



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**Development of Small Volume Watering & Soil Cooling System By
Using Microcontroller**

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

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 of Engineering Technology (Industrial Electronic) (Hons.). The member of the supervisory is as follow:

Signature:
Supervisor name : IR. NIK AZRAN BIN ABDUL HADI
Date:

ABSTRACT

Important of water to the plant ignite the creation of intelligence watering system. Small scale smart watering system such as microcontroller based watering system can be seen during these days. Thus for this project a small volume watering system and soil cooling system will be developed. Current small scale microcontroller based watering system is not good enough and not suitable for some plants in term of watering volume. for example strawberry plant are very sensitive to water logging, using water pump based smart watering system might cause water logging and the risk of rotten strawberry plant crown. besides that, strawberry seed required specific soil temperature for germinate where state Melaka, Malaysia soil temperature is not suitable for strawberry seed germination due to out of temperature range. So in methodology, to control the water volume of watering system, a small plastic tube will be use to control the water flow to the soil based on the plastic tube bending angle that controlled by the servo motor. The water flow rate will be monitored by a sensor that acts as feedback to the microcontroller for regulated water flow rate accordingly. As for soil cooling system for seed germination purpose, a Peltier module that controlled by the microcontroller will be used to coil down the soil to a temperature value. From the results, the small volume watering system are capable to supply vary small water volume to the soil range from minimum 15 micro liter of water per minute to maximum 0.3milli liter of water per minute. As for soil cooling system, it is capable to cool down soil temperature from approximately 30°C to lowest temperature 20°C. From the project finding, during the small volume watering system development process, the bending angle of the plastic tube doest has linear relationship with the water flow rate. As a conclusion, small volume watering system has high potential in commercial and used for others application such as in medical field, agricultural field, chemical field and etc.

ABSTRAK

Kepentingan air untuk tumbuhan menyalakan penciptaan sistem penyiraman perisikan. Sistem penyiraman pintar kecil seperti sistem penyiram mikrokontroler boleh dilihat pada hari-hari ini. Oleh itu untuk projek ini, sistem penyiraman isipadu kecil dan sistem penyejukan tanah akan dibangunkan. Sistem penyiraman mikrokontroler berskala kecil masih tidak cukup baik dan tidak sesuai untuk beberapa jenis tumbuhan dari segi jumlah air. contohnya pohon strawberi sangat sensitif terhadap takongan air, menggunakan sistem penyiraman pintar berasaskan pam air boleh menyebabkan takongan air dan risikonya tumbuhan akan menjadi busuk. Selain itu, benih strawberi memerlukan suhu tanah tertentu untuk bercambah di mana negeri Melaka, Malaysia suhu tanah tidak sesuai untuk percambahan benih strawberi kerana keluar daripada julat suhu. Oleh itu, dalam kaedah untuk mengawal jumlah air sistem penyiraman, tiub plastik kecil akan digunakan untuk mengawal aliran air ke tanah berdasarkan sudut lenturan plastik yang dikendalikan oleh motor servo. Kadar aliran air akan dipantau oleh sensor yang berfungsi sebagai maklum balas kepada mikrokontroler untuk mengawai kadaran aliran air. Bagi sistem penyejukan tanah untuk tujuan percambahan benih, modul Peltier yang dikawal oleh mikrokontroler akan digunakan untuk menyejukkan suhu tanah. Dari hasilnya, sistem penyiraman isipadu kecil mampu membekalkan isipadu air kecil dari minimum 15 liter mikro air per minit kepada maksimum 0.3milli liter air per minit. Bagi sistem penyejukan tanah, ia mampu menyejukkan suhu tanah dari kira-kira 30 ° C hingga suhu paling rendah 20 ° C. Dari hasil projek, semasa proses pembangunan sistem penyiraman isipadu kecil, sudut lenturan plastik tidak mempunyai hubungan linear dengan kadar aliran air. Sebagai kesimpulan, sistem penyiraman kelantangan kecil mempunyai potensi tinggi dalam perdagangan dan digunakan untuk aplikasi lain seperti medan medis, medan pertanian, medan kimia dan sebagainya.

DEDICATION

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

LDR	Light Dependent Resistor
UART	Universal Synchronise Receiver Transmitter
LDR	Light-Emitting Diode

CHAPTER 1

INTRODUCTION

1.1 Overview

Nowadays, many task was done by robot or intelligent system for reduce human work load. This intelligence system can be found in many places or field. For example at home which are washing machine, home automation system, anti-theft system and etc. existing for these intelligent systems let the human to focus more important thing in their life and reduce their daily repeating task. Beside the intelligence system that take care of human things, there is also have intelligence system that take care specifically for plants like vegetables, flower, herbs and etc. This kind or intelligence may take care the plant grow required parameter such as, intensities of sunlight, irrigation amount, fertilizer amount humidity and some others parameter that affect the plants life. Water is important to plant as well for human. Water has many roles to play for a plant to growth. Water allow constituent of protoplasm and dissolved nutrient to let the plants absorb. Water also used for transport nutrients from the soil to green plant tissues beside for photosynthesis. And also, Water is essential for the germination of seeds, growth of plant roots. When the weather is hot human need shower to cool down their body same for plant, Water regulates the temperature and cools the plant. Thus, important of water to the plant ignite the creation of intelligence watering system. Small scale smart watering system such as microcontroller based watering system can be seen during these days. Most commonly use Arduino and Merochip. Beside plant need water; temperature also is one of the important parameter for a plant to grow.

1.2 Problem Statements

Microcontroller such as Microchips, Arduino and others microcontrollers has been widely used for plant watering system that watering automatically. Mostly small scale microcontroller based watering system utilizes a water pump or solenoid to allow or disallow the water supply to the target soil. With a specified program on the microcontroller, the microcontroller can control the water pump either on or off depending on the condition as stated in the program to watering the plant on a pot or ground. Some microcontroller based watering systems utilize GSM, WIFI or Bluetooth as support/feature for its user to control this system from far distance for plant watering purpose. However, the microcontroller based watering system by using water pump and solenoid has issue in some condition. Following figure show the microcontroller based watering system using water pump or solenoid for control the water flow.



Figure 1-1: Water Flood on the Soil (Haber, 2016)



Figure 1-2: Water Flood on the Soil (Svseembedded, 2017)

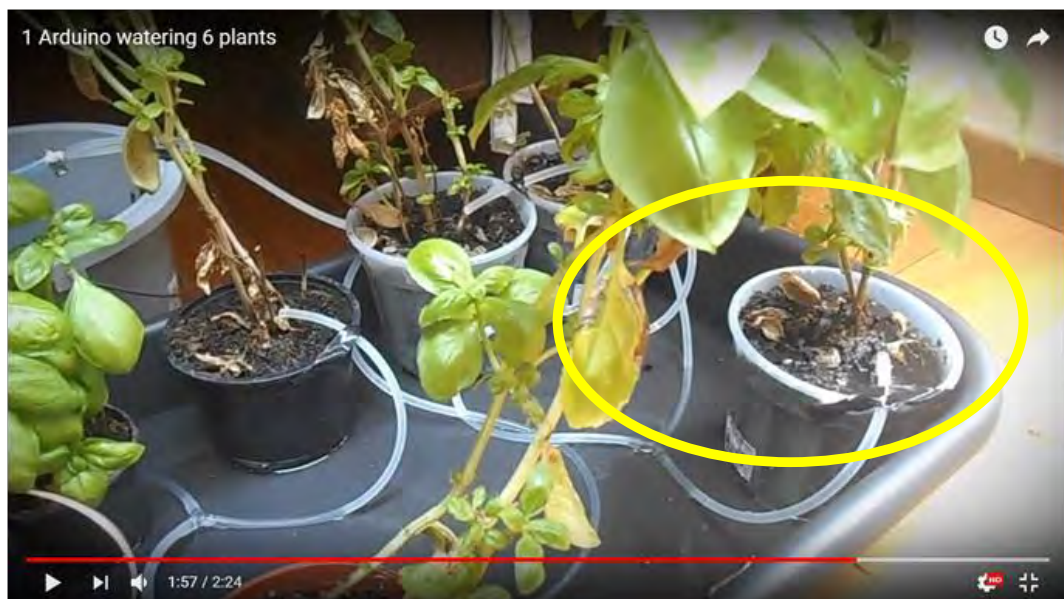


Figure 1-3: Water Flood on the Soil (Ottevangers, 2016)



Figure 1-4: Water Flood on the Soil (watch, 2017)

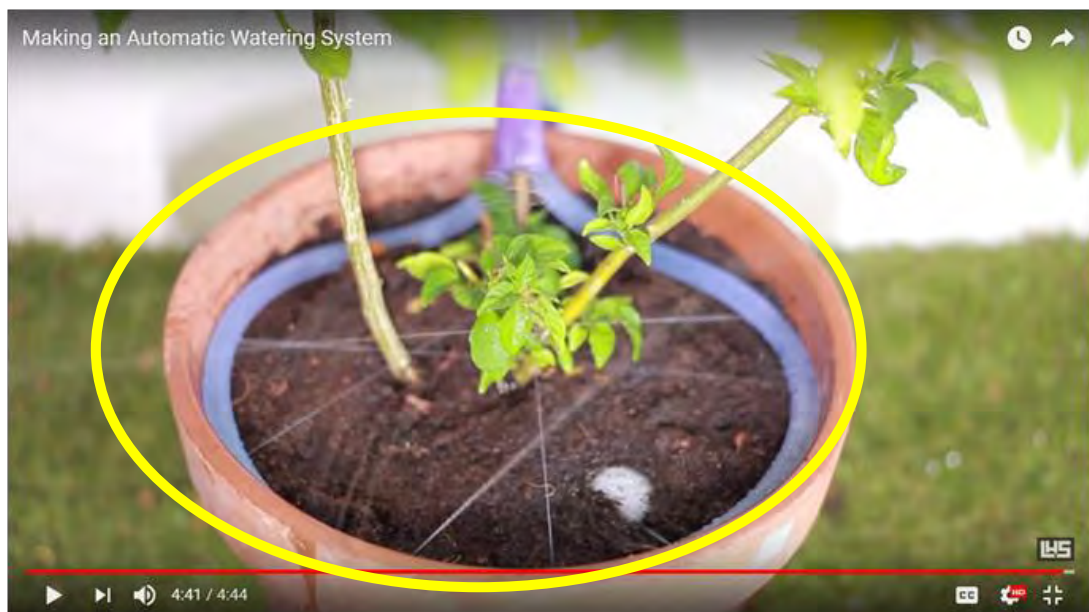


Figure 1-5: Water Flood on the Soil (Hack, 2016)

From the figure above, there is a water pump which is connected to water tank using water pipe so that the water from the tank can be supply to the target flower pot. At figure 1-5, as soon as the water pump activated by the microcontroller, the water was splash everywhere when it hit the soil/plant in the flower pot. At figure 1-1~1-4, the flower pot was filled with water on the top of soil when water pump was

continuously turned on. Some plant might can tolerance with water that filled on the top of soil but not for some plant. So there is a risk of plant die due this type of watering system which uses water pump or solenoid to control the water to the soil. Also with strong water flow rate to the soil for seed germination is not suitable. So there is a need for control the water volumes to the soil so that this problem can be avoid.

Next, the soil temperature also important for a plant to grow especially during the seed germination stage, correct temperature range allows the seed to germinate and grow. Thus, specified range of soil temperature need to be monitored, maintain and control.

1.3 Objectives

- To develop small volume watering system in the purpose of control water volume to the soil.
- To develop soil cooling system in the purpose of maintains and control soil temperature for seed germination.

1.4 Project Scopes

To know more about which plant is water sensitive plant literature review will be carrying out. Next, current technology regard small scale microcontroller based watering system will be studied and compared for each others. An automated small scale microcontroller based watering system that can control the water volume to the soil can be expected at the end of this final year project.

After the hardware is completed, analysis will be carry out. The analysis will be on the range of the water volume in minutes that can supply by the gentle watering system and it output tolerance.

This project also aims to be low cost as possible while remain it effectiveness and functionality. To reduce the chance of unexpected product failure during operation, product evaluation and improvement will be made to make sure long term functional to let the user peace of mind for not worrying too much about their planting.

For controlling soil temperature, the microcontroller based temperature control system journey will be disuses. Next, the soil temperature required for general flower/plant to germinate will be reviewed.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introductions

This section will be discussed about the type of plant which is sensitive to water. Next, current microcontroller based watering system and the soil cooling system will also be mentioned and discussed.

2.1.1 Literature Review on Flood Prone Plant

As with other climatic factors, water can possibly cause unfavorable effects on plant growth and development. Excess water in the soil can injure flood prone plants, like corn (maize), due to lack of oxygen. In this case water stress due to flooding means oxygen stress by deficiency (hypoxia) or total absence (anoxia).

Excess water within the plant can also cause injury. Edmond, et al. (1978) explained that under conditions that favor high absorption and low transpiration rates, there is build-up of high turgor pressure in the region of cell elongation which causes maximum swelling of the cells. This results to the development of leggy seedlings.

The water pressure inside plant cells is called turgor pressure, and it is maintained by a process called osmosis. Osmosis is the movement of water across a differentially permeable membrane from a place where water concentration is higher to one where the concentration is lower.

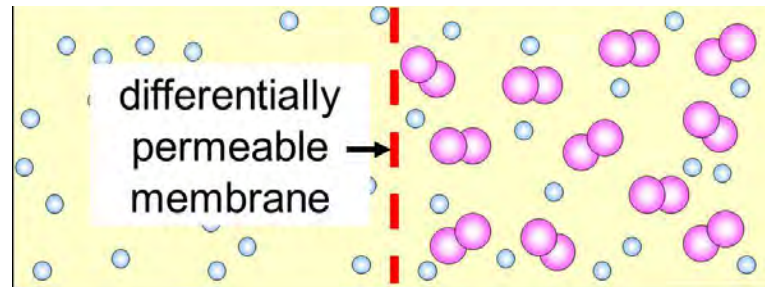


Figure 2-1: Plant Cell Membrane

The cell membrane is "differentially permeable," that mean salt contained water molecules can enter, but the salt molecules are too large to escape. The result is that water pressure builds inside the cell, causing the cell membrane to exert pressure on the cell wall.

2.1.1.1

Flood Prone Plant (Strawberry Plant)

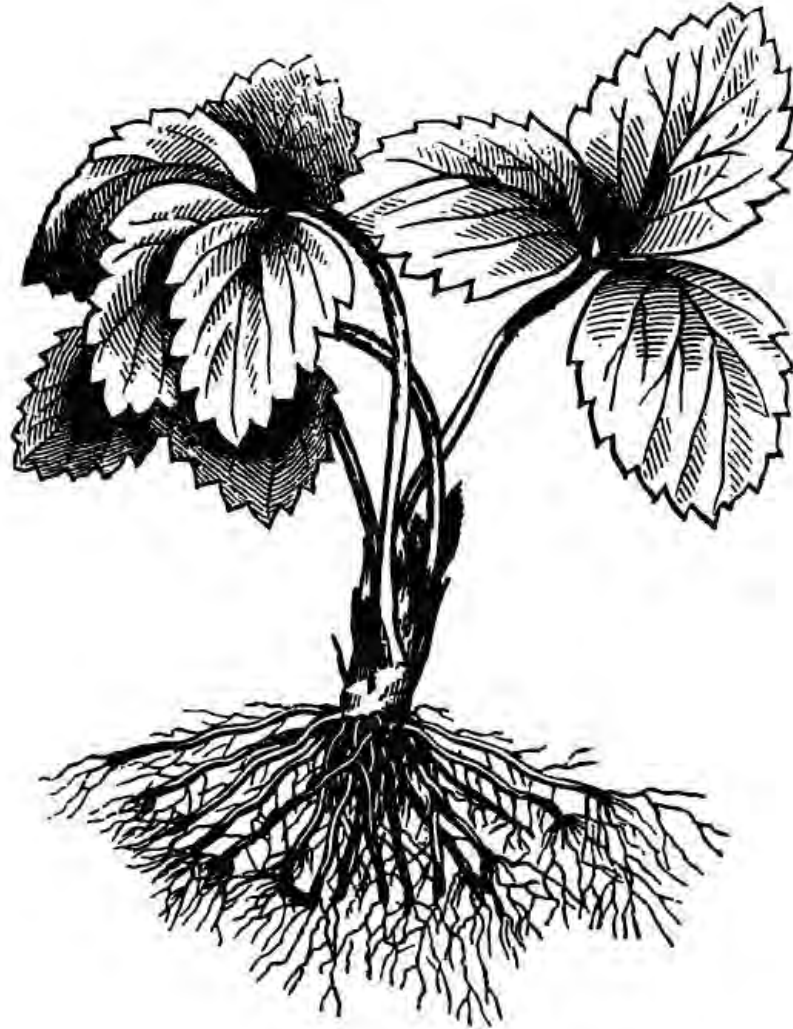


Figure 2-2: Strawberry Plant Shallow Roots

According to article Vanderlinden (2017) and Domenghini (n.d.) both of the authors mention that strawberry plant has shallow root systems and watering should be done regularly. This prevents the plants from stress or dry due to insufficient water (Vanderlinden, 2017). Furthermore, regular watering also help the shallow root system from dry out especially during warm weather (Domenghini, n.d.).