologic processes (Iles, 2001). Therefore, watering is an important activity in plant care. Each plant needs vary adequate quantity of water because too much water can suffocate plant roots and too little water causes growth to become erratic and stunted.

Thus, in order to resolve these problems, an automatic watering system proposed. The automatic watering system is designed to be assistive to the user. This automatic system is one of the solutions to do the watering independently without need human to supervise the system regularly. Even in horticultural activities and production, there are research conducted, focused on the automation of the most tedious and repetitive tasks (HE N, 2012).

1.2 Problem Statement

The plant requires the owner to always sensitive with it needs. Watering plants at the appropriate rate for the plant is important. However, many people forget this watering routine. Busy people always forget to water the plants due to tight schedule.

For those who possess a tight daily schedule and always travelled, they cause to forget the desire to have indoor planting for fear bound by watering schedule and thought it was a tiring and burdensome task. People also tend to forget to nurture their plant. Even though, there are other alternative, such as hired someone to watering the plant periodically, but this is could swallow a lot of cost. Besides that, they also may have some issue regarding letting other people to enter their house when they are absence. They are concerned about their house security and does not trust the worker without any supervise the worker. Additionally, watering plants are tedious repetitive tasks and may cause exhaustion to busy people.

Besides that, usually people is not able to predict the essential amount of water needed by plant to restore the soil moisture needed by plants. Then, there was a situation where even though the plant is watered periodically, the plant still dies. This is happening because the plant may have less water or over water. People that do not have experiences always have a problem with the watering routines.

1.3 Objectives

The objectives of developing this system were:

(a) To identify the suitable components needed for supporting auto watering system.

(b) To design and implement an auto watering system using soil moisture sensors.

(c) To develop an auto watering system that facilitates human in the watering task.

1.4 Scopes of Project

This project is an improvement of conventional method of watering plants to the auto watering system. The auto watering system development is divided into software and hardware implementation and the development of this system will cover these areas:

(a) Arduino Uno Board and The Arduino programming language

(b) The sensor system

(c) The output system

1.4.1 Arduino Uno Board and The Arduino programming language

Arduino is an open-source electronics prototyping platform that consist both physical programmable circuit board and IDE (Integrated Development Environment). The Arduino platform allows user to run it on the computer, allow to writes and upload computer code to the physical board, Arduino Uno. The programming language of Arduino IDE used is C++. The Arduino takes inputs from a sensors and controlling the output.

1.4.2 The Sensor System

The special sensor uses to detect and responds to the moisture of the soil from the physical environment. The system acts as the measurement system. The input will be interpreted into data and record the information in a certain manner.

1.4.3 The Output System

The output system is the system that controls the flow of water in watering channel. The system Then, the system will trigger the water supplier to start the watering and send interrupt to stop the water supplies.

1.5 Thesis Outlines

There are five chapters in this thesis which are included of introduction, literature review, methodology, result and discussion and finally a conclusion and recommendation. Each chapter will discuss its own aspects that related to the project.

Chapter one is the introduction to the project or study. There is the problem statements, object and scope of the project along with the summary of works have been discussed and presented in this chapter.

Proceed to chapter two, in this chapter previous studies are reviewed. This chapter is discussing about the approaches and methods used in previous studies. The comparison of strength and weakness can be used as the guidelines to develop an efficient automatic watering system. The own idea also proposed and justified in this chapter.

Chapter three focuses on the methodology and approaches on the project. This includes the software implementation and hardware development of the project.

Results and discussion are presented in chapter four. Lastly, is the chapter five that presents a comprehensive conclusion of the project. The suggestion and recommendation for future improvement in the functional also mentioned.

1.6 Project Significant

This project will beneficial to the society especially for those are busy with tight schedule whose do not have time to watering their plant, the people that usually forget to watering the plant, the people that often go travelling and outstation. Besides that, this project proposed a solution by providing a method and system to facilitate human in watering plant task.

Further studies on the system's approaches and method can be used to develop so that applicable in the wide areas such as to watering the plantation with a large number of crops. This project also contributes ideas for researchers to develop watering and irrigation system using Arduino system.

CHAPTER 2
LITERATURE REVIEW

In this chapter, further discussion on the related past studies and information that make significant contributions in this area of study, auto watering system or closely related system. There is a wide source of information of the related areas published in the web about watering system. The gathered information gives recommendations on the method and sample current opinion. Thus, the idea supported and justified with significant past research.

2.1 Previous Research of Existing System

Developing a functional auto watering system requires a deeper understanding on the plant. There are basic necessities of the plant require by plant to grow healthily such as adequate space for root growth, sufficient sunlight for photosynthesis, adequate mineral or manure, and appropriate temperatures. Past studies proved that, the basic requirement for plant to grow is sufficient water supply. An adequate amount of water is essential for plant growth and maintenance of essential plant processes (Iles, 2001).

It is important to watering the plant periodically in accurate amount. The amount of water needed by the plant is influences by the type of plant and the meteorological factors that around them. Hagan (1957) states that, the light, temperature, moisture and wind control the rate of water loss from the soil surface. The plant growth is probably dependent upon plant turgor, whose relation to soil moisture stress for different rates of transpiration needs to be explored (Hagan, 1957). In other words, one of the main factors

to grow a healthy plant is the soil moisture. Each species of plant need different amount of water to keep it healthy and not wilting. Plant may become will die or wilt if the water supplied is less or too much. Thus, a system that is equipped with effective method to measure the amount of water needed by plants, so that the watering task will be a lot easier and precise.

2.1.1 Gravimetric method

The best way to know how much the water needed by the plant, is by determine the moisture of the soil. It is important to not over-watered or less-watered the plant.

Thus, one of the ways proposed to accurately watering the plant, is by measured the water content of the soil. There are many research conducted and various method has been proposed to measure the water content with varied implementation. One of them is gravimetric method.

The gravimetric method involves collecting a soil sample, weighing the sample soil after drying it, and calculating its original moisture content. By using gravimetric method, initially the sample of soil without loss of water content needed. Then, when the soil has experienced water loss, the ratio mass of water to the dry weight of the soil calculated to determine the soil moisture content. Thus, the gravimetric method is expressed the soil moisture and water content of soil by weight.

The drying of the soil using the oven is usually in the most gravimetric method. In determining soil moisture, the oven dry method has been known as the standard calibration. A balance with high precision about ±0.001 g and oven with heating capability 100 ^{0}C and above. This method may efficient for determining the water content in the soil. However, this method is not suitable for common people that need help in facilitate them in watering their plant because, the gravimetric method need people regularly determine actual weight of the plant too instead of determining the water content of the soil only. Moreover, the water content of the soil is not fixed since

the light, temperature, moisture and wind of environment is keep changes (Johnson, 1962). In summarize, the gravimetric method may is expressed in weight.

2.1.2 A Precise Automatic Water Dispenser for Plants Growing In Pots

There are few systems proposed may related to the gravimetric method to help human to watering the plant. As an example, a watering system that has precise water dispenser for plants in greenhouse. This system also expressed in weight. A common method of restoring moisture stress to the desired level is to add water periodically to the pot until the original weight of the pot and plant is reached (Agriculture Canada, 1976). However, this system requires human to measures weight of the pot manually on a balance or scale and adding water until the original weight is reached. Even though this method is give accurate result, however it is not suitable for frequent watering task since every plant may have different growing rate. Moreover, as the time passes by, the original weight need to be adjusted periodically since the plant growth and the weight may increase. Stevenson and Munn (1970) state that, it may be desirable to adjust the original weight to account for changes in plant weight as growth occurs. This method is beneficial to save a lot of time in watering a large number of potted plants because the apparatus dispenses the water automatically into the pot and restore the weight by adding water according to the set weight. Based on the apparatus in Figure 2.1, it is consists of a 1,600-9 balance, two solenoid valves mounted on an adjustable stand to accommodate various sizes of pots, a photoelectric controller and a limit switch (Agriculture Canada, 1976).

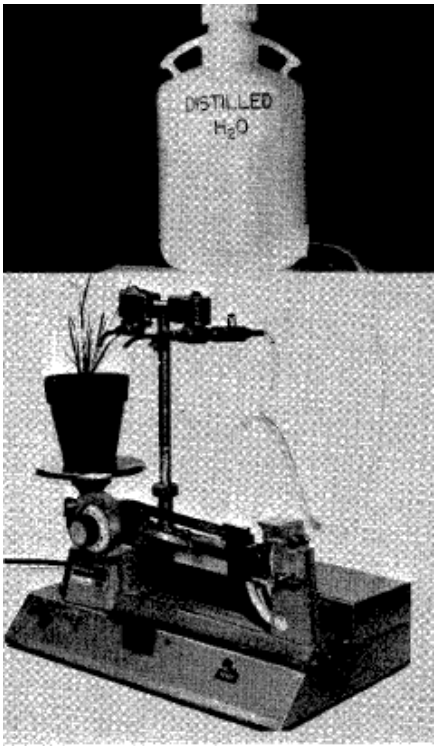

Figure 2.1: Automatic water dispenser for potted plant (Agriculture Canada, 1976)

This system consists of solenoid valves that are connected with the water channel. The position of water channel can be controlled by an adjustable tube clamp which is placed on the line to one valve. An adjustable needle valve is placed in the line of the low flow rate valve while, the high flow rate valve is controlled by a limit switch mounted. It is actuated by the balance arm of the scale in the unbalanced position which is in the down position. It is when the weight of the pot is below the set weight. When water is added and balance position is approached, the released limit switch will cut off the high flow of the water. Then, low flow of water delivered until exact balance is attained. When the exact balance reached, the photoelectric controller in Figure 2.2, which can sense the balance position will cut off the water source. Overall, this system specially designed to water the plant daily so that can help to restore the soil moisture needed by a large number of potted plants without need to check the amount of water used. About nine pots per minutes were watered. Even though, this system can save a lot of time, however consecutively, human need to place the pots on the balance by