UNIVERSITY OF DAR ES SALAAM

COLLEGE OF INFORMATION AND COMMUNICATION TECHNOLOGY (CoICT)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CS 498 PROJECT REPORT

PROJECT TITLE: SMART IRRIGATION SYSTEM

A Project Report in Partial Fulfillment for the Award of Bachelor of Science in Computer Engineering and IT

Name of Candidate: MTURI, GABRIEL B.

Registration Number: 2018-04-01677

Name of Supervisor: Dr. Wilfred Senyoni

Submission Date: Friday 04 – 02 – 2022

ABSTRACT

The smart farm system is the system developed to optimize water use for agricultural crops, to improve the health of the soil together with the plant health by the use of multiple sensors. The system has a distributed wireless network of soil moisture and PH sensors placed into root zone of the plant. This smart systems are very productive especially in developed counties and most system uses big networks such as Internet.

In Developing countries case, this system couldn't be adopted effectively as in most of the developing countries including Tanzania there is no reliable internet access especially in rural areas where most of farms reside.

This project is to develop a Smart irrigation System that will be controlled using a simple text messages. Simple text message is the most used way of communication which is also the most reliable and cheap. This project will be accomplished by the use of GSM technology which is the heart of all cellular networks used by mobile devices.

The user will be able to communicate with the farm from anywhere with only simple messages. The GSM is integrated to the microcontroller to pass simple messages that are defined by the programmed instructions in the microcontroller. This module will be used for control and notification part of the system.

ACKNOWLEDGEMENT

I would like to thank Almighty God for giving me good health especially from when I started this final year project. Also, I would like to appreciate all those who provide their support from starting up and continue to provide their support up to completion of this project. The special gratitude I give to Dr. Wilfred Senyoni who is my Supervisor for his contributions in advising and encouraging me by drawing some suggestion on performing day to day activities on performing project.

Furthermore, I would also like to acknowledge with much appreciation the crucial role of my team mate, Ms. Dorcas Leskanga to whom I spent most of time with to conduct this project. Her advice is much appreciated on performing this project. Also many thanks goes to Final Year Project Co-ordination Team for the work it has done from analysis of students' Titles, and solving problems facing challenges with FYP portal and other challenges related to Final Year Project.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

Irrigation has been a way-out when there is a delay on rain season, it has been very helpful into helping people to maintain the food circle in societies and to maintain plant's life in general.

Irrigation is the artificial application of water to the soil through various systems of tubes, pumps, sprays and more. Irrigation is usually used in areas where rainfall is irregular or dry times or drought is expected. There are many types of irrigation systems, in which water is supplied to the entire field uniformly.

The earliest form of irrigation involved people carrying buckets of water from wells or rivers to pour on their crops. As better techniques developed, societies-built irrigation canals, dams, dikes, and water storage facilities, canals or pipelines carry the water from reservoirs to fields.

1.2 STATEMENT OF THE PROBLEM

There has been a rapid growth of technology and smart systems all over the world, one of the developed smart systems is the smart irrigation system where by people can control their system automatically with a use of internet. There is unavailability of reliable internet services in developing countries such as Tanzania especially in rural area where the most agricultural activities take place. This makes it impossible to access the smart systems for those who lives in these areas. The rural area people cannot benefit from these smart systems due to this problem.

1.3 OBJECTIVES

1.3.1 MAIN OBJECTIVE

The main objective of this project is to use the normal text messages to control the smart irrigation system. Normal text messages are the most accessible and reliable way of communication used in developing countries especially in rural areas. With the help of Global System for Message communication (GSM) anyone with any type of a phone will be able to control the smart farm system.

1.3.2 SPECIFIC OBJECTIVES

- To build a centralized microcontroller which is programed to receive input signals of multiple sensors of the field and generate an output that drives the relays of the circuitries.
- To integrate a soil moisture and PH sensors that will be able to sense the moisture and PH of the soil respectively then sends notifications to the microcontroller.
- To integrate the Global System for Message communication (GSM) in order to manage the normal text messages.
- To create a web based application that will store the records about the farm progress.
- To make a system that is understandable and easy to be used by farmers.

1.4 PROJECT SIGNIFICANCE

"Smart" technology is taking over everything in our nowadays life, we are surrounded with smart devices and different kinds of smart systems. Smart farm systems offer a variety of advantage over traditional irrigation systems. Smart irrigation systems can optimize water levels based on things such as soil moisture and PH of the soil. This is done by the communication between sensors and smart farm controllers. The smart system will help one to have better control of landscape and irrigation needs as well as peace of mind that the smart system can make decisions independently in case of one's absence.

It helps to save a significant amount of money on water bills because through intelligent control and automation, the smart irrigation system will optimize resources so that everything gets what it needs without needless waste.

Additionally, we all have enough knowledge to understand how our water resources are precious. With smart irrigation systems we can be better stewards of our resources which is better for environment. Also with automated system one can save a tremendously amount of time.

1.5 SCOPE AND LIMITATION

Currently, the aim on this project is to use a simple message with the help of GSM technology which will integrate a notifications chip with the controller for message management to control the smart irrigation system. Although in the future there are other scope that can be used with this work to improve the efficiency and effectiveness of the system. The idea of using IOT for irrigation can be implemented with this system. Other activities in farming such as cattle management, fire detection and climate control can be introduced with this system. This system can be improvised

by adding a Webs caper which can predict the weather and water the plants/crops accordingly. If rain is forecasted, less water is let out for the plants.

Some limitation includes:

- System cannot be used in places where there is low network signal which will result in delaying of notifications to the user and the system.
- The system should be used in areas experiencing low amount of rainfall.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 AUTOMATED IRRIGATION SYSTEM USING SOLAR POWER IN BANGLADESH

The gadget specializes in rice fields in nations depending on agriculture within the economy, such as Bangladesh. The primary concept in this gadget is to cognizance on the level of water in agricultural fields because those fields lose lots of their merchandise due to floods. The sensor sends a message from the field to the person approximately the extent of water within the area if it will increase or decreases then the operator controls the pump to regulate or flip off the telephone. The blessings of this machine are that it depends on the sun energy to get hold of electricity. The dangers of this system are that it centered on one sort of sensor, the water stage sensor, no matter whether the plant desires water or not. There may be no opportunity source of energy in case there is no solar electricity to run the device.

2.2 DESIGN AND IMPLEMENTATION OF AN AUTOMATIC IRRIGATION SYSTEM IN NIGERIA

In this machine the basic idea is to rely on the type of soil and the amount of water needed by each type of soil. This process is done by measuring the level of moisture in each type and using the pump to supply water. The result indicates that sandy soil requires less water than clay soils. The blessings of this device are to focus on soil moisture and water conservation. But making the machine much less powerful is to measure the moisture of soil from one location in the agricultural land. It's far viable that the vegetation at the other end of the rural land does no longer need watering. Also, the water source isn't constant.

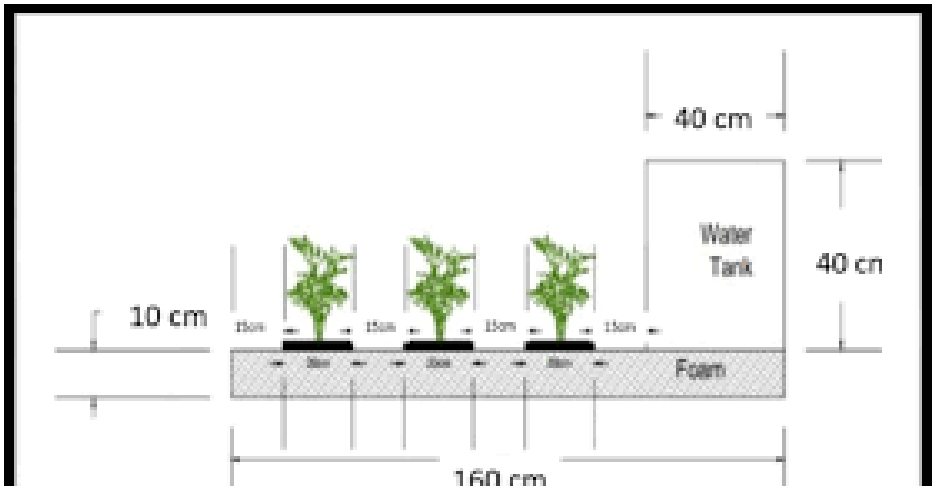

Figure 1: Automatic Irrigation System in Nigeria

2.3 SENSOR-BASED AUTOMATIC IRRIGATION SYSTEM

This system also depends on the measurement of soil humidity and temperature. The system works by sending a signal from farm controller to user phone and it phone must be in automatic reply in case that soil needs water. a signal from phone send to farm controller again to switch on or off the system.

Step 1: Start the process.

Step 2: Initialize power is supplied to GSM.

Step 3: Check the moisture level (less than or more than).

Step 4: If the level will be more than fixed criteria, no Need for irrigation.

Step 5: If the Moisture level is less than fixed criteria, start irrigation.

Step 6: Initialization of pump and rain gun.

Step 7: After the process completed, it moves to the original state.

Step 8: Stop the process

The only disadvantage of this study is that it works with Wi-Fi. Often agricultural land is far from the city so the network is not good in these areas. Also, this system needs to enter the farmer via his phone.

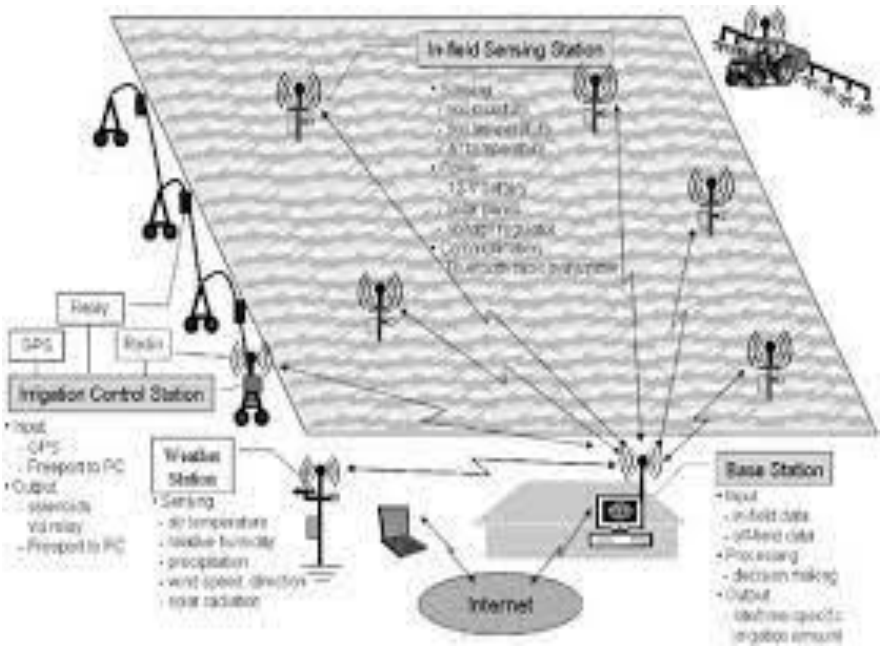

Figure 2: Sensor-Based Automatic Irrigation System

2.4 SENSOR-BASED AUTOMATIC IRRIGATION MANAGEMENT SYSTEM

The aim of this study is to build a system that helps the process of regulating water by measuring the humidity ratio. The grounded sensors all around the land area will give notice about the need for water and likewise, it will be provided. At the same time arranged a mechanized approach for the water tanker to be filled when it is empty.

2.5 SMART AGRICULTURE TO MEASURE HUMIDITY, TEMPERATURE, MOISTURE, PH AND NUTRIENTS VALUES OF SOIL USING IoT

This system helps farmers to get required information and relative data to monitor the plant's growth by use of INTERNET OF THINGS (IoT) which connects different sensors, actuators and other embedded devices to provide quality crops based on soil nutrients level and its moisture content along with Ph. factor, also been maintained. Hence in this system all these parameters are detected and controlled by with help of micro controller. Humidity sensor used to detect the moisture content where color sensor is used to determine the percentage of soil nutrients (N_2, P4 and K). It will analyses soil nutrients content present on soil at real time and Ph. sensor is used to

determine the Ph. value of the soil. Monitoring of this to provide proper fertility to the soil depending upon the soil nutrients. GSM is used to display the information to the farmers. Thus, it reduces the growing of husk in terms of wastage and there by getting good quality and health crops.

2.6 PLANT MOISTURE AND Ph. SENSING ALARM USING 8051

This system is done by using 8051 microcontroller-based systems that makes use of soil moisture sensor along with ph. value sensor to constantly check for these values. Plants need water as well as good soil (ph. rich) to ensure proper plant growth. It becomes difficult to monitor these things manually each time to ensure proper growth and any ignorance may lead to bad plant health or plant decay/death. The system microcontroller ensures the plant gets proper moisture and ph. by continuously monitoring for it. It also displays this on a display screen for user to monitor. Also, the system is equipped with an alarm which sounds a buzz in case the values fall below a certain limit which may be bad for plant health. Thus, the system ensures proper plant health using soil moisture and ph. sensing.

2.7 SOIL MOISTURE MONITORING SYSTEM USING WIRELESS SENSOR NETWORK

The response monitoring system measure the moisture of the soil, compare it with the desired values given by the user and generate alert if soil moisture goes below desired value. It helps in problems related to growing of crops in which irrigation is required at irregular interval. It is also helpful in monitoring of soil moisture in golf fields for fields. Irrigation water management practices could greatly benefit by the knowledge of moisture in the soil. To determine the soil moisture, we have designed and developed a nickel probes-based soil moisture sensor and a response monitoring system. By knowing the moisture value, we can estimate when to water and how much to water the fields so that there is no over-watering or wilting of crops. These practices will increase crop yield, improve quality of crops, conserve water resources, save energy, and decrease fertilizer supplies.

2.8 AUTOMATIC PLANT WATERING SYSTEM

This system considered to sense dryness of the soil and in the end switch on the electric pump to begin the supply of water and switch off the pump on every occasion enough water is provided. The Materials used are: Transistor 548, Resistor 1k, Variable resistor 47kΩ, Diode 1N4007, Relay

5v, LED, DC converter, Circuit board, Probes, AC water pump, Water reservoir. In this study, there is no real implementation it is only on circuit and information about how the system should work.

CHAPTER THREE

3.0 METHODOLOGY

This system is developed using a waterfall model where by one step will be accomplished after another. This model is direct to use through its steps. The following are the procedures that will be used into developing this project.

i. Requirements gathering and analysis:

- All possible requirements needed for developing Smart Irrigation System will be captured and documented in requirement specification document, method used to obtain requirement on this system are Questionnaires and Interview.

ii. Design and simulation:

- After obtaining requirements from first phase system design is prepared, system design will involve specification of hardware and system requirements that helps in defining the overall system architecture of the System.

iii. Circuit implementation and testing:

- From the overall architecture of the system, system is then developed on small unit so as to allow unit testing to take place ie. sensors will developed separately before linking them to other devices.

iv. Integration and testing:

- After unit testing has been done on all single units (devices), those unit are combined to form full Smart Irrigation System then integration testing is performed so as to test for any fault on the whole system.

v. Operational/deployment:

- Involves deploying the system to the farmer, in this step the system is completed to be used by customers if it has any fault customer should give feedback so as to be maintained on next step.

vi. Maintenance

- It is done once farmer encounters any fault on using the system.

Advantage of this methodology

- Simple and easy to understand and use
- Easy to arrange tasks

- Clearly defined stages
- Phases are proceeded and completed one at a time
- Works well on projects where requirements are well understood

Disadvantage of this methodology

- No working software will be produced until later stages.
- Not good for complex projects
- Cannot accommodate changing requirements.

3.1 BLOCK DIAGRAM OF THE SYSTEM

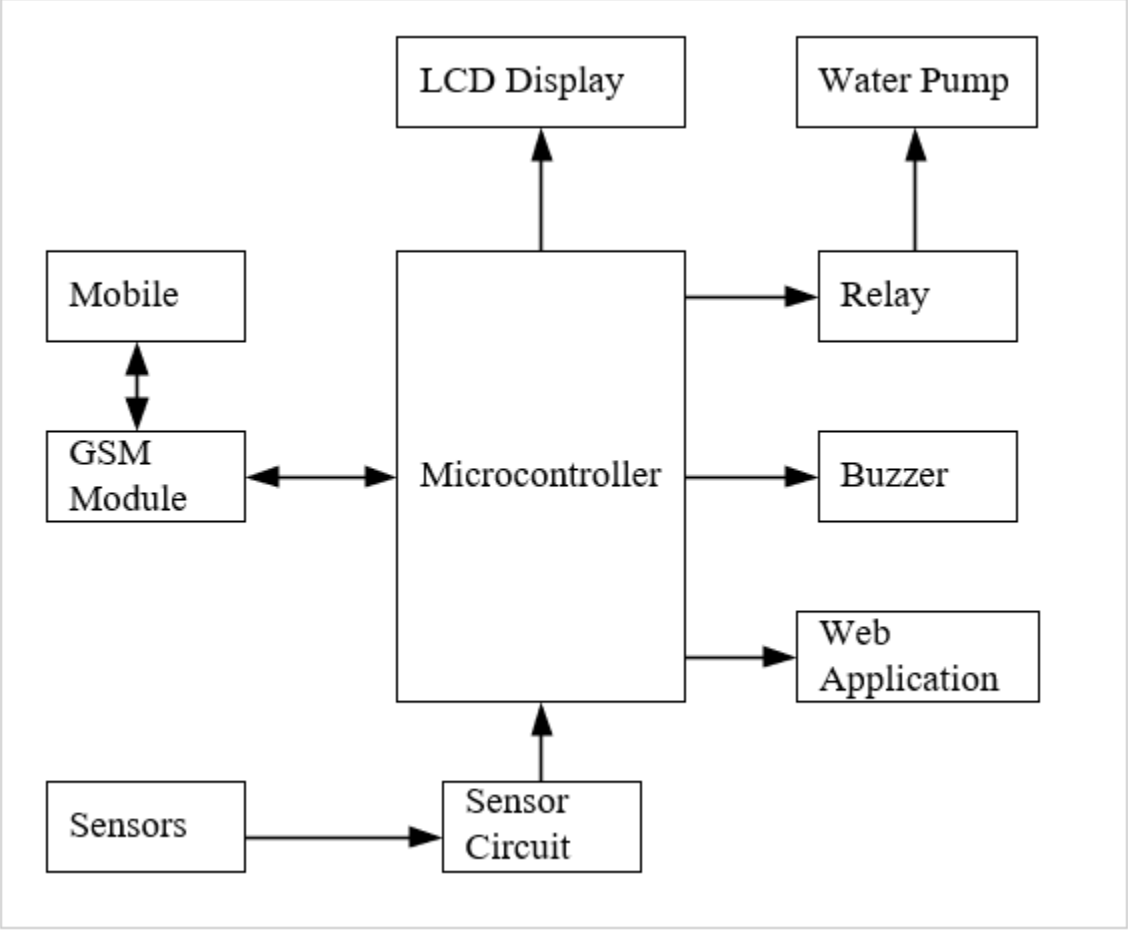

Figure 3: Block Diagram for the System

This system is categorized into three parts which are monitoring part, notifying part and control part which are integrated with software and hardware to form the complete system. Monitoring parts involves all sensors equipped on collecting data and sending them to microcontroller, such components include sensors, sensor circuit, GSM module and mobile phone. Notification unit involves all components used for sending signals from microcontroller to external components like Buzzer, Mobile phone and Web App. Monitoring unit including Water pump and water source to control status of the farm and Microcontroller which acts as the medium of connection which connecting all components.

CHAPTER FOUR

4.0 ANALYSIS AND DESIGN

In this phase requirements are analysed and used in designing the system, as far as Smart Irrigation System is concerned requirements involved all components used in designing micro-controller based system such components divided into three category.

4.0.1 MONITORING UNIT

The monitoring unit involves sensors necessary for collecting data from farm and sending them to microcontroller. In this project there are two sensors that sends notification signals from the sensor circuit to the microcontroller. These are PH sensor and Moisture sensor that sends PH values and the moisture of the soil respectfully.

PH Sensor sense the Ph level on soil and sends data to microcontroller and Moisture sensor capture value of moisture in the soil and send to microcontroller.

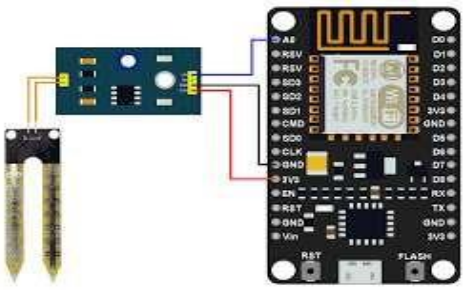

Figure 5: Moisture Sensor

Figure 4: PH Sensor

4.0.2 CONTROL UNIT

In this project the control part includes several hardware devices which are Microcontroller, GSM module and a Mobile phone.

Arduino (Microcontroller)

After receiving the notification signals from the monitoring part, the microcontroller defines the signals according to the instructions programmed in it and sends the appropriate instructions to the specified devices for control mechanisms. Microcontroller controls the devices integrated with it such as buzzer and relay.

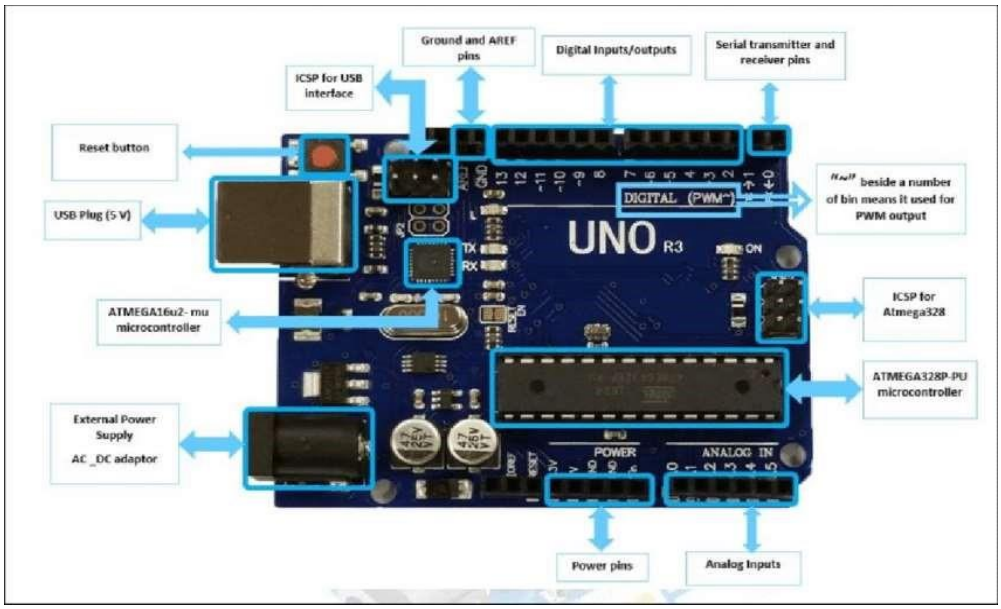

Figure 6: Microcontroller

GSM module

"GSM", the Global System for Mobile communication is the technology that defines the entire cellular system for mobile communications. In this project the GSM is integrated to the microcontroller to insert the chip that will be used to pass control information from the user's mobile phone to the microcontroller. This control information are sent as a normal text messages whereby they will be

Figure 7: GSM Module

defined by the programs in the microcontroller and perform the intended control work.

Mobile phone

A mobile phone will be used to send normal text which are defined as control instructions from the user to the chip inserted in the GSM module. The phone to be used in here can be a normal phone without the need of internet connection.

Figure 8: Mobile Phone

Relay

A relay is an electrically operated switch. Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Here relay will be used to control the water pump after receiving signals from the Microcontroller, it will either allow or deny the flow of water from the water pump.

Figure 9: Relay

4.0.3 NOTIFICATION UNIT

The microcontroller sends notification signals to notify on the certain conditions in the system, notification signals are sent to the following hardware devices:

Buzzer

This device is used for notifications to the users close to where the buzzer is installed, whereby on the receiving of the notification from the microcontroller the buzzer make some notification sound to attentively notify a user on a farm needy state.

Figure 10:Buzzer

GSM Module

The GSM is also used for notification purpose, the chip inserted into the GSM device receives the message from the microcontroller and sends it to the user's phone to notify the user about the current

Figure 11:GSM Module (Notification)

situation of the farm.

Web Application

The microcontroller also sends notifications to the Web app for displaying status of the farm. These notifications sent to the Web app will be another way to notify the user on a farm state that will help the user to know the progress on the farm activities.

Figure 12:Web Application

4.1 SYSTEM DESIGN

System design involves the overall system layout that described as block diagram, flowchart and circuit diagram.

4.1.1 BLOCK DIAGRAM

The following is a block diagram indicates how the system components are interconnected with each other, and how communication is directed from one component to another. Components are grouped according to their categories that is those for monitoring unit, notification unit and controlling unit.

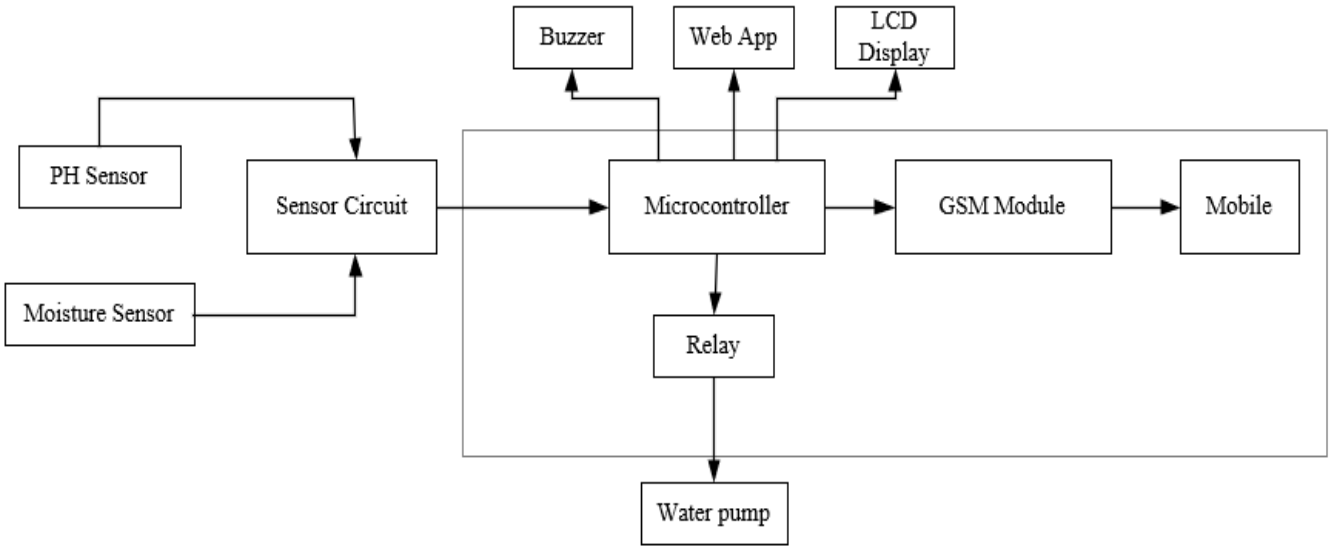

Figure 13: Block diagram (System layout)

4.1.2 FLOWCHART

Flowchart involves all the processes involved from when devices are initialized, collection of data from sensors, sending them to microcontroller, displaying and sending them to various unit and applying necessary decisions according to the command set on microcontroller. As shown on diagram below.

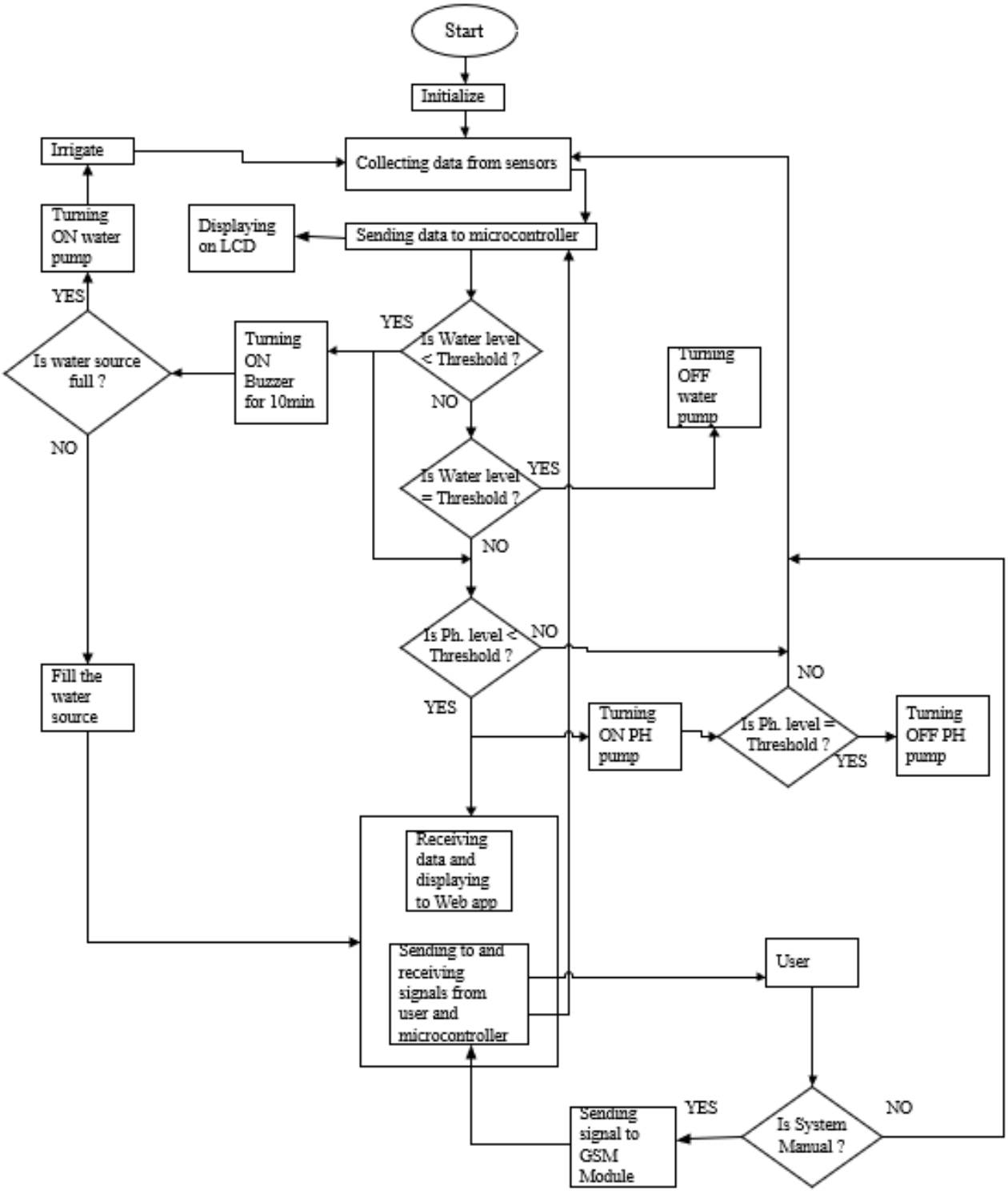

Figure 14: Flowchart of System

4.1.3 CIRCUIT DIAGRAM

This involves the physical connection of devices to microcontroller as shown in diagram below.

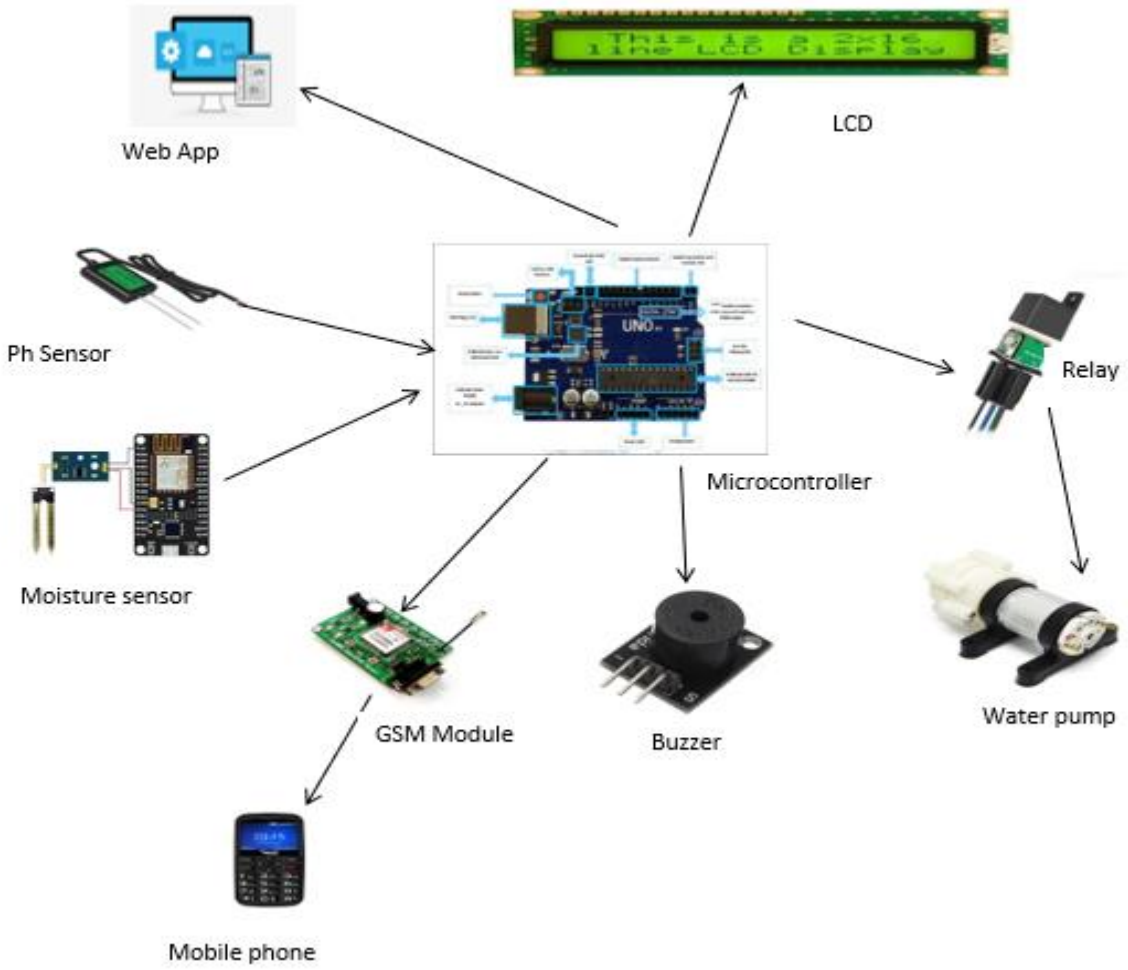

Figure 15: Circuit Diagram

CHAPTER SIX

6.0 DISCUSSION AND RECOMMENDATION

From data obtained from customers through questionnaires and interview reveals that the system will be more advantageous for the local farmer who uses feature phone most of the time. But it can also be used for the advanced farmers to view status of farm on web app. It can also be extended to be applied on livestock keeping to automatic turn ON lights at night.

Responses shows that Ph level of the soil can not be controlled automatic, so it can be controlled manual with help of alarm and notification sent to the farmer so as to control it manually. Multifunctional operation of GSM module to be used to notify and control provide essential and most crucial part of the system as long as network signal in such place is stable.

REFERENCES

Arduino Microcontroller Processing for Everyone, Third Edition, Steven F. Barret

International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958 (Online), Volume-9 Issue-5, June 2020

https://create.arduino.cc/

https://www.autobatteries.com/

www.alamy.com

APPENDIX A : PROJECT SCHEDULE

S/N	ACTIVITIES	WEEKS														
	First Semester	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Project Research															
2	Literature Review															
3	Submission of mid-semester progressive report															
4	Mid-semester presentation															
5	Reconstruction of the project per comments															
6	Gathering informatioon required for the system															
7	Study the components required for the system															
8	Design the block diagram of the system															
9	Design the flow chart for the system															
10	Design the circuit diagram of the system															
11	First-semester presentation															

Figure 16: Project Schedule

APPENDIX B : PROJECT BUDGET

Table 1: Project Budget

ITEM	**COST**
Microcontroller (Arduino)	35,000/=
Ph. Sensor	150,000/=
Moisture Sensor	6500/=
Relay	15000/=
Buzzer	600/=
GSM	120,000/=
Water Pump	10,000/=
LCD Display	15,000/=
Voucher	30,000/=
Transportation	25,000/=

TOTAL	**407,100/=**

APPENDIX C : QUESTIONNAIRE USED

Questionnaire used is obtained from the link below and is shown as seen in pictures below

https://docs.google.com/forms/d/e/1FAIpQLSfriq5NbTk0_EsU9YPYgZxgFPDbNXVCq1ZkwCZMTov7Phj0hQ/viewform?usp=sf_link

SMART IRRIGATION SYSTEM

Hellow there, Here is Gabriel Mturi and Dorcas Leskanga both pursuing BSc. in Computer Engineering and Information Technology, 4th year at University of Dar es salaam. We are conducting research to gather some information concerning to our final year project titled "SMART IRRIGATION SYSTEM", System itself aims to monitor status of the farm, notifying user on any variation of status of the farm and monitor the variation occured on the farm. Responses provided will be used for studying purpose

As a student, do you think is it necessary to monitor status of the farm once the farmer lives far away from the farm ? *

- ○ Yes
- ○ No

If answer is yes what parameters do you think should be monitored in the farm ?

Short-answer text

Which of the following ways will be better for notifying status of the farm if the farmer is far away from the farm ? *

- ○ Normal SMS
- ○ Reminder on Android/IOS devices
- ○ Using Web App
- ○ Using Alarm
- ○ Other_

Which of the following ways will be better for notifying status of the farm if the farmer is not far away from the farm ? *

- ○ Normal SMS
- ○ Web App
- ○ Android/IOS App
- ○ Alarm
- ○ Annoying sound

Do you think existance of past monitoring records on status of the farm are useful to the farmer/ anyone using the system ? *

- Yes
- No

If answer is Yes, explain why!

Long-answer text

Does it make sense developing the system on areas which receives rainfall frequently ? *

- Yes
- No

Do you know any automatic way of controlling soil PH. ? *

- Yes
- No

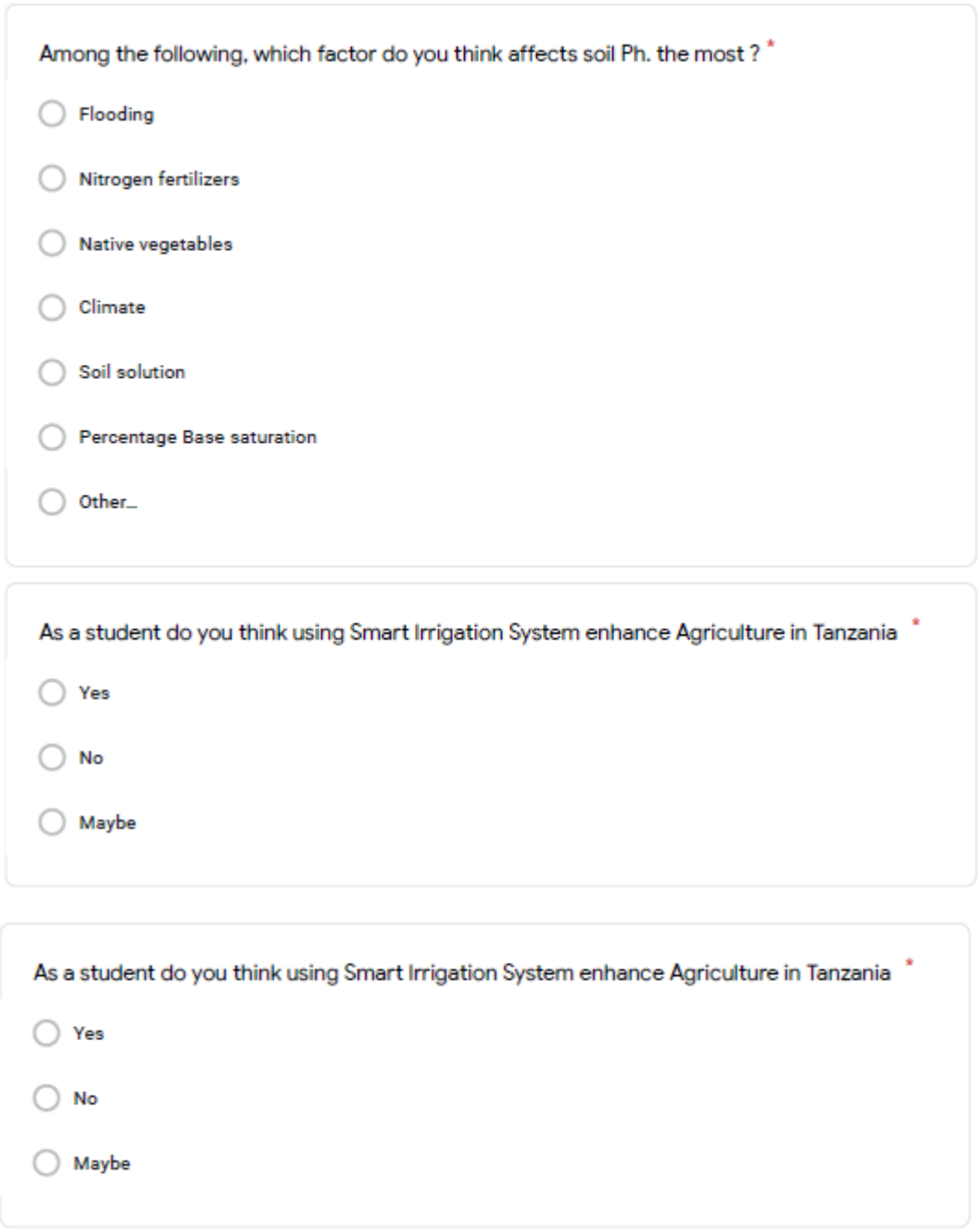

Figure 17: Questionnaire questions