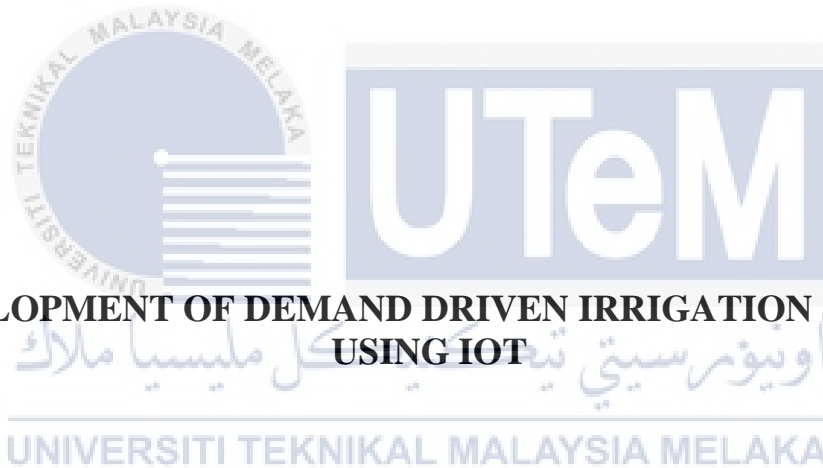




**Faculty of Electrical and Electronic Engineering Technology**



**DEVELOPMENT OF DEMAND DRIVEN IRRIGATION SYSTEM  
USING IOT**

**MUHAMMAD MUADDIB BAKHTIAR BIN MUZAFAR**

**Bachelor of Electronics Engineering Technology (Industrial Electronics) with  
Honours**

**2023**

# **DEVELOPMENT OF DEMAND DRIVEN IRRIGATION SYSTEM USING IOT**

**MUHAMMAD MUADDIB BAKHTIAR BIN MUZAFAR**

**A project report submitted  
in partial fulfillment of the requirements for the degree of  
Bachelor of Electronics Engineering Technology (Industrial Electronics) with  
Honours**



**Faculty of Electrical and Electronic Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2023**

BORANG PENGESAHAN STATUS LAPORAN  
PROJEK SARJANA MUDA II

Tajuk Projek : Development of demand driven irrigation system using IoT

Sesi Pengajian : 1- 2022/2023

Saya Muhammad Muaddib Bakhtiar 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)

(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

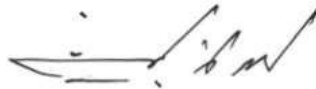
**TIDAK TERHAD**

Disahkan oleh:



(TANDATANGAN PENULIS)

Alamat Teta :  
B21 kuartes guru smk bandar kerayong,  
28200 bandar bera,  
pahang



(COP DAN TANDATANGAN PENYELI A)

**SYED MOHAMAD SHAZALI BIN SYED ABDUL HAMID**  
PENYARAH  
FAKULTI TEKNOLOGI KEJURUTERAAN ELEKTRIK DAN ELEKTRONIK  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Tarikh: 27/1/2023

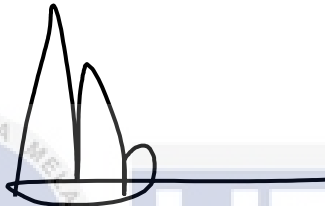
Tarikh: 27/01/2023

## DECLARATION

I declare that this project report entitled “Development Of Demand Driven Irrigation System 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

:

MUHAMMAD MUADDIB BAKHTIAR BIN MUZAFAR

Date

:

15/01/2023



اونيورسيتي تيكنيكل مليسيا ملاك  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## APPROVAL

I approve that this Bachelor Degree Project 2 (PSM2) report entitled “DEVELOPMENT OF DEMAND DRIVEN IRRIGATION SYSTEM USING IOT” is sufficient for submission.

Signature :



Supervisor Name :

Mohamad Shazali Bin Syed Abdul Hamid

Date :

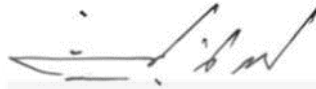
27/01/2023



## 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 :

Mohamad Shazali Bin Syed Abdul Hamid

Date :

27/01/2023

Signature :



Co-Supervisor :

Name (if any)

Date :

## DEDICATION

*To my beloved mother, Salemah Binti Salleh, and father, Muzafar Bin Maarof,  
and  
To brothers, Muhammad Mujahid Danial and Muhammad Murshid Anuar  
and  
My sister, Nurul Umairah*



## ABSTRACT

Good irrigation system has the potential to transform the agricultural sector from one that is manual and static to one that is intelligent and dynamic, resulting in improved production while requiring less human supervision. A job that takes a lot of people can be turned into a job that requires very little manpower and imprecise data collecting can be turned into a very good, automated irrigation system with zero-error accurate reading. This research proposes the development of an IoT-based demand-driven irrigation system that autonomously checks and maintains the appropriate soil moisture content. The Arduino Uno microcontroller platform is used to build the control unit. Finding a way to calibrate the sensors so that an accurate reading may be obtained will be a key breakthrough throughout the project. Soil moisture sensors are used in this configuration to determine the exact moisture content of the soil. This number allows the system to use the correct amount of water, preventing over- and under-irrigation. The Internet of Things (IoT) is utilized to keep farmers up to date on all data acquired during the irrigation process. All the data obtained by the sensors is sent to the cloud on a regular basis, allowing a farmer to verify whether the water pump watered the crop according to the pre-determined timetable. The sensor data is also sent to a Blynk application, where it is graphed for study.



## ***ABSTRAK***

Sistem pengairan yang baik berpotensi untuk mengubah sektor pertanian daripada yang manual dan statik kepada yang pintar dan dinamik, menghasilkan pengeluaran yang lebih baik di samping memerlukan pengawasan manusia yang kurang. Pekerjaan yang memerlukan ramai orang boleh ditukar menjadi pekerjaan yang memerlukan tenaga kerja yang sangat sedikit dan pengumpulan data yang tidak tepat boleh diubah menjadi sistem pengairan automatik yang sangat baik dengan bacaan tepat sifar ralat. Penyelidikan ini mencadangkan pembangunan sistem pengairan berasaskan permintaan berasaskan IoT yang secara autonomi memeriksa dan mengekalkan kandungan lembapan tanah yang sesuai. Platform mikropengawal Arduino Uno digunakan untuk membina unit kawalan. Mencari cara untuk menentukur penderia supaya bacaan yang tepat boleh diperolehi akan menjadi kejayaan utama sepanjang projek. Sensor kelembapan tanah digunakan dalam konfigurasi ini untuk menentukan kandungan lembapan tanah yang tepat. Nombor ini membolehkan sistem menggunakan jumlah air yang betul, mengelakkan pengairan berlebihan dan kurang. Internet of Things (IoT) digunakan untuk memastikan petani mendapat maklumat terkini tentang semua data yang diperolehi semasa proses pengairan. Semua data yang diperolehi oleh penderia dihantar ke cloud mengikut jadual yang ditetapkan, membolehkan pengguna mengesahkan sama ada pam air menyiram tanaman mengikut jadual waktu yang telah ditetapkan. Data sensor juga dihantar ke aplikasi Blynk, di mana ia digraf untuk kajian.

## ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Sir Syed Mohamad Shazali Bin Syed Abdul Hamid for their precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and my faculty for the financial support which enables me to accomplish the project. Not forgetting my fellow colleagues, for the willingness of sharing their thoughts and ideas regarding the project.

My highest appreciation goes to my parents and family members for their love and prayer during the period of my study.

Finally, I would like to thank all fellow colleagues and classmates, the Faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

## TABLE OF CONTENTS

	<b>PAGE</b>
<b>DECLARATION</b>	
<b>APPROVAL</b>	
<b>DEDICATIONS</b>	
<b>ABSTRACT</b>	<b>i</b>
<b>ABSTRAK</b>	<b>ii</b>
<b>ACKNOWLEDGEMENTS</b>	<b>iii</b>
<b>TABLE OF CONTENTS</b>	<b>i</b>
<b>LIST OF TABLES</b>	<b>iv</b>
<b>LIST OF FIGURES</b>	<b>v</b>
<b>LIST OF SYMBOLS</b>	<b>viii</b>
<b>LIST OF ABBREVIATIONS</b>	<b>ix</b>
<b>LIST OF APPENDICES</b>	<b>x</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 Background	1
1.2 Problem Statement	4
1.3 Project Objective	4
1.4 Scope of Project	5
<b>CHAPTER 2 LITERATURE REVIEW</b>	<b>6</b>
2.1 Introduction	6
2.2 Irrigation system in general	7
2.3 Traditional and modern irrigation systems	7
2.3.1 Traditional irrigation systems	7
2.3.1.1 Moat irrigation	7
2.3.1.2 Chain pump irrigation	8
2.3.1.3 Dhekli irrigation	9
2.3.1.4 Rahat irrigation	9
2.3.2 Modern irrigation systems	10
2.3.2.1 Surface irrigation	12
2.3.2.2 Localized irrigation	15
2.3.2.3 Drip irrigation	16
2.3.2.4 Surface drip irrigation	16
2.3.2.5 Sub-surface irrigation	17

2.4	The plants	18
2.5	Water source	19
2.6	Controlling irrigation	21
	2.6.1 Data acquisition unit	21
	2.6.2 System rectification unit	25
	2.6.3 Processing unit	29
	2.6.4 Internet of Things (IoT) and Cloud-Based Solutions	32
	2.6.5 Actuators and Motors	36
	2.6.6 Graphical User Interface	39
2.7	Overview of studies	39
<b>CHAPTER 3 METHODOLOGY</b>		<b>41</b>
3.1	Introduction	41
3.2	Project workflow	41
3.3	Process Flow of the system	43
3.4	System design	44
3.5	Block diagram	45
3.6	Hardware Development	46
	3.6.1 NodeMcu ESP8266	46
	3.6.2 Float switch	47
	3.6.3 Soil moisture level sensor	48
	3.6.4 6-12v water pump	49
	3.6.5 16 x 2 LCD	49
3.7	Software Development	50
	3.7.1 Arduino IDE	50
	3.7.2 Blynk	51
3.8	Physical Test Planning	52
	3.8.1 Mobile application	52
	3.8.2 Sensor Part	52
3.9	Expected result	53
	3.9.1 Mobile application	53
	3.9.2 Sensor Part	53
3.10	Summary	53
<b>CHAPTER 4 RESULTS AND DISCUSSIONS</b>		<b>54</b>
4.1	Introduction	54
4.2	Results and Analysis	54
	4.2.1 TinkerCad simulation	54
	4.2.1.1 Testing the implementation of soil moisture level sensor	54
	4.2.1.2 Testing the float switch as water level sensor	56
4.3	Testing the float switch as water level sensor	57
4.4	Soil moisture calibration	59
4.5	The Developed Irrigation System	62
4.6	Result analysis	65
	4.6.1 Accuracy sensors reading and actuator	65
	4.6.2 Parameters result	66
	4.6.2.1 Soil moisture level sensor	67
	4.6.2.2 Water level sensor	69
	4.6.2.3 Growth of the spinach	69

4.7	Summary	71
<b>CHAPTER 5</b>	<b>CONCLUSION AND RECOMMENDATIONS</b>	<b>72</b>
5.1	Conclusion	72
<b>REFERENCES</b>		<b>74</b>
<b>APPENDICES</b>		<b>76</b>



## LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1	Type Of Irrigation	10
Table 2.2	Comparison of water supply options	20
Table 2.3	Type of sensors	21
Table 2.4	Type of modules	26
Table 2.5	Type of microcontroller	30
Table 2.6	Type of software	33
Table 2.7	Type Of actuator & motor	36
Table 2.8	Type Of presentation element	39
Table 3.1	soil moisture sensor features	48
Table 4.1	water level sensor time response	66
Table 4.2	Spinach growth	70

## LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1	Moat Irrigation System	8
Figure 2.2	Chain Pump Irrigation	8
Figure 2.3	Dhekli Irrigation	9
Figure 2.4	Rahat Irrigation System	10
Figure 2.5	Basin Surface Irrigation	13
Figure 2.6	Border Surface Irrigation	13
Figure 2.7	Furrow Surface Irrigation	13
Figure 2.8	Localized Irrigation	15
Figure 2.9	Surface Drip Irrigation	17
Figure 2.10	Sub-Surface Drip Irrigation	17
Figure 2.11	Brazilian Spinach	19
Figure 2.12	Well water supply	19
Figure 2.13	Well tank supply	20
Figure 3.1	General flowchart of the project	42
Figure 3.2	Flowchart of the system	43
Figure 3.3	Illustration of irrigation system	44
Figure 3.4	Block diagram of irrigation system	45
Figure 3.5	NodeMcu ESP8266 pinout	46
Figure 3.6	NodeMcu ESP8266 and float switch connection	47
Figure 3.7	Switch cutaway	48
Figure 3.8	Connection between NodeMcu and sensor	49
Figure 3.9	Connection between NodeMcu and water pump	49

Figure 3.10	Connection between NodeMcu and LCD	50
Figure 3.11	Arduino IDE interface	51
Figure 4.1	Circuit diagram for the sensor	55
Figure 4.2	Indicate the moisture level at low level	55
Figure 4.3	Indicate the moisture level at high level	56
Figure 4.4	red LED indicates water low level	56
Figure 4.5	yellow LED indicates water mid level	57
Figure 4.6	green LED indicates water at high level	57
Figure 4.7	Full water level display	58
Figure 4.8	Mid water level display	58
Figure 4.9	Low water level display	58
Figure 4.10	Empty water level display	59
Figure 4.11	connection of controller and sensor	59
Figure 4.12	coding for reading output	60
Figure 4.13	sensor in wet condition	60
Figure 4.14	reading for wet state before calibration	61
Figure 4.15	sensor in dry state	61
Figure 4.16	reading for dry state before calibration	61
Figure 4.17	coding for calibration	62
Figure 4.18	reading for dry state after calibration	62
Figure 4.19	reading for wet state after calibration	62
Figure 4.20	top view of the prototype	63
Figure 4.21	water pump placement	63
Figure 4.22	control box	64
Figure 4.23	Blynk app interface	65
Figure 4.24	water level sensor time response	66



Figure 4.25 day 1 data	67
Figure 4.26 day 2 data	67
Figure 4.27 day 3 data	68
Figure 4.28 day 4 data	68
Figure 4.29 Water level usage	69
Figure 4.30 Spinach growth	70



## LIST OF SYMBOLS



## LIST OF ABBREVIATIONS



## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
----------	-------	------

**No table of figures entries found.**



# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Since it comes to giving water to plants, an irrigation system is a must, especially when climate change is not on our side. Irrigation systems, also known as sprinkler systems, drip irrigation systems, landscape irrigation systems, and lawn drip irrigation systems, are artificial means of providing water directly to plants or indirectly via land or soil. They come in a variety of types, including sprinkler systems, drip irrigation systems, landscape irrigation systems, and lawn drip irrigation systems, to complement various geographical surfaces or regions. In dry places and during seasons of little rainfall, it is essential for growing crops, landscape upkeep, and the vegetation of disturbed soils.

A water source, a destination, and a conveyance system are all required components of an irrigation system. A pond, reservoir, or lake is a more popular choice for water confinement since it is easier to maintain and keep the proper amount of water than the other options. Streams, in particular, can be unpredictable in terms of volume throughout the rainy season as well as during periods of drought. If an appropriate irrigation system is not in place, this climatic inconsistency will have a severe influence on agricultural produce. The rainy season may result in agricultural or plant floods, in which case too much water will do more harm than benefit. During dry spells, on the other hand, evaporation is higher, therefore water is not adequately utilised unless a good irrigation system of water running straight to

the root is in place. You end up spending more money watering the plant while potentially missing out on abundant harvests.

Agriculture was the important development of a country in this age of globalisation, providing the major source of food, money, and jobs for rural areas, but the global food system is beginning to sag as the world population is expected to reach 9.7 billion by 2050. In addition to population growth also increases the demand for food. Food demand is anticipated to rise between 59% to 98% by 2050 hence the planet's arable land is estimated to be half of what it was in the 1970s by that period. Land use change, as represented in land cover change, is the most significant component of global environmental change, influencing climate, biodiversity, and ecosystem services, as well as land use decisions.

The Internet of Things (IoT) is an emerging paradigm that is a crucial part of our lives. The terms “Internet Of Things “ was coined by Kevin Ashton in 1999 when he included it in the title of a presentation he made at Procter & Gamble . It allows sensors and electronic devices to communicate with each other through the internet to facilitate maintenance management . For example, with the implementation of smart devices, it able to automate aquaponics maintenance system. This show that IoT became essential to our life.

The two important words in IoT are “Internet” and “Things”. The internet is an electronic communications network that connected computers network and lets people share and receive information around the world. The definition of term “things” in the dictionary is an object that eminent from a living being. Simply to said, the IoT means that a system interlinks devices, mechanical and digital equipment, objects or people to transmit data across the network without the need for human- to-human transmission . Generally, IoT

began with the best tools for communication. The devices can be monitored, operated by mobile phones or computers that connect through the Internet. Cloud serves as a great IoT partner as a forum for all sensors and it can store and access data.

NodeMCU is a free and open-source LUA-based firmware for the ESP8266 wifi chip. NodeMCU firmware comes with the ESP8266 Development board/kit, i.e. NodeMCU Development board, as a result of investigating capability with the ESP8266 chip.

Smartphones have become a highly frequent source and primary means of communication for everyone in the world to communicate or update most of the farming community as development of technology. A smart agriculture system with IoT based system helps to monitor and maintain the optimal condition for aquaponics system. IoT based smart agriculture able to help users to control the pH value, water level, water temperature, light and fish feeder through the internet with improve services. Users allow to manually control it by using smartphone and it also can be automated by controlling the aquaponics system to reduces the manpower in process of care and planting of fish and vegetables respectively. This will save them a lot of time.

The rate of growing vegetables is increasing proportionally to the good maintain of optimal condition. Smartphone development encourages users to prefer using mobile app. Growth of IoT allows the communication between the networking devices based on requirements. This mobile application developed to allow users check the current situation of irrigation system whenever they want

## 1.2 Problem Statement

Agriculture is the lifeblood of all industrialised nations. It consumes 85 percent of the world's fresh water resources, and due to population expansion and growing food demand, this percentage will continue to be dominating in water use. As a result, efficient water management is a key challenge in many arid and semi-arid farming systems. To maximise water utilisation for agricultural crops, an automated irrigation system is required. The goal of an automated irrigation system is to avoid overwatering and underwatering. Over irrigation happens as a result of inefficient waste water distribution or management, resulting in water contamination. To solve these issues and save manpower, a smart watering system is needed

## 1.3 Project Objective

The objectives for this project are:

- a) To design and develop an IoT based irrigation system by using NodeMcu ESP8266.
- b) Providing good soil moisture level to plant requirement for them to grow healthily.
- c) Achieving accurate and error-free data during data collecting process and reduceman work.