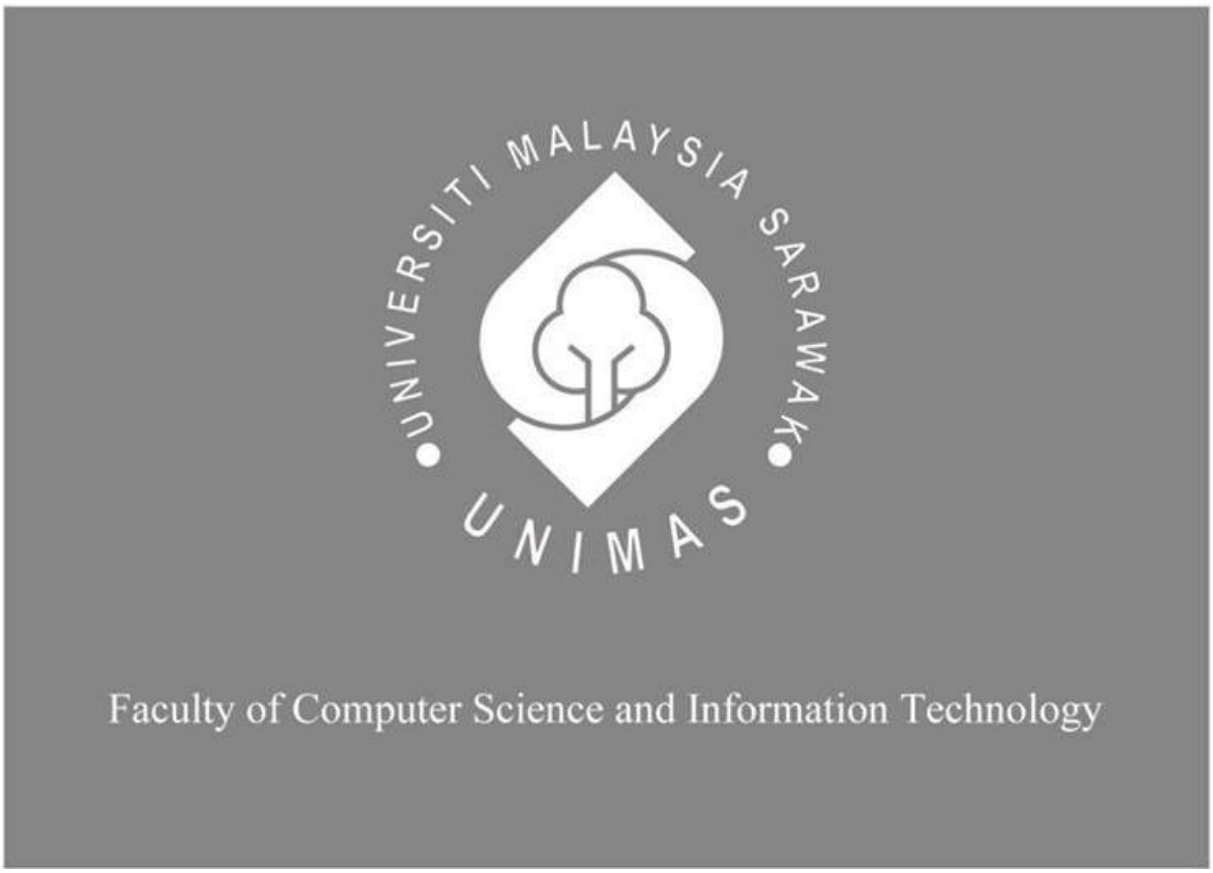

IOT BASED SMART GARDEN IRRIGATION SYSTEM FOR HOUSEHOLD

Muhammad Nuriman bin Roslan
(56840)

Bachelor of Computer Science with Honours
(Software Engineering)
2020

UNIVERSITI MALAYSIA SARAWAK

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IOT BASED SMART GARDEN IRRIGATION SYSTEM FOR HOUSEHOLD

MUHAMMAD NURIMAN BIN ROSLAN

This project is submitted in partial fulfillment of the
requirement for the degree of
Bachelor of Computer Science with Honours
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Faculty of Computer Science and Information Technology

UNIVERSITY MALAYSIA SARAWAK

2020

SISTEM PENGAIRAN TAMAN PINTAR UNTUK SEISI RUMAH BERASASKAN OBJEK RANGKAIAN INTERNET (ORI)

MUHAMMAD NURIMAN BIN ROSLAN

Projek ini merupakan salah satu keperluan untuk
Ijazah Sarjana Muda Sains Komputer dengan Kepujian
(Kejuruteraan Perisian)

Fakulti Sains Komputer dan Teknologi Maklumat

UNIVERSITI MALAYSIA SARAWAK

2020

DECLARATION

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(Muhammad Nuriman bin Roslan) August 2020

ACKNOWLEDGEMENT

Bismillahirrahmanirrahim,

First and foremost, praises and thanks to Allah S.W.T for His showers of blessings throughout my final year project work to complete the project successfully.

I would like to express my sincere gratitude to all those who contribute in this report. A special appreciation I give to my final year project supervisor, Assoc. Prof. Dr. Hj. Noor Alamshah Bin Bolhassan, for his patience, insightful comments, invaluable suggestions, practical advice and unceasing ideas in coordinating my final year project especially in writing this report. Without his guidance and helpful information, this thesis is just an imagination. My sincere thanks and grateful also goes to all lectures and staffs of Faculty Science Computer and Information Technology, UNIMAS for their kindness, hospitality and technical support.

I also wish to express my deepest thanks to my beloved parents, Mr. Roslan bin Abu Hassan and Mrs. Jamaliah binti Jamaludin and also my beloved siblings, Muhammad Irfan Hafizin bin Roslan and Arisha Raihanah binti Roslan. Their unwavering support and encouragement is my source of strength for completing this project. Last but not least, a heap of thanks for my friends and course mates who have supported and assisted me throughout the entire process. Whenever I was at the edge of giving up, they braced me up by keeping me happy and give me the strength to continue my project.

ABSTRACT

Nowadays, Internet of Things (IoT) become a phenomenon in the technology world. Its concept that allow various devices interacting with each other through internet connection make it widely implemented in various industries especially agriculture industry. The rapid growth of world population year by year is the main challenge for agriculture industry in order to maintain the food supply for people. The approach of IoT technology in the industry is expected to enhance optimum application of resource which leads to high crop yields and low operation cost. Irrigation system is one of important element that need to be monitored in agriculture. Efficient irrigation process can be achieved with IoT approach as it ensure the plant or crops get water supply as needed for well growth. So, Iot based Smart Garden Irrigation System for Household is proposed to solve problems regarding the needs of irrigating the plant as needed and monitoring the plant's environment remotely.

ABSTRAK

Pada masa kini, Objek Rangkain Internet atau “Internet of Things (IoT)” menjadi satu fenomena dalam dunia teknologi. Konsepnya yang membolehkan pelbagai peranti untuk berinteraksi antara satu sama lain melalui sambungan internet menjadikan ia semakin digunakan secara meluas dalam pelbagai industri terutamanya industri pertanian. Peningkatan populasi dunia secara mendadak saban tahun merupakan cabaran utama dalam industri pertanian untuk memastikan bekalan makanan kepada manusia mencukupi. Pendekatan teknologi IoT dalam industri dijangka dapat meningkatkan penggunaan sumber secara optimum yang membawa kepada hasil tanaman yang tinggi dengan kos operasi yang rendah. Sistem pengairan merupakan salah satu elemen penting yang perlu diberi perhatian dalam bidang pertanian. Proses pengairan yang efisien boleh dicapai dengan pendekatan IoT kerana ia memastikan tumbuhan atau tanaman mendapat jumlah air yang tepat untuk tumbuh dengan baik. Oleh itu, Sistem Pengairan Taman Pintar berasaskan Objek Rangkaian Internet dicadangkan untuk menyelesaikan masalah berkaitan perlunya mengairi tanaman ketika perlu dan memantau keadaan sekeliling tanaman dari jauh.

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CHAPTER 1 : INTRODUCTION

1.1 Introduction

Internet of Things (IoT) plays a major role in development of 21st century. IoT refers to a network of any Internet connected objects that able to collect and exchange data. It provides a platform for people to connect these device and able to control them with big data technology which can assist efficiency in performance and minimize the human involvement in many life aspects. With the advent of open source Arduino boards along with moisture sensors, it is viable to create devices that can irrigate the landscape or fields as an when needed and also can monitor the soil moisture.

Irrigation is the application of controlled amount of water based on needed intervals.There are 3 types of irrigation which are surface, overhead and drip. Surface irrigation is where water is applied over the surface of soil by gravity. Overhead irrigation basically use sprinkler to spray water to the air above and surrounding the foliage of plant and the water will disperse to the root zone while drip irrigation use dripper that drip the water slowly to the root zone, either from top of soil surface or buried below the surface. It is the most efficient irrigation system compared to others as it channel the water flow directly to the root zone which can prevent water loss due to evaporation or runoff.

The use of microcontroller on Arduino Uno platform and IoT enables the household to remotely monitor the status of dripper installed on the garden by knowing the sensor values thereby, making the household's work much easier as they can concentrate on other activities.

1.2 Problem Statement

Presently, the household are using manual irrigation methods to water the plants in their backyard which are using watering can or garden hose. This methods consume a lot of energy and more time spent. An optimum condition of soil moisture, and balanced supply of water are necessary for a healthy plant. Human factor will cause over-watering or under-watering of plant because they tend to pour the water without giving them the right amount . Thus by having a proper technique and right amount of water through remote monitoring will ensure the

growth of plants. Other than that, using manual methods they shall promote the growth of grass or other parasitic plants which will cause competing of nutrients between host plants and parasitic plants. Furthermore, the presence of household also plays an important role to taking care of the plants. If the plants are left for a long time for example if the household went for travelling or committed to outstation's duty, the plant will abandoned and stunted. Being able to have a real-time monitoring method, their plants can be taken care of from a far.

1.3 Scope

The scopes of this project are:

i. Focus on backyard gardening for household.
ii. Focus on landscaping plants that can be planted in pot such as bougainvillea,hibiscus and roses.
iii. This IoT based system is used to irrigate the plant based on soil moisture level.
iv. Blynk application is used as platform that control and monitor the system devices from smart phone.

1.4 Objectives

i. To design and develop a system with the implementation of IoT based that can be used to help household irrigating their plants.
ii. To enhance the efficiency of garden irrigation system to be more reliable and easy being monitor.
iii. To fabricate a wireless irrigation using sensors and microcontroller.
iv. To save human energy and water consumption.

1.5 Brief Methodology

This project applies Rapid Application Development (RAD) methodology. RAD is a form of Agile software development methodology.It emphasizes rapid prototyping and iterative delivery and an alternative to the waterfall model, which often focuses on sequential design practices and planning. There are four phases in RAD model which are requirement planning, user design, construction and cut over.

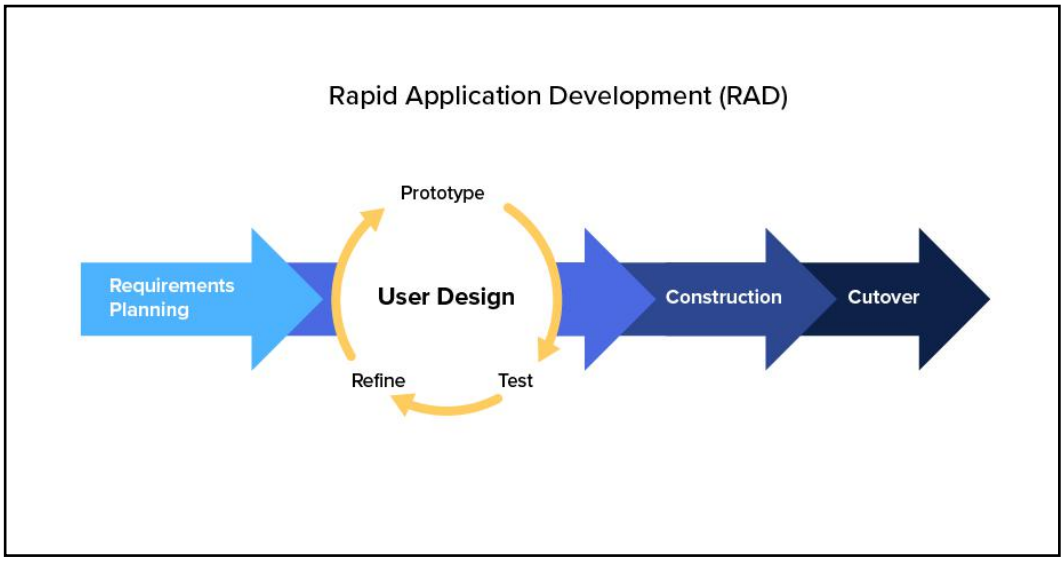


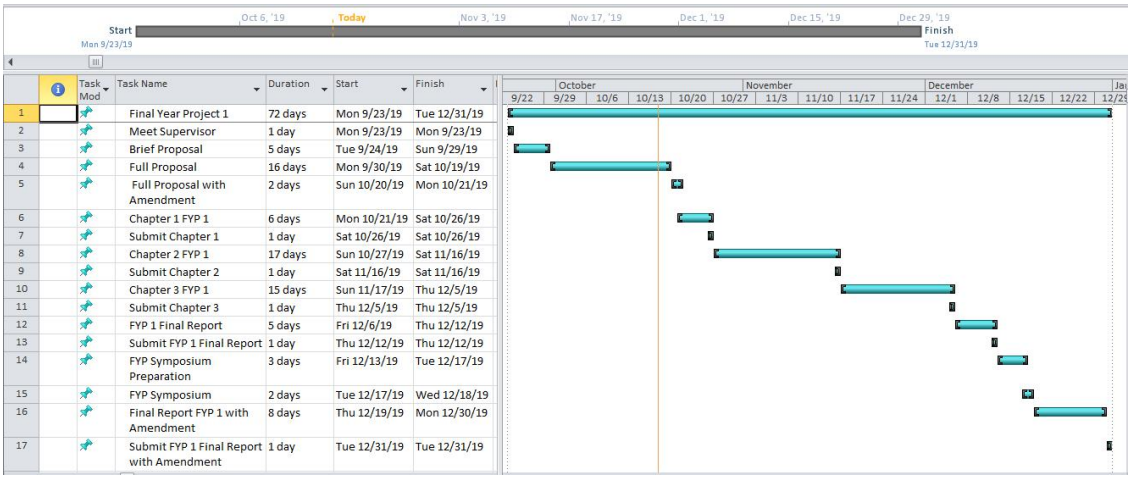
Figure 1.1 Structure of Rapid Application Development Methodology

1.6 Significance of Project

This IoT based system will help the household to save time and decrease human workload specifically for watering their plant as they do not need to water their plant manually. Besides, the inefficiency in irrigation, water evaporating and overwatering issues can be prevented as this technology control the water usage when needed.

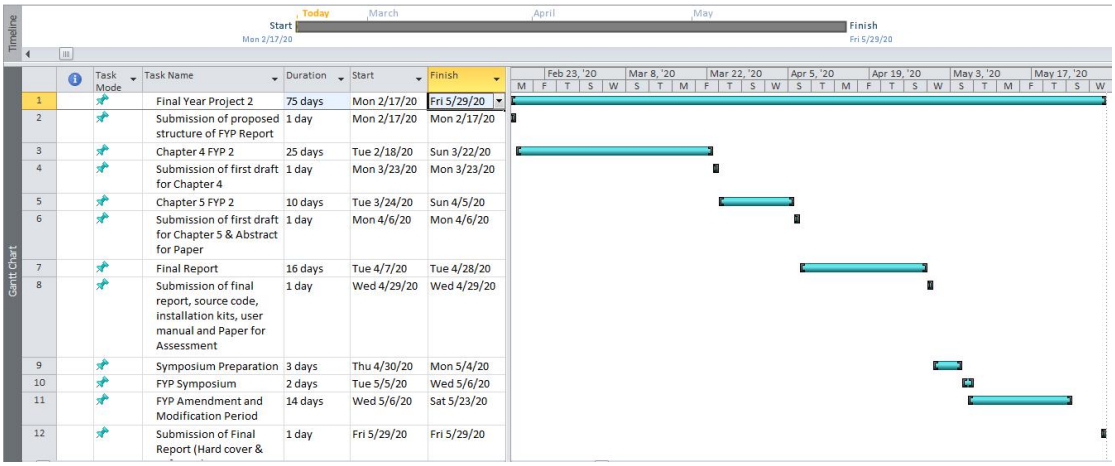
1.7 Project Schedule

Project schedule acts as a management tool for monitoring the progress of the project as well as for evaluating alternative strategies for accomplishing the project goals. It list and place the tasks into a sequence of linked events with dates for each to be started and finished. Duration to complete Final Year Project 1 is 72 days with 17 tasks that need to be completed and 75 days required to complete Final Year Project 2 with 11 tasks. Figure below is the Gantt Chart for Final Year Project 1.



	Task Mod	Task Name	Duration	Start	Finish
1		Final Year Project 1	72 days	Mon 9/23/19	Tue 12/31/19
2		Meet Supervisor	1 day	Mon 9/23/19	Mon 9/23/19
3		Brief Proposal	5 days	Tue 9/24/19	Sun 9/29/19
4		Full Proposal	16 days	Mon 9/30/19	Sat 10/19/19
5		Full Proposal with Amendment	2 days	Sun 10/20/19	Mon 10/21/19
6		Chapter 1 FYP 1	6 days	Mon 10/21/19	Sat 10/26/19
7		Submit Chapter 1	1 day	Sat 10/26/19	Sat 10/26/19
8		Chapter 2 FYP 1	17 days	Sun 10/27/19	Sat 11/16/19
9		Submit Chapter 2	1 day	Sat 11/16/19	Sat 11/16/19
10		Chapter 3 FYP 1	15 days	Sun 11/17/19	Thu 12/5/19
11		Submit Chapter 3	1 day	Thu 12/5/19	Thu 12/5/19
12		FYP 1 Final Report	5 days	Fri 12/6/19	Thu 12/12/19
13		Submit FYP 1 Final Report	1 day	Thu 12/12/19	Thu 12/12/19
14		FYP Symposium Preparation	3 days	Fri 12/13/19	Tue 12/17/19
15		FYP Symposium	2 days	Tue 12/17/19	Wed 12/18/19
16		Final Report FYP 1 with Amendment	8 days	Thu 12/19/19	Mon 12/30/19
17		Submit FYP 1 Final Report with Amendment	1 day	Tue 12/31/19	Tue 12/31/19

Figure 1.2 Gantt Chart Final Year Project 1



	Task Mode	Task Name	Duration	Start	Finish
1		Final Year Project 2	75 days	Mon 2/17/20	Fri 5/29/20
2		Submission of proposed structure of FYP Report	1 day	Mon 2/17/20	Mon 2/17/20
3		Chapter 4 FYP 2	25 days	Tue 2/18/20	Sun 3/22/20
4		Submission of first draft for Chapter 4	1 day	Mon 3/23/20	Mon 3/23/20
5		Chapter 5 FYP 2	10 days	Tue 3/24/20	Sun 4/5/20
6		Submission of first draft for Chapter 5 & Abstract for Paper	1 day	Mon 4/6/20	Mon 4/6/20
7		Final Report	16 days	Tue 4/7/20	Tue 4/28/20
8		Submission of final report, source code, installation kits, user manual and Paper for Assessment	1 day	Wed 4/29/20	Wed 4/29/20
9		Symposium Preparation	3 days	Thu 4/30/20	Mon 5/4/20
10		FYP Symposium	2 days	Tue 5/5/20	Wed 5/6/20
11		FYP Amendment and Modification Period	14 days	Wed 5/6/20	Sat 5/23/20
12		Submission of Final Report (Hard cover &	1 day	Fri 5/29/20	Fri 5/29/20

Figure 1.3 Gantt Chart Final Year Project 2

1.8 Expected Outcome

i. IoT based Smart Garden Irrigation System for Household include a set of system hardware has been developed.

ii. Blynk-based mobile application to control and monitor the proposed system.

iii. Final year project 1 and final year project 2 report.

1.9 Project Report Outline

i. Chapter 1: Introduction

Chapter 1 is focus on the introduction and description of the project that provide the readers with a detailed overview about the proposed system. Chapter 1 consist of the introduction, problem statement,

objective, methodology used, significance of project, project schedule, expected outcome and summary. The problem statement describes the difficulty and obstacles that faced by specific group of people while the objective focus on the goals of the proposed project to solve those problems stated in problem statement section. Besides, type of methodology used for the project is highlighted in this chapter. For project schedule section, all the tasks and activities is listed to ensure that the project can be accomplished in time period. The expected outcome section describes the expected result and output of the proposed system.

ii. Chapter 2: Literature Review

Chapter 2 is concerned about the reviews based on the existing system which can be found in the commercialized market. The restrictions of the existing system will be identified and analyzed in order for the current system enhance the drawbacks. Furthermore, this chapter also includes the technology tools required, techniques and skills used to develop the proposed project. The overall background study is accomplished from published materials such as articles, journals, web sites and conference paper.

iii. Chapter 3: Requirement Analysis and Design

Chapter 3 is concerned about the methodology used in the development of the proposed system. Furthermore, it also discusses about the method used for gathering the requirements from the stakeholders of the proposed system. This chapter also portrays about the design of the proposed system and justifying how it can fulfill the stakeholder's needs. Therefore, this chapter will include flow chart, sequence diagram, use case diagram and the layout design of the proposed system.

iv. Chapter 4: Implementation and Testing

Chapter 4 will focus on the detailed description and justification of the proposed system's implementation. A walk-through of the proposed system will be carried out to explain its behaviour and relate it to the design. Besides, the prototype of the proposed system will be tested in this chapter where the environment of all tests should be fully specified. Moreover, the features and

functionalities of the proposed system will also be evaluated.

v. Chapter 5: Conclusion and Future Work

Chapter 5 will conclude the entire project and outlines further work. All the improvement matter required that obtain throughout the project will be presented with appropriate examples. This chapter will also includes new ideas that can enhance the project in future.

CHAPTER 2 : BACKGROUND STUDY

2.1 Introduction

Chapter 2 is focusing on the literature review and the background study of the project. Literature review plays a vital role in a project as research is done based on the selected area of study and it also important to develop a successful project. This chapter includes review of existing system, comparison between existing system and proposed system, details of proposed system and technology and tools used in the development of proposed system.

2.2 Background Study

Nowadays,The Internet of Things (IoT) plays a vital role in our daily life. Rajkumar, Abinaya and Kumar (2017) also indicates IoT as a new wave of information and communication technology (ICT) advancements. Basically, it is a concept of connecting one device with another devices through Internet connection. There are a lot of invention from various industries such as agriculture industry that implement IoT in their system. Irrigation management is one of important factor in agriculture especially for the farmers to increase the cultivation in a way the plants need. By implementing IoT technology, the crops or plants can be monitored and managed simultaneously and all the data will be trasmitted to farmers which have precise controlling decision for their crops.

2.3 Review Existing System

In this section, three existing systems will be reviewed which are Arduino based Automatic Plant Irrigation System with Message Alert, Arduino Based Smart Irrigation System using IoT and Smart sensor for automatic drip irrigation system for paddy cultivation system. All the existing systems have their own characteristics, advantages and disadvantages.

2.3.1 Arduino based Automatic Plant Irrigation System

Arduino based Automatic Plant Irrigation System will automatically provide sufficient water to the plant and update every process to the user by sending message to their cell phone. This irrigation system use soil moisture sensor to

sense the soil moisture level. If the moisture level is low then the water pump will be turned on to provide water to the plant. Once the moisture level of the soil reach optimum level then the water pump will be switched off. Whenever the system switched on or off the water pump, a message will be sent to the user via GSM module, updating the status of water pump and soil moisture. This irrigation system is very useful in farms, garden or home. The system is completely automated and no need for any human intervention (Saddam, 2016).

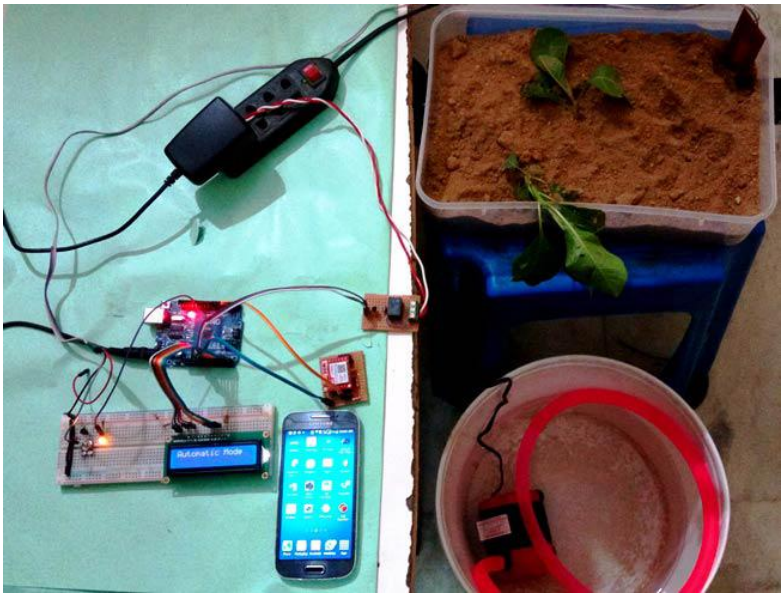


Figure 2.1 Arduino based Smart Plant Irrigation System

Arduino is used for controlling the whole process of this irrigation system. The output of the soil moisture sensor will be connected to digital D7 of Arduino. A LED is used at the sensor circuit to indicate the status of soil moisture. This LED's ON state indicates the presence of moisture in soil while OFF state indicates the absence of moisture in soil. TTL SIM800 GSM Module is used for sending SMS to the user. LM317 Voltage Regulator is used to power the GSM Module. The operating voltage rating is 3.8v to 4.2 v and 3.8v is recommended for operation.A 12V Relay is used for controlling the 220VAC small water pump. BC547 Transistor is used to drive the relay which is further connected to digital pin 11 of Arduino. An optional LCD is also used for displaying status and messages. Control pins of LCD, RS and EN are connected to pin 14 and 15 of Arduino and data pins of LCD D4-D7 are directly connected at pin 16, 17, 18 and

19 of Arduino. LCD is used in 4-bit mode and driven by Arduino's inbuilt LCD library.

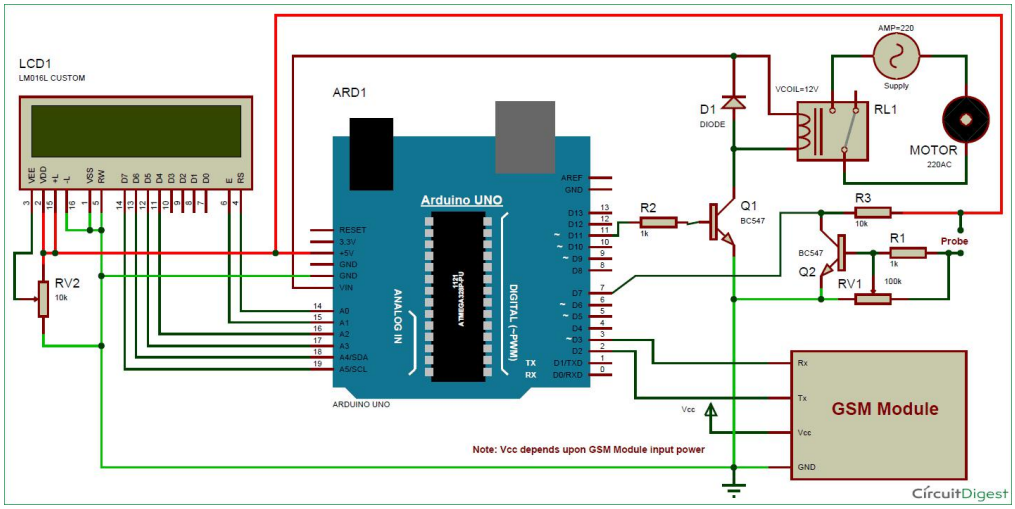


Figure 2.2 Circuit diagram of Arduino based Smart Plant Irrigation System

2.3.2 Smart sensor for automatic drip irrigation system for paddy cultivation

Barkunan, Bhanumathi and Sethuram (2018) propose an automatic drip irrigation system that apply smart sensor. The irrigation system comprises ARM microcontroller, smart phone, GSM Module, sensor unit and motor control unit. The sensor unit is consist of temperature sensor, humidity sensor, light sensor and rain sensor which are used to monitor the environment conditions by collecting the physical parameters such as temperature, humidity, light intensity and rainfall of the agricultural field. Advanced RISC Machine (ARM) micro controller is used to manage the irrigation process by controlling the motor unit and updates the information to the user periodically. The Global System for Mobile Communication (GSM) module acts as platform for sending and receiving message between micro controller and smart phone. Smart phone is used for capturing the soil image and it also used by the user for receiving the information from micro controller. This irrigation system also need a mobile application that has been installed in the smart phone. The application is used to capture the wetness of soil. The application is developed in Eclipse SDK 3.6.2 compiler using Java and converted into Android software package as a .apk file. Figure below is block diagram for the Smart Sensor based Automatic Drip Irrigation System.

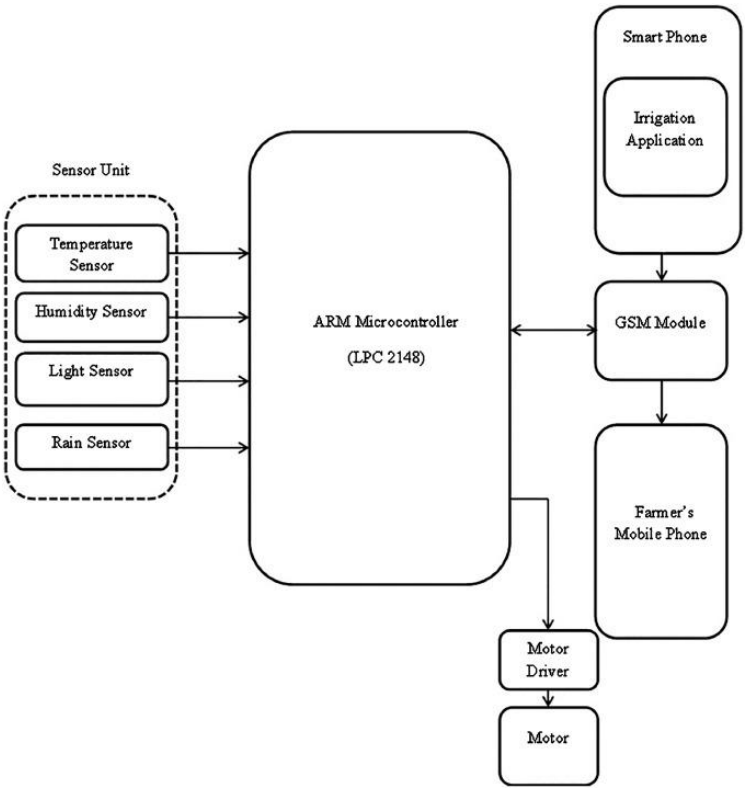


Figure 2.3 Block Diagram of Smart Sensor for Automatic Drip Irrigation System

The work flow of the irrigation system starts with capturing the soil image by the mobile application which is installed in the smart phone placed within the closed chamber. Then, the application will convert the captured color images into gray scale images which produce histogram values. The histogram values will determine the condition of the soil,either wet or dry. If the total numbers of pixels present in the gray scale image exceed 5000 at pixel intensity around 200, the soil is considered wet and need irrigation. Otherwise, the soil is dry and need irrigation. Based on the wetness of soil and rain sensor input, the ARM micro controller will operate the motor through motor unit sensor. There are three categories that working in this irrigation system.The categories are as follow:

1. Soil is in wet condition and motor needs in OFF state.
2. Soil is in dry condition and there is possibility of rainfall, then motor needs in ON state.
3. Soil is in dry condition and there is no possibility of rainfall, the motor needs in ON state.