Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF AUTOMATED MONITORING AND SELF-WATERING PLANTER BOX USING IOT

NURNAJIHAH BINTI JOHARI

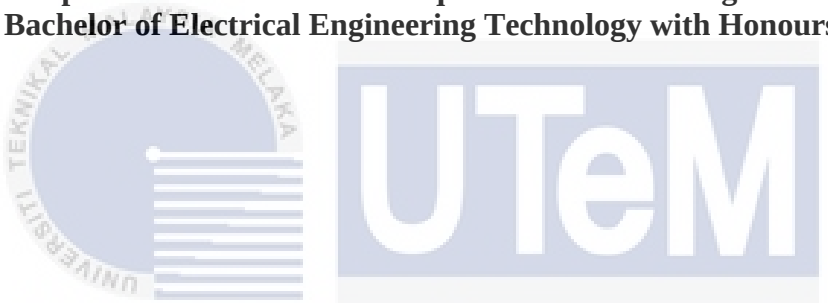
Bachelor of Electrical Engineering Technology with Honours

2021

DEVELOPMENT OF AUTOMATED MONITORING AND SELF-WATERING PLANTER BOX USING IOT

NURNAJIHAH BINTI JOHARI

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF AUTOMATED MONITORING AND SELF-WATERING PLANTER BOX USING IOT

Sesi Pengajian : SEM 1 2021/2022

Saya NURNAJIHAH BINTI JOHARI mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐ **SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐ **TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑ **TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)
Alamat Tetap:
NO 138, JALAN LAMAN BAKAWALI C/10,
KOTA SERIEMAS,
71800 NILAI,
NEGERI SEMBILAN

Tarikh: 5 JANUARI 2022

(COP DAN TANDATANGAN PENYELIA)
TS. MOHAMED AZMI BIN SAID
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Elektrik
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik
Universiti Teknikal Malaysia Melaka

Tarikh: 10 JAN 2022

*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this project report entitled “Development of Automated Monitoring and Self-Watering Planter Box using IoT” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

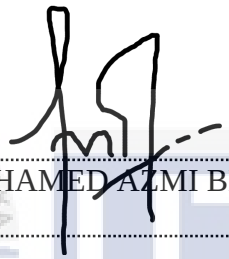
Signature : 

Student Name : NURNAJIHAH BINTI JOHARI

Date : 5 JANUARI 2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology with Honours.

Signature : 

Supervisor Name : TS. MOHAMED AZMI BIN SAID

TS. MOHAMED AZMI BIN SAID
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Elektrik
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik
Universiti Teknikal Malaysia Melaka

Date : 10 JAN 2022

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

To my beloved mother, Aisah binti Mohamed Azmi, and father, Johari bin Abdul Ralip,

and

To dearest siblings,

Aiman, Anwar, Aqilah, Azhari and Asyraaf,

who have been my source of inspiration and continually giving me

moral, spiritual, and emotional support.

ABSTRACT

In recent years, greater investment in science and technology in agriculture have create attention into significant improvements in agriculture. Plant's health is very crucial in agricultural sector because it can cause significant reduction in both quality and quantity of the crops if the plant is not well cared for. In this era, there is lot of factors affecting the growth of the plants that can limit a healthy plants production. The efficiency of plant's growths is heavily depending on the environmental parameters such as moisture of the soil, light intensity, and pH level of water, which is varied differently according to the plant type. The objective of this project is to design a plant monitoring and automated watering system to maintain the health of the plant to maximize the growth of the plant. This project proposed on using a systematic irrigation system for indoor plants. Arduino boards is used to control the inputs and outputs and Blynk apps is used for monitoring plant's health condition using smartphone. Moisture sensor is used to detect soil moisture in the pot, hence the water motor pump supplies water to the plant automatically in when the moisture detected is low. PH sensor is used for detecting pH level of water while ultrasonic sensor is used to detect water level in the water storage. As conclusion, with this advancement's innovative techniques, it helps the farmers to produce more yields with less manpower, while maintaining the health of the plant to maximize the growth.

ABSTRAK

Dalam beberapa tahun kebelakangan ini, pelaburan yang besar dalam bidang saing dan teknologi telah mendapat perhatian kepada mereka yang inginkan peningkata yang signifikan dalam sektor pertanian. Kesihatan tanaman sangat penting dalam sektor pertanian kerana boleh menyebabkan pengurangan kualiti dan kuantiti tanaman yang ketara jika tanaman ini tidak dijaga dengan baik. Pada era ini, terdapat banyak faktor yang mempengaruhi pertumbuhan tanaman yang dapat membatasi pengeluaran tanaman yang sihat. Keberkesanan pertumbuhan tanaman sangat bergantung kepada parameter persekitaran seperti kelembapan tanah, keamatan cahaya dan tahap pH air yang bervariasi secara berbeza mengikut jenis tanaman. Objektif projek ini adalah untuk merancang sistem pemantauan tanaman dan sistem penyiraman secara automatik untuk mengekalkan kesihatan tanaman supaya dapat memaksimumkan pertumbuhan tanaman tersebut. Projek ini mencadangkan penggunaan sistem pengairan yang sistematik untuk tanaman dalaman. Papan Arduino digunakan untuk mengendalikan semua input dan output, manakala *Blynk Apps* digunakan untuk memantau keadaan kesihatan tanaman dengan hanya menggunakan telefon pintar. Sensor kelembapan digunakan untuk mengesan kelembapan tanah di dalam pot tanaman, oleh itu pam motor air akan menyiram pokok secara automatik apabila kelembapan tanah didapati rendah. Tambahan itu, sensor pH digunakan untuk mengesan tahap pH air manakala sensor ultrasonik digunakan untuk mengesan paras air di tempat penyimpanan air. Kesimpulannya, dengan kemajuan teknik inovatif ini, ianya dapat membantu para petani untuk menghasilkan lebih banyak hasil tanaman dengan menggunakan tenaga kerja yang sedikit di samping dapat menjaga kesihatan tanaman untuk pertumbuhan yang maksimum.

ACKNOWLEDGEMENTS

First and foremost, praises and thanks to Allah S.W.T for the blessings throughout my research work to complete this project.

I would like to express my deepest gratitude and appreciation to Universiti Teknikal Malaysia Melaka (UTeM) and my supervisor, Ts. Mohamed Azmi bin Said for giving the oppurtunity to do this project and providing me all the support throughout completing this project. I am very fortunate as the success and final outcome of this project required a lot of assistance and guidance from him.

I would like to express my humbleness and gratefulness to all those who have helped me during the completion of this project, especially my family who have been supportive either morally, financially and physically.

Last but not least, I would like to extend my appreciation to those who could not be mentioned here but have played their role to inspire me to be motivated on completing this project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

T	-	Time
C	-	Speed of sound
V	-	Voltage
A	-	Current
W	-	Power
°C	-	Temperature
Hz	-	Frequency
CO_2	-	Carbon Dioxide
O_2	-	Oxygen
nm	-	Wavelength (nanometers)

LIST OF ABBREVIATIONS

IoT	-	Internet of Things
LDR	-	Light Dependent Resistors
LED	-	Light-Emitting Diode
MIT	-	Massachusetts Institute of Technology
SoC	-	System-On-a-Chip
kB	-	kiloBytes
MB	-	MegaBytes
IDE	-	Integrated Development Environment
XML	-	Extensible Markup Language
RH	-	Relative Humidity
ID	-	Identifier
MIPI	-	Mobile Industry Processor Interface
DC	-	Direct Current
LCD	-	Liquid Crystal Display
UI	-	User Interface

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This chapter contains of the project descriptions, problem statement, the objectives of proposing this project and the scope of the project. This should be the key reason for doing this project and briefly explain about the concept of the project.

1.1 Project Background

Today's world is overtaken by the automation and internet of things which most of the devices are connected to internet. Plant cultivation using modern agriculture methods is currently very common among farmers. The most difficult aspect in agricultural fields is improving the tools and technologies that enables the farmers to increase their productivity such as modern irrigation methods, crop management and the use of mobile technology in managing their farms.

The IoT is a notion that allows items to remotely feel and handle across a network. It refers to the interconnections between common things and the Internet so that people may encounter each other more reliably and effectively. IoT is an environment where all the sensors and devices relate to wireless communication devices to communicate with each other, deliver and record data obtained, and controlling the parameters without any human intervention. The cloud computing and IoT system are integrated with each other as for storing the data.

An automatic method for monitoring and irrigation system is proposed to continuously monitor the health and growing of the plant in a regulated environment. The fundamental idea of the system is to determine the behavior of plants by observing and analyzing the environmental parameters which affect the growth of the plant. This helps the user to control the health directly and constantly from a remote location. The implementation of Internet of Things (IoT) has opened a new era to monitor health of the plants. Sensor are connected to Arduino, as it interfaces all the circuit logically. The system is developed based on IoT technology to provide real time monitoring of the important environmental parameters in plant growth such as the soil moisture, light intensity, and acidity of water.

Irrigation is an agricultural use of watering of land. The soil water needs rely on the soil characteristics such as soil humidity [2]. The whole development process may be influenced by an effective watering system. Most of the irrigation system is usually operated manually. However, these strategies can be replaced with an automated irrigation system to supply the plant with sufficient water. A sensor based automated watering system provides promising solution to the user as it can reduce manual intervention. Soil moisture is employed in this system to detect the plant's soil dampness. The device automatically waters the plant when the soil is too dry and switches off when the ground is sufficiently watered on, depending on the moisture content of the soil.

The elements such as water acidity, soil humidity and light intensity influence plant growth productivity. Therefore, sensors such as pH level sensor, ultrasonic sensor and soil moisture sensor are used to detect all the changes that could affect the plant. By analyzing and storing the data in the cloud based, the user can remotely monitor the plant via the smartphone.

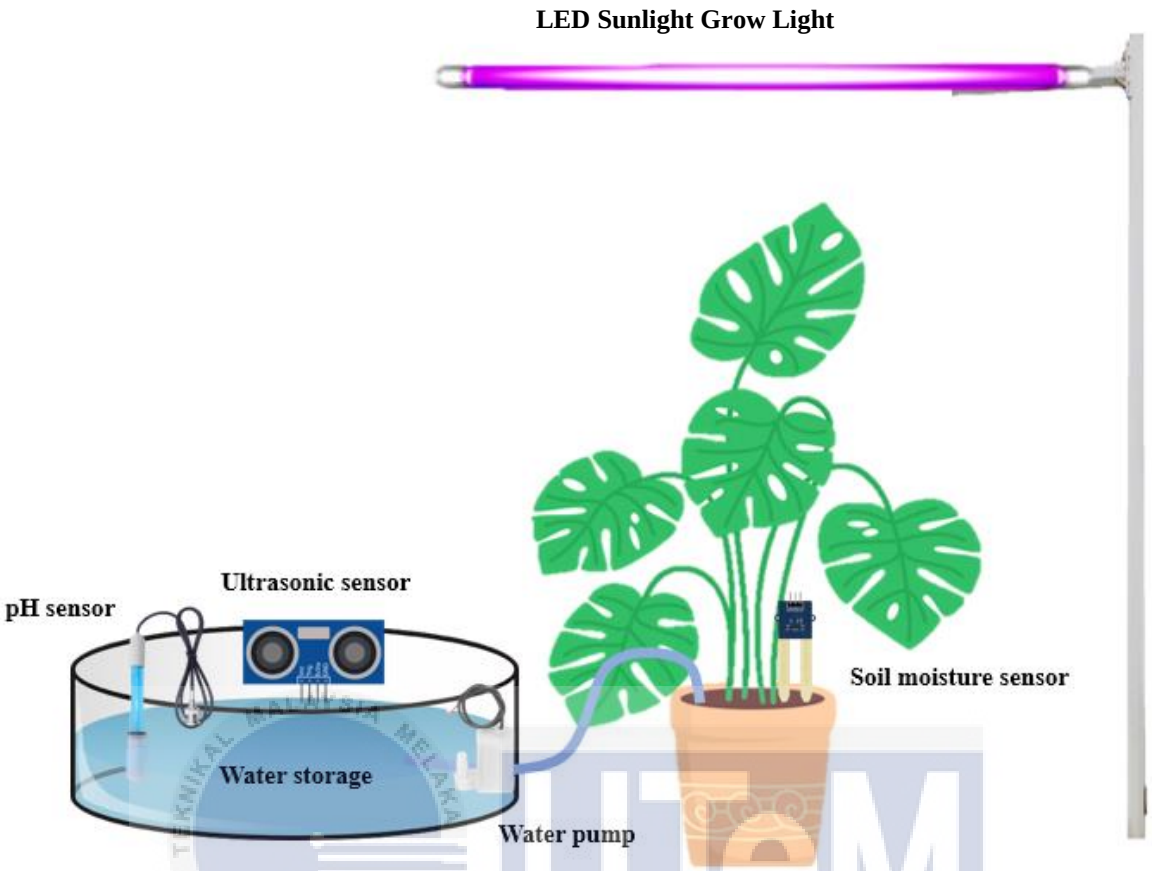


Figure 1.1: Concept design of the system.

Figure 1.1 shows the design concept of the automated watering system. Based on the figure above, all the sensors are attached to the water storage, inside the plant's pot and near to the LED light. This system helps the user to monitor the health of the plant remotely by using smartphone, which all the data measured are being displayed. The sensors will read the environmental parameter, and then send the data to the smartphone apps which is Blynk Apps.

1.2 Problem Statement

Plant health is a key condition for sustainable land. It can expose them to many problems that can threaten their health that leads to serious consequences which result in crop less production in yield and quality and plant death. Many different factors can cause plant health problems such as moisture, lighting, and acidity. It can impact plants in many ways including the flowers, leaves, stems, branches, growing tips, and roots. For example, dry soil can result in root damage and death. Moreover, excessive direct sunlight can dry out the leaves. If one of these parameters is below the ideal limit of that certain plant, it will impact the growth and health of the plant. Thus, many farmers and growers need to give more attention to the plants to make sure healthy crops can be produced.

In recent years, there has been a surge in interest in indoor plants which can be utilized to produce food or simply for decoration and health benefits. The rising city congestion and less available area for outside plants have caused the use of indoor plants to soar in order to maintain a connection with nature [3]. Majority of people spend their time indoors, either at home or working in an office environment. As such, it is important to ensure the air quality is clean. An average home has dangerous toxins such as carbon monoxide, formaldehyde; found in synthetic fabrics, benzene; found in tobacco smoke and paint, and ammonia; found in cleaners and waxes. Indoor plants are most likely filters and purifies the air inside the house as it absorbs up to 90% of indoor air pollutants [4].

One of the common problems growing plants indoor is difficulties on watering the plants. The right amount of water to irrigate the plant is crucial as overwatering could lead to some other problems that can reduce the crop yields. Many people are lack of knowledge regarding this matter as different plants require different amount of water. In addition, monitoring the soil moisture content also important to avoid from overwatering. Hence,

developing a self-watering system utilizing soil moisture sensor and motor pump to irrigate the plants helps to lighten the burden of the user.

Moreover, for people who lives in high-rise building such as apartment or condominium are facing difficulties to grow plants as the space might not be able to receive a proper sunlight. In addition, every plant has different light requirements and exposing them to direct sunlight for a long time can be harmful to these plant especially when the sun is scorching hot. Therefore, a right lights with enough intensity are needed to support the growth of the chili plants by using LED sunlight grow lights, which help the plant to continue the photosynthesis process that replicates the natural solar spectrum.

This project intended to develop a self-watering system that can automatic irrigate sufficient water to the plant without any manual workload. Moreover, this system also helps the user to remotely monitor the plant's health via smartphone.

1.3 Project Objectives

The main objective of this project is to develop effective system to monitor plant's health and growth. The objectives are as follows, in particular:

a) Development of a monitoring system with an application software that tracks environmental parameters such as soil moisture, pH level of water and light intensities for growing indoor plants.

b) Implementation of hardware and software such as moisture sensor, HC-SR04 ultrasonic sensor and pH sensor for displaying a real-time data on Blynk apps for plant monitoring and self-watering system.

c) Analyze data results from parameters value measured by the sensors and display it on Blynk apps for better understanding of growing chili plants indoor.

1.4 Scope of Project

The scope of this project are as follows:

a) This project proposes using indoor plants to observe the parameters such as soil moisture, water pH level, and light intensity or brightness.

b) LED sunlight grow light with daylight white illumination can simulate sunlight spectrum that allows the plant to perform photosynthesis.

c) Software used in this project are Arduino board of ESP-WROOM-32 and Blynk Apps to interfaces all the sensors and the outputs in this project.

d) Implementation of automatic irrigation system that used soil moisture sensor to detect dryness of the soil that can trigger water pump to supply water.

e) Chili plants grow best in a pH range of 6.0 to 6.5.

f) Suitable soils are an organic soil-based compost with contents of micro, coco peat, red-burnt soil, fine sand, old humus, and charcoal.