I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the bachelor of Mechanical Engineering (Thermal-Fluid)

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DESIGN AND DEVELOPMENT OF AUTOMATED IRRIGATION SYSTEM FOR HOME GARDEN

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"I hereby the author, declare this report entitled "**DESIGN AND DEVELOPMENT OF AUTOMATED IRRIGATION SYSTEM FOR HOME GARDEN**

is my own except for quotations and summaries which have been duly acknowledged"

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ABSTRAK

The scopes of this proposed project are to research about irrigation type and flowers or ornamental plants in Malaysia. The scopes also involve the research to determine the home garden area according to the different type of house, flow rate of the irrigation system and the relationship between the pressure drop or friction loss with the length of the piping system. In the irrigation system for home garden, there are several problems occur which is the system must be able to operate according to the irrigation time interval for each plant and the system must able to deliver water according to how much the plants require water. Therefore, as a solution a timer will be install in the system to control the irrigation time interval and deliver the water according to the water required for each type of plant. For this project design, four timers were used to avoid the problem. Several interviews and a survey had been conduct to research the irrigation system. Two experiments also had been conduct to investigate the relation between pressure drop or friction loss with the length of the piping system. For this project design, four types of plant were involved according to the survey which is fern type, palm type, flower type and grasses. The irrigation type of this design is using the combination of drip and sprinkler irrigation system based on the feedback from the survey. Sample calculation also had been done to determine the water required for each type of plant and the irrigation time interval. For fern and flower type, water quantity needed is about 0.617 and 1.045 liter in one day and for palm and grass type, the water that needs to irrigate them in one day is about 1.389 liter and 61.74 liter. The Irrigation time for fern type and flower type in one day is 21 minutes and 35 minutes. While for palm type and grasses type is 47 minutes and 14 minutes. From the experiments, if the length of the piping system increases, pressure drop or friction loss will also increase except for the length of the 4 mm diameter LDPE tube.

ABSTRAK

Dalam projek ini, bidang kajian yang terlibat adalah kajian mengenai jenis-jenis sistem pengairan dan juga jenis-jenis tumbuhan hiasan di Malaysia. Kajian juga melibatkan keluasan halaman rumah, kadar alir air di dalam sistem pengairan dan juga kajian untuk menentukan perhubungan diantara kehilangan tekanan air dengan panjang sistem paip. Dalam sistem pengairan untuk halaman rumah, ada beberapa masalah yang berlaku. Antaranya sistem itu perlu membekalkan air mengikut kadar keperluan air yang diperlukan oleh sesuatu tumbuhan. Untuk itu, alat yang dipanggil timer dipasang pada sistem pengairan untuk menyelesaikan masalah ini. Untuk rekaan sistem pengairan pada projek ini, empat timer dipasang untuk mengatasi masalah tersebut. Beberapa temubual dan juga tinjauan telah dilakukan untuk mengkaji dengan lebih mendalam mengenai sistem pengairan ini. Dua eksperimen juga telah dijalankan untuk mengkaji hubungan diantara kehilangan tekanan air dengan panjang sistem paip. Dalam rekaan untuk projek ini, sebanyak empat jenis tanaman terlibat berdasarkan maklum balas yang diterima daripada tinjauan yang telah dibuat. Jenis-jenis tanaman tersebut adakah tanaman jenis herba, bunga, pokok palma dan juga tanaman jenis rumput yang digunakan untuk menutupi kawasan halaman sesebuah rumah. Jenis sistem pengairan yang digunakan dalam rekaan projek ini adalah sistem pengairan yang mengabungkan pengairan jenis menitis dan juga pengairan jenis merenjis. Pengiraan juga telah dilakukan untuk mengetahui kadar keperluan air bagi sesuatu jenis tumbuhan. Untuk tumbuhan jenis herba dan pokok bunga, keperluan air dalam satu hari bagi setiap jenis tanaman tersebut ialah 0.617 liter dan 1.045 liter. Manakala bagi tanaman jenis palma dan juga tanaman jenis rumput, sebanyak 1.389 liter dan 61.74 liter air diperlukan. Berdasarkan eksperimen yang telah dibuat, hubungan diantara kehilangan tekanan air dengan panjang sistem paip ialah jika panjang paip meningkat, maka kehilangan tekanan air juga akan meningkat.

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PET	=	Potential Evaporation, in / day
D	=	Diameter of a Plant Root, ft
ΔP_L	=	Pressure Drop, kPa
f	=	Darcy Friction Factor
L	=	Length of a Pipe, m
ρ	=	Density of Fluid, kg / m^3
v	=	Velocity, m/s
D	=	Diameter of a Pipe, m
C	=	Coefficient of Friction
Q	=	Flow Rate, gpm

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Most of the home in Malaysia has their own yard. The yard area is depending on the type of the house. Bungalow has more large yard area compare to terrace house. The yard area is not same for the house which has same type. So, it depends on the contractor which builds that house.

Usually, flowers or ornamental plants are planted or cultivated in the yard to make it look more beautiful and to decorate it. In Malaysia, this crop is classification into five type or class. The classes are climber, fern, shrub, palm, tree, grasses, flower and aquatic plant.

So, water must be supply to those plants so that the plant can grow. Watering or irrigation system can be dividing into six types. The types are flood irrigation, overhead or sprinkler irrigation, center pivot irrigation, lateral move irrigation, drip or trickle irrigation and sub irrigation [2]. But, center pivot irrigation and lateral move irrigation can be classification in overhead or sprinkler irrigation [3].

In Malaysia, most of the plants which grow in yard are watering by hand watering. This type is popular because it is an effective and efficient way of applying water to selected plants that show signs of stress during dry periods. The direct

application of water to the base of the plant provided it is applied slowly enough to be absorbed by the soil and uses less water [4]. It also is the most cheap and easy type irrigation compare to other.

But, in several case the hand watering is not suitable to use. This is because if the owner is getting out in several days or weeks for work or holiday, so who will water their plants? For this solution, overhead or sprinkler irrigation, drip or trickle irrigation or sub irrigation is suitable for irrigate home garden because they can add timer to their system. The owner can setting the timer which install at their irrigation system to set up the time and how many time their home garden want to irrigate.

This research is more specially to design and development the suitable type of irrigation in home garden. The result obtained of this study hopefully can be used as a reference or guideline by other researcher.

1.2 Problem Statement

Irrigation or watering system is usually used is a hand watering system which is not suitable for those who busy with work and like having vacations. This is because if they are busy with work, they will have not enough time or forget to water their home garden. That is same as with those out stationed for several days or weeks for visiting relatives or having vacations and their home garden will be not watering.

To design the suitable system also is a problem because it depends on the area of the yard and the type of the flowers or ornamental plants which want to plant. It is because there is system which suitable for large area and there is a system which suitable for small area. These systems also different for each type of the plant because each system have different water flow rate and the plant also need different water supply.

1.3 Objectives

The objectives of this proposed project are:

a) To study the concept of irrigation system for home garden.
b) To research about equipments or components in irrigation system.
c) To design and develop an automated irrigation system for home garden.

1.4 Scope

The scopes of this proposed project are:

a) Research about irrigation type.
b) Research about flowers or ornamental plants in Malaysia.
c) Research about home garden area according to the different type of house.
d) Research about the flow rate of the irrigation system.
e) Research about the relationship between the pressure drop and friction loss with the length of the piping system.
f) Design and development the irrigation system.

1.5 Expected Result

This system must delivered water to home garden according to how much water the plants are need. For residential house the water source usually come from the main pipe, the water meter. So, this system will connect to the water tank which located at the roof of the house and the water will flow through the components of the irrigation system such as valve, filter and other to the plant.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review is based on the physics of the project undertaken here, concentrating on the irrigation system in home garden, type of irrigation, components in irrigation system, classification of plants, and home garden area.

2.2 What is Irrigation?

Irrigation is the replacement or supplementation of rainfall with water from another source in order to grow crops or plants [5]. Supplementary irrigation is the application of water to plants when natural precipitation is not adequate to secure crop production. Depending on the size of the farm and type of irrigation system, application of water is possible by using modern power sources from deep well pumps and by storage of large quantities of water in reservoirs, ponds, streams and rivers. City water is also often used directly by small farmers who use drip irrigation for their vegetable gardens.

Under the climatic condition of the southeastern regions, supplementary irrigation during dry spell periods is essential to secure plants production. If water shortage occurs early in the crop's development, maturity may be delayed and yield

could be reduced significantly. Similarly, if moisture shortage occurs later in the growing season, quality is often reduced even though total yields are not affected [6]. It is essential to maintain soil moisture during the growing seasons of plants. Humans are able to collect, store, and bring water to the land to produce crops and other desirable plants. Whenever plant growing areas receive 20" of precipitation or less (semi-arid), irrigation is necessary to insure continuous plant growth. So, the purpose of irrigation is to supply water to plants during dry periods of plant growth [8].

2.3 Type of Irrigation System

The methods of applying irrigation may be classified as surface, subsurface, sprinkler and drip/micro irrigation [6].

2.3.1 Drip or Micro or Trickle Irrigation

Drip irrigation is watering at a slow rate (or drip) right at the roots of plants. Root irrigation is a good water conservation choice because it provides a deeper level of watering than surface watering, which is prone to wastage due to evaporation and runoff. The drip irrigation lines do not need to be buried (although they can be if the owner prefer), so it can easily move them about and make adjustments to the watering pattern as needed [9]. Water is applied in the form of drops, tiny streams, or miniature sprays [19]. It also doesn't wet plant leaves, and helping to control some diseases [10].

Drip irrigation slowly delivers water directly to the plant's root zone through a tube with little drippers in it. Studies show that drip irrigation can save you up to 70 percent of applied water compared with an overhead sprinkler system. The best time to install drip irrigation is right after you plant your shrubs or perennials. That way it's easy to get in and around the plants [11]. It is the most common type of micro irrigation [12].

A drip system can be as simple as a few emitters on a specific zone to a series of drip zones that water foundation plantings, container-grown flowers, and vegetable gardens. In all cases, drip installations require additional and more complex equipment than the typical sprinkler system, including pressure reducing equipment and filters. With a drip system, the valves and controller must be carefully selected to ensure they are compatible with the watering times and flow rates used in drip irrigation. Problems with a drip system may be harder to pinpoint and more difficult to fix. Poor filtration and back siphoning of contaminants into the emitters can render the system ineffective in a short time [13]. These little drippers, about the size of a quarter don't hang above the plants and drip but are actually laid along the ground. Linked to an appropriate water source by a main feeder hose, they provide a slow and steady flow of water [14].

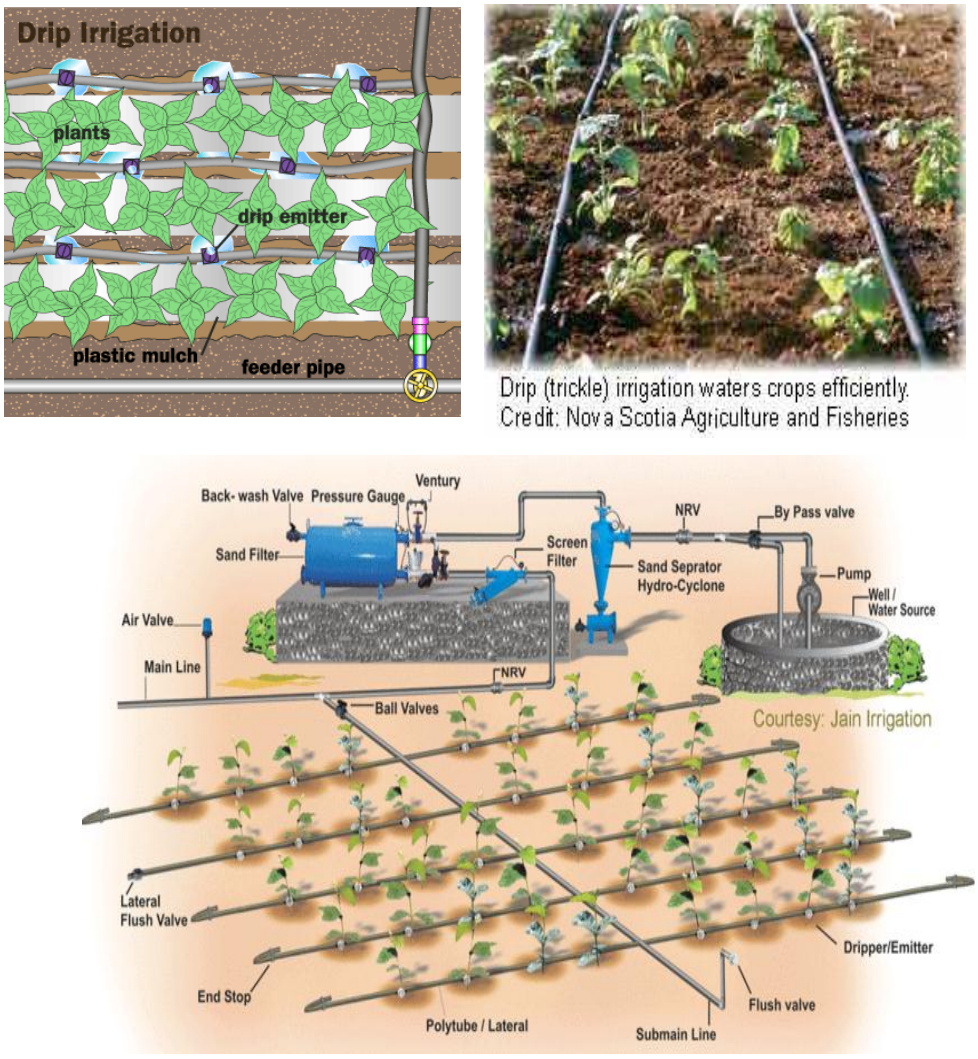

Fig. 1 : Layout of drip irrigation system

2.3.1.1 Type of Drip Irrigation

Several types of drip or trickle equipment are available such as soaker hose, emitter type system, micro sprinklers or micro spray heads and subsurface drip irrigation or SDI.

a) Soaker hose [10]
   - The easiest to use as no installation is required.
   - It is a fibrous hose that allows water to slowly seep out all along its length.
   - It is simply laid at the base of the plants and moved around the garden.

b) Emitter type
   - In which short tubes, or emitters, come off a main water supply hose and go right to the roots [10].
   - Also called as dripper is a device to transfer water from a pipe or tube to the area to be irrigated [17].
   - Typical emitter flow rates are from 0.16 to 4.0 US gallons per hour (0.6 to 16 L/h) [17].
   - Flow will vary with pressure, while some emitters are pressure compensating [17].
   - These emitters employ silicone diaphragms or other means to allow them to maintain a near-constant flow over a range of pressures, for example from 10 to 50 psi (70 to 350 kPa) [17].
   - Emitter discharge rates for drip and subsurface irrigation are generally less than 12 liters per hour.
   - Most emitters emit 4 liters/hour (4,0 l/hr) of water. That's about 1 gallon per hour (1 gph) [15].
   - Use pressure compensating emitters if irrigating a hilly area
   - Most emitters operate best at around 20 PSI. At pressures over 45 PSI emitters may blow apart. Barbed emitters in poly tubing may pop out of the tubing at 30 PSI.