Smart Monitoring and Prediction system of Agriculture

Submitted by

Rana Muhammad Zaryab Khan (FA18-BSCS-339-H)

Muhammad Muaz (FA18-BSCS-320-H)

Session Fall 2018-2022

Supervised by:

Mr. Umer Ahmed

Department of Computer Science

Lahore Garrison University

Lahore

Smart Monitoring and Prediction system of Agriculture

A project submitted to the

Department of Computer Science

In

Partial Fulfillment of the Requirements for the

Bachelor's Degree in Computer Science

By

Rana Muhammad Zaryab Khan (FA18-BSCS-339-H)

Muhammad Muaz (FA18-BSCS-320-H)

Supervisor

Mr. Umer Ahmed _____
Assistant Lecturer
Department of Computer Science

External Examiner _____

Chairperson

Dr. Muhammad Asif _____
HOD
Department of Computer Science

COPYRIGHTS

This is to certify that the project titled "**Smart Monitoring and Predication system of Agriculture"** is the genuine work carried out by **Muhammad Zaryab (Fa18-BSCS-339-H)** and **Muhammad Muaz (Fa18-BSCS-320-H) ,** students of BS in Computer Science Department, Lahore Garrison University, Lahore during the academic year 2018-22, in partial fulfilment of the requirements for the award of the degree of Bachelor of Computer Science and that the project has not formed the basis for the award previously of any other degree, diploma, fellowship or any other similar title.

Rana Muhammad Zaryab Khan _____

Muhammad Muaz_____

DECLARATION

This is to declare that the project entitled "**Smart Monitoring and Predication system of Agriculture**" is an original work done by undersigned, in partial fulfilment of the requirements for the degree "Bachelor of Science in Computer Science" at Computer Science Department, Lahore Garrison University, Lahore.

All the analysis, design and system development have been accomplished by the undersigned. Moreover, this project has not been submitted to any other college or university.

Rana Muhammad Zaryab Khan _____

Muhammad Muaz _____

Acknowledgement

All praise is to Allah Almighty who bestowed a minute portion of His boundless knowledge upon us by dignity of which we were able to carry off this challenging task.

We are obliged to our project supervisor “Mr. Umer Ahmed”. Without his personal supervision, advice and valuable guidance, completion of this project would have been doubtful. We are deeply indebted to him for the encouragement and guidance during this project.

And we are also thankful to our parents and teachers who have been an effective source of encouragement for us during the period of time.

Dedication

This project work is dedicated to my Parents, who have been a constant source of support and encouragement for me during the whole way through this graduate school and life. I am truly thankful for having them. This project work is also dedicated to my Supervisor, Teachers, who have always been a great source of knowledge and encouragement for me and whose good examples have helped me learn to work hard for the things that I aim to achieve.

Motivation

The motivation behind this project is developing a system for agriculture to help farmers by using smart technology. Smart agriculture by using latest technology such as IOT is gaining success and has been an important area of research worldwide. The motivation behind this project also includes the factor to overcome the supply chain demand by producing more with better ways and to build an eco-friendly system. In future, we want to expand our project on larger scale.

Table of Contents

List of Figures

LIST OF TABLES

Keywords:

SM, Smart Irrigation, Land Condition, NPK, Farmers, Land, Crop, IOT, Prediction system

List of Abbreviation

SRS	Software Requirement Specification.
SDD	Software Design Document.
SMS	Smart Monitoring System.
IOT	Internet of things.
STP	Software Test Plan.
FR	Functional requirement
UC	Use cases.

Abstract

There is a lot of work in the field of agriculture has been done using IoT by the developed countries. They have implemented automated irrigation systems in their farms such as Smart irrigation systems, smart plant monitoring, Autonomous greenhouse etc. But this technology is not being used by our farmers as we are less educated and under developed country. There are monitoring systems and irrigation system however, there is no work done for the prediction system using IOT.

This Project is aiming to provide a smart system to the farmers and the people who are related to the field of agriculture and facing issues related to their fields Such as Fields burn, lack of water, excessive use of water, not proper monitoring and chemical intakes for field, wastage of water, wastage of resources. These are some major issues every farmer is facing now a day around us. And it's very difficult for farmers to be there in fields all the time to monitor their fields. So, this system will help them in many aspects as by allowing them to monitor from anywhere and anytime and they are also being aware of any need by land.

Chapter no 1

Introduction

1.1 Purpose

The purpose of this project is to help the farmers and the people related to the field of agriculture and also the concerns regarding to this project are really considerable with all the parameters such as Economy of country, population, developing technologies, etc. Here are some benefits/purposes listed that how this project can handle real time issues and why we choose this project.

- **Easy-Monitoring:**

  We are able to monitor our land without going to it as we do in traditional way.

- **Easy-Prediction:**

  We can easily predict the crop for our land without doing traditional soil tests and also figure out the chemical need of our land.

- **Eco-Friendly:**

  The product is eco-friendly in a sense we are not going to use any technology which can harm our environment.

- **Less Work:**

  By Using this system our farmers have to do less amount of work and take more benefits, as they can monitor their fields by using technology at anywhere and anytime.

- **Overcome Demand:**

  As with the increase of population the demand of production is increased with time. So, by using this system they can increase the production rate as well.

- **Labor Cost:**

  By using this system, the labor cost is decreased as they do not need any labor for monitoring, they can do it by their own using technology.

A farmer decision about which crop to grow is generally clouded by his intuition and other irrelevant factors like making instant profits, lack of awareness about market demand, overestimating a soils potential to support a particular crop and so on. The need of the hour is to design a system that could provide predictive insights to the farmers, thereby helping them make an informed decision about which crop to grow. This calls for the need of smart farming, which requires use of IoT. Application of IoT in agriculture could be a life changer for humanity and the whole planet. That's why we choose to build a system for monitoring and prediction of crops.

1.2 Product Scope

The problem with traditional ways of farming is very tedious and they need more hard work as the farmers have to go to lands to check whether there is any need of water or anything else. There is a need of system or field expert who can do this work for them.

In this project, we are going to build a Smart Monitoring using IoT. The objective of this project is to offer assistance to farmers in getting Live Data (Temperature, Humidity, Soil Moisture, Soil Temperature, Chemical Intake) for efficient environment monitoring which will enable them to increase their overall field and quality of products. This smart agriculture using IoT system consists of sensors, Moisture sensor, Temperature Sensor, Weather Sensor, Electro-Chemical Sensor, and Android interface for end User. When the IoT-based agriculture monitoring system starts, it checks the Soil moisture, temperature, humidity, and soil temperature. It then sends this data to the IoT cloud for live monitoring. It notifies the user about their land and user can also use it to monitor the type of field and what to grow according to the type of land.

1.3 Product Perspective

The system we are working on is a Smart Agriculture system that will perform automated monitoring and predications using IOT technology. This proposed system will enable farmers to monitor their lands remotely and increase the production of crops by using the prediction feature of the system which predicts which crop is better for their land to increase productivity. Smart Monitoring and Prediction system of Agriculture is a self-Contained Product. As this is the fact that our country's population is majorly related to the agricultural sector. And also, the GDP of our country is based on the revenue generated from agriculture sector. So, it's a good thing to work in the main field which directly or indirectly connected with the stability of government. By automating and using the technology in this sector will increase the productivity, income and reduce the supply chain gap and also helps the farmers to grow well.

Chapter 1: In first chapter Purpose and Scope of the Project were discussed.

Chapter 2: This chapter Define project problem definition. This chapter also included Gantt chart which display evaluation time for this project and defines about the project.

Chapter 3: This chapter included Software Requirements Specification, functional and nonfunctional requirements.

Chapter 4: This chapter includes method tools technology used for deed of project.

Chapter 5: In this chapter, system's structure and behavior is discussed through diagrams.

Chapter 6: This chapter includes that how to perform tests and also the test plans and maintenance details of the project.

Chapter 7: This defines evaluation of results.

Chapter 8: This chapter concludes the whole working and post work of the project.

Chapter no 2

Problem Definition

2.1 Problem statement

The problem with traditional ways of farming is very tedious and they need more hard work as the farmers have to go to lands to check whether there is any need of water or anything else. There is a need of system or field expert who can do this work for them. Our system will cope with all the problems of farmers, related to their fields such as land monitoring, water level checking, wastage of water, wastage of resources etc. we want to develop a methodology that can automatically monitor the lands remotely, more efficiently and reduce the time and resources spent on traditional manual monitoring. In this system there will be steps of monitoring and prediction in which first data is fetched from a piece of land and preprocessing will be done where data is arranged according to our need and then send to user and prediction will be performed by comparing the data with dataset we are using and result will be displayed.

2.2 Project deliverables and milestones

Project milestones and deliverables

7th Semester

Activity	1	2	3	4	5	6	7	8	9 MID TERM	10	11	12	13	14	15	16	17	18 FINAL TERM
Project Proposal	■	■	■	■	■													
Defense						■	■	■										
Research										■	■	■						
Hardware collection + Understanding													■	■				
Implementation															■	■	■	

8th Semester

Activity	1	2	3	4	5	6	7	8	9 MID TERM	10	11	12	13	14	15	16	17	18 FINAL TERM
Documentation	■	■	■	■														
Implementation					■	■	■	■										
Updates										■	■	■						
Testing + Remaining Implentation + Finialization													■	■	■	■	■	

Figure 1

2.3 Present Systems

• **Smart Irrigation system**. • **Smart monitoring system for bolting reduction in Onion Farms**. • **Smart Monitoring systems**.	• Not for prediction. • Systems for specific types of Fields. • Only available for government level uses.

Table no 1

2.4 Our system

By going through the present system and looking at its shortcomings. We are proposing a system that can overcome the limitations of the present system.

Objectives of our system are

- **Availability:** We are designing a system which is available to local farmers as well for better production-rate.
- **Accurate:** Results are generated by an automated system by using the latest technology (IOT) with less efforts.
- **Automated System:** The farmers no more have to go to fields they can monitor the lands from anywhere they want with their mobile and this automated system.
- **User Friendly:** The interface is easy to use for anyone without having much knowledge about the system.
- **Prediction:** Farmers can predict what to plant/grow in their lands. They can also check the nutrient contents of their land with this automated system.

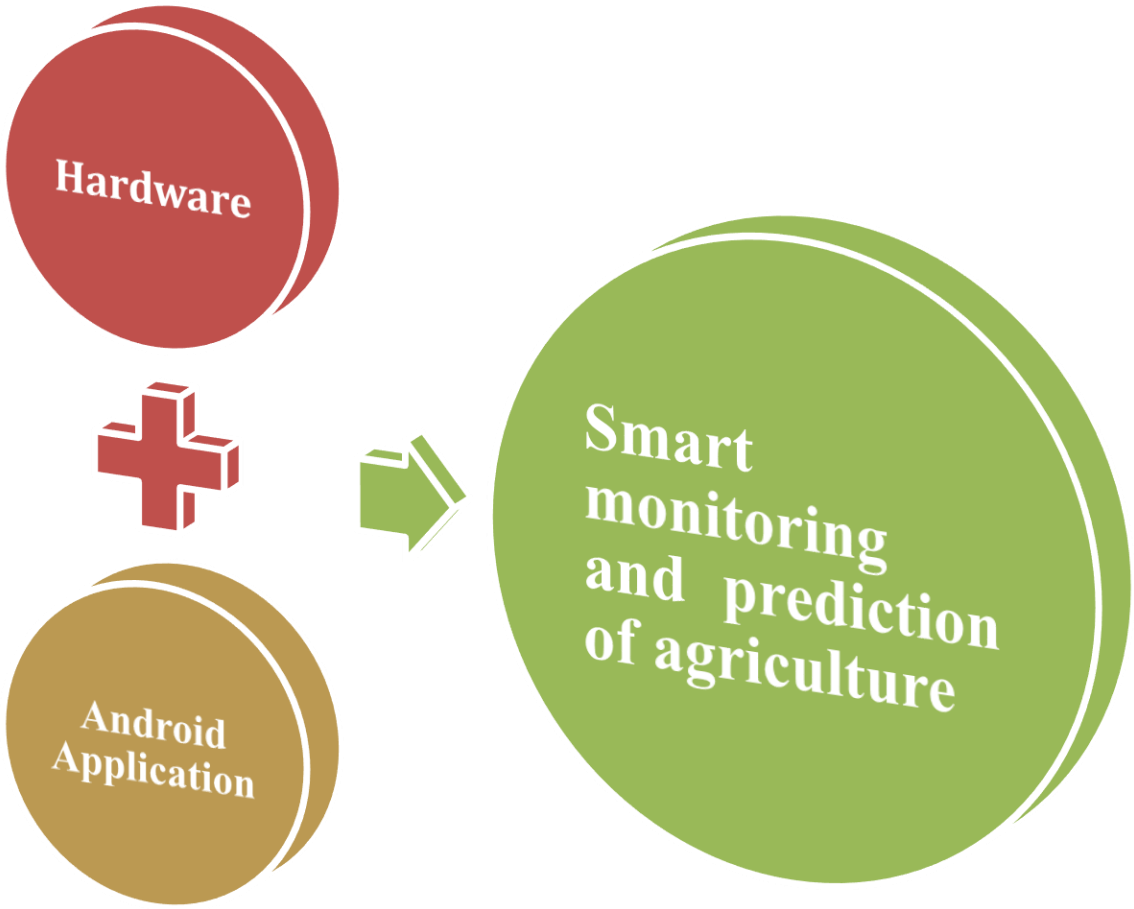


Figure 2 System Components

Chapter no 3

Software Requirement Specification

3.1 Introduction

As we see day by day world is moving towards technology. Agriculture is the major asset of any country (contribution of agriculture in GDP is about 18.9%) but we have lack of work in this field with technology. There is also a major wastage of water due to over watering of fields just because lack of knowledge of water needs of field. Our Farmers are facing very difficulties such as they do not get proper crops, their fields may burn due to water deficiency, their fields may fall due to heavy wind or they don't get proper crop or anything they plant due to access of water, or they do not plant something according to field requirements. So, there must be a system which monitor the condition of field/land, water need, chemical need etc. and notify the farmer or the person about the need so proper actions could be taken for the field. With IoT efficiency level would increase in terms of usage of soil, water, fertilizers, pesticides etc.

The proposed system contains all the features which are needed to overcome the existing problems. It contains monitoring of land in an automated way and will warn the user about water conditions and helps him to keep an eye on his land remotely. There is also a prediction feature which will help farmers to predict the crop according to their land nutrient conditions by comparing them with weather as well.

3.2 Overall Description

Smart Monitoring and Prediction system of Agriculture is a self-Contained Product. As this is the fact that our country's population is majorly related to the agricultural sector. And also, the GDP of our country is based on the revenue generated from agriculture sector. So, it's a good thing to work in the main field which directly or indirectly

connected with the stability of government. By automating and using the technology in this sector will increase the productivity, income and reduce the supply chain gap and also helps the farmers to grow well.

The functionality of the Application is to provide the complete requirement guidance to the Farmer

Such as:

- Temperature and Humidity Level.
- Soil Moisture Level.
- Soil Nutrient values.
- Soil fertility.
- Predicts which Crop is best for their field etc.

Alerts the Farmer about the need of field.

Allow them to monitor from anywhere and anytime.

- Eco-Friendly.
- Cost Effectively.
- Increase productivity to overcome the demand.

3.3 Platform

3.3.1 Operation Systems

- Windows
- LINUX
- MAC OS

3.4 Software Requirement

3.4.1

- Android Studio
- Arduino IDE

- C

3.5 Interface

3.5.1 User Interface:

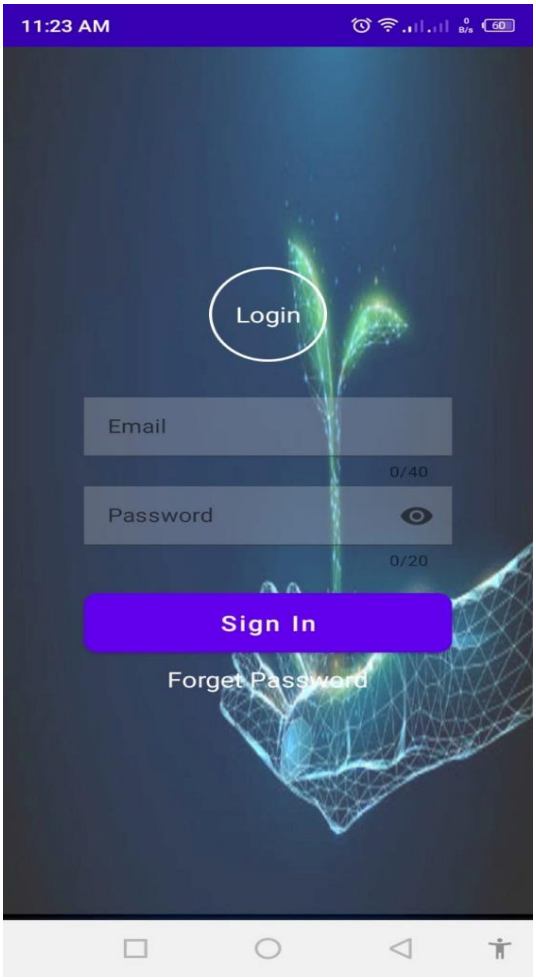


Figure 3 Login Screen

Figure 4 Main Screen

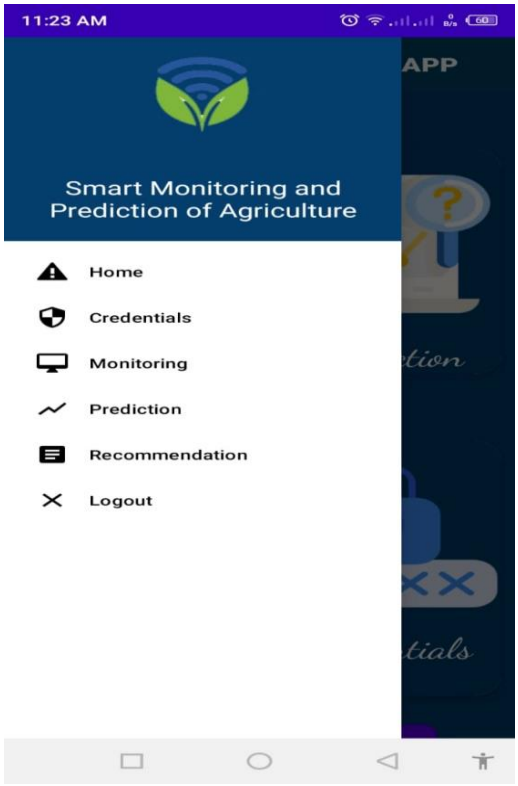


Figure 5 Side Menu

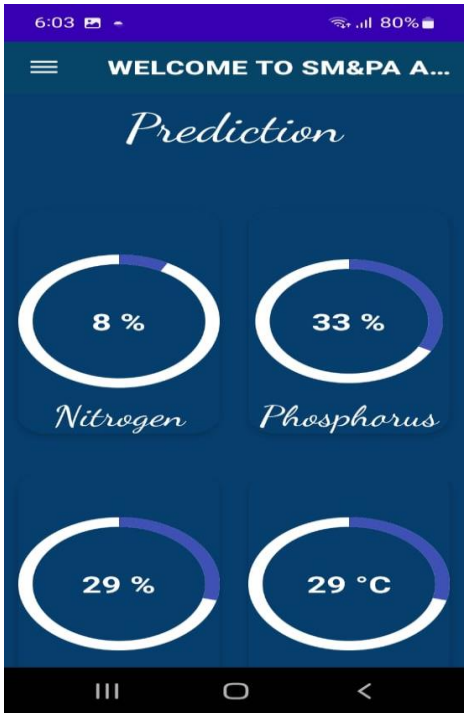


Figure 6 Prediction screen

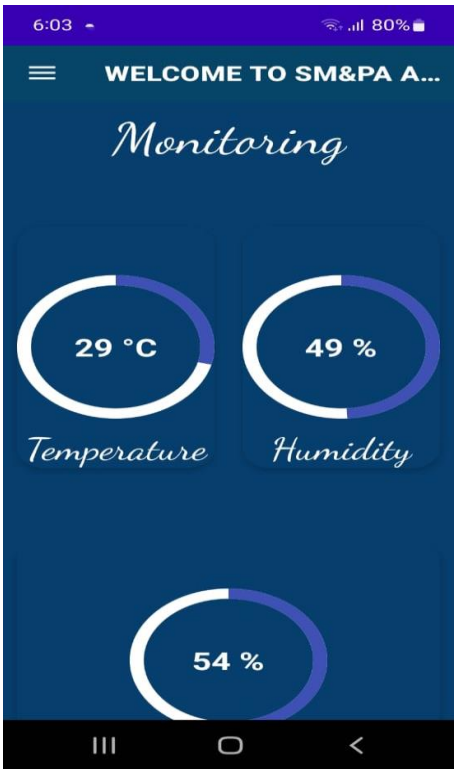


Figure 7 Monitoring screen

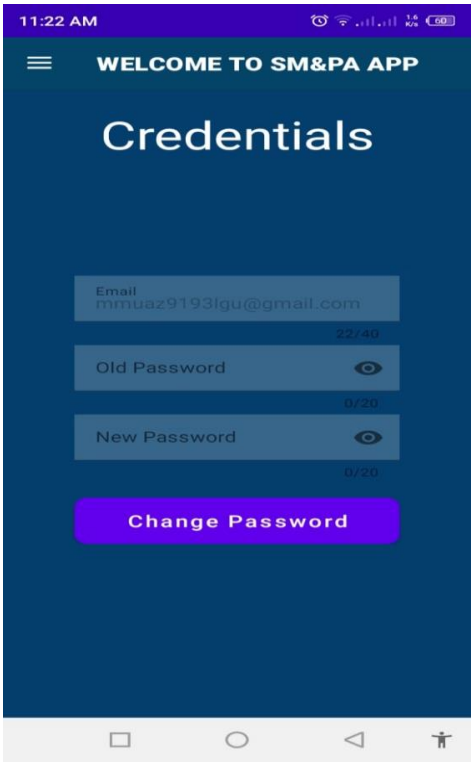


Figure 8 Credential Screen

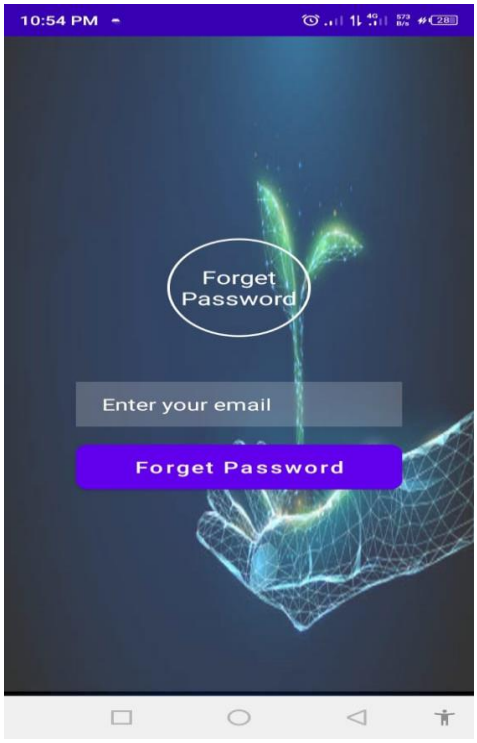


Figure 9 Forget Password Screen

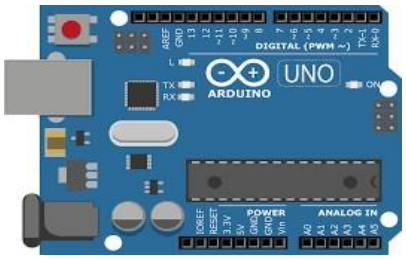
3.6 Hardware Requirements

3.6.1 Basic Hardware Requirements

- Arduino Board.
- Node-MCU.
- Temperature and Humidity sensor.
- Soil Moisture senor.
- Air Quality sensor.
- I2C-Display
- NPK sensor/kit.
- Rain sensor.
- Mobile device for app.
- System for coding.

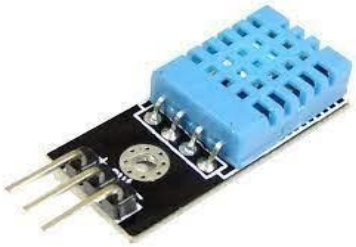
3.6.2 Pictorial Representation of Hardware used:

- **ARDUINO:** Arduino Uno is an Open-source Micro Controller Board which can integrated into variety of electronic projects such as home automation, smart irrigation etc. Arduino can be interfaced with other Arduino boards, LEDs, Sensors etc. Here is the pictorial representation of Arduino:

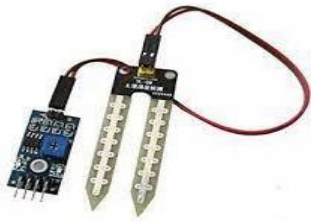


- **Node-MCU:** Node MCU is an Open-source Board with wi-fi chip embedded on it which can connect object to internet and allow them to send data over internet using wi-fi protocol. Here is the pictorial representation of Node-MCU:

- **Temperature and Humidity:** Temperature and Humidity are major factors in deciding which crop will best to cultivate and begin to produce. So, to measure this we have used temperature and humidity Sensor (DHT11).



- **Soil Moisture Sensor:** It is very important to know about the moisture level of soil for every farmer because it is not good to give excessive or less amount of water to land. For this purpose, we have used Soil Moisture Sensor to sense the moisture level of Soil continuously and send data to the system.



- **Electrochemical Sensor (NPK):** It is good to test soil for nutrient and fertilization, to increase the productivity it's important to know the quality of soil for better results. For this purpose, we use Soil NPK sensor to check the quantity of nitrogen, phosphorus and potassium in soil.

- **Air Quality Sensor:** As we know fields/crops needs fresh air to grow, if there are toxic gases present in the air that will harm our lands also. So, to detect the presence of toxic gases in the air we are using the air quality sensor (MQ135).

- **Rain Sensor:** The Rain Sensor can detect the rain falling on it and generates the signal, then the system will sense it and tells the user about it.

3.7 Product Functions

3.7.1 Login:

Farmers can login to system with great ease. And the credentials of each user should be maintained separately.

3.7.2 Monitoring:

Monitoring of the lands will be done with ease. Measurement of all parameters such as temperature, moisture level, humidity and all other parameters should be precise for better monitoring.

3.7.3 Fetching of data:

All the details of the parameters will be fetched from the land with the help of sensors, is the major feature of the system. Through this fetched data all other processing would be done.

3.7.4 Prediction of crop:

With the help of this system, we will be able to predict which crop is better for the field. So, with this feature productivity of the land will increase.

3.7.5 Recommendation:

With the help of this system, user will able to know what are the chemical proportions suitable for the desired crop.

3.7.6 Alerting the user:

When any of the parameter is disturbed such as, water level goes down or water level increases it will notify the user about it.

3.8 Operating Environment:

The operating environment for this project will be your land or your garden where you want to set up your system to monitor your land. As you need the product to give you updates when you want so you simply need a real time environment for it to operate in.
Major Hardware Components of our system contains ARDUINO, NodeMCU and Sensors and Environment for testing.
Software Components Includes: ARDUINDO IDE (for Arduino coding), Android Studio (for App).

3.9 Design and Implementation Constraints

As we know nothing can be so perfect everything has some limitations so we also have to consider them.

Some of the constraints which may affect our product are mentioned below:

- Lack of infrastructure.
- Less Secure.
- May be costly for applying on large scale.
- May be complex for someone who never use technology before.
- May be affected by surrounding.
- Need Internet connection.

3.10 Functional Requirements

3.10.1 Performance Requirements

Data retrieving speed of the system should be fast as possible from the sensors, delays may cause wrong results. Based on the capabilities on current android systems, performance of app will not be an issue. Systems App will work on any android device without slowing down the functions. The features will be very simple, specific and not overly detail so that it will be easy to understand and run. The system will continuously

fetch the data from sensors and keeps update the user about it.

3.10.2 Safety Requirements

Our Agriculture monitoring system will not be harmful for the environment, does not damage any other thing and also our app will not affect the user's device in any case. It will be safe to use and free from any type of virus. It will not disturb or slow down the functioning of other applications. User will be satisfied with the performance of the app. App will be safe to use on Android mobiles.

3.10.3 Quality attribute Requirements

- Availability.
- Correctness.
- Flexibility.
- Usability.
- Maintainability.

3.10.4 Features

- Fetching.
- Monitoring.
- Prediction.
- Recommendation.

Chapter no 4

Methodology

4.1 Model and Approach

- We've used Incremental model in this System. The reason of choosing this methodology is risk evaluation and management. The system is completed in different increments and at each step new functionality will be tested and added and evaluated. This helped in smooth system development.

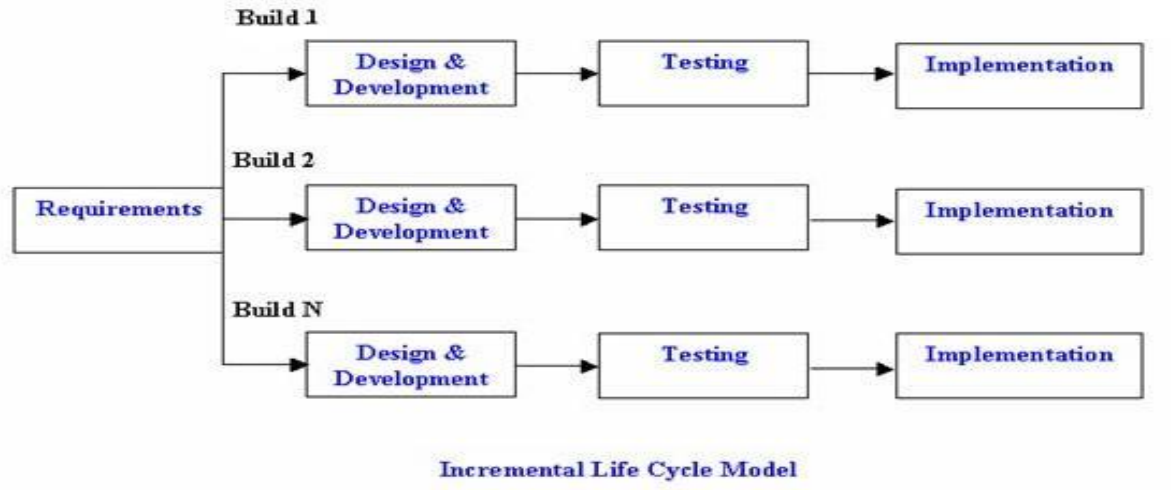


Figure 10 Incremental Life Cycle

4.2 Approach

For our project we are using the IOT approach for monitoring and prediction. IOT is a well-known and accepted approach for network of physical objects that are embedded with sensors, software's, and technologies for connecting and sharing data with other devices over internet and used in implementing automated systems. The main advantage of this approach is its ability to provide best possible accuracy in collection of real time data and much more.

4.3 Methodology Diagram Representation:

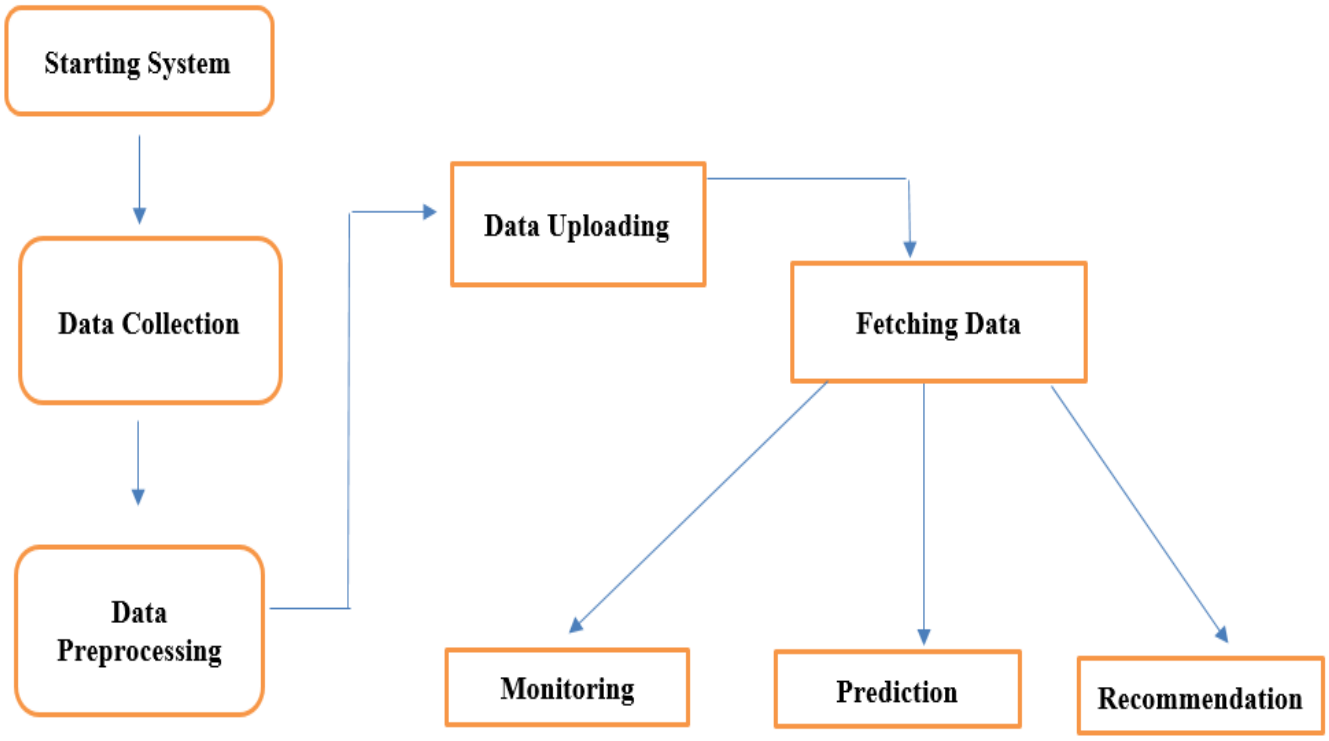


Figure 11 Methodology Diagram

4.4 Tools and Technologies

	Tools	Version	Rationale
Tools And Technologies	Arduino IDE	1.8.16	Programming
	MS Word	2016	Documentation
	MS Power Point	2016	Presentation
	Android Studio	2021.2.1	Application development
	Technology	**Version**	**Rationale**
	C	unspecified	Programming language
	XML	unspecified	App Frontend
	Java	Unspecified	App backend
	Firebase	Unspecified	Database

Table no 2

Chapter no 5

Design and Architecture

5.1 Introduction

This chapter describes the architecture and model used for this project. This chapter also explains about the reason for the architecture and model used and software's tools and technology necessary for its implementation.

5.2 System Architecture

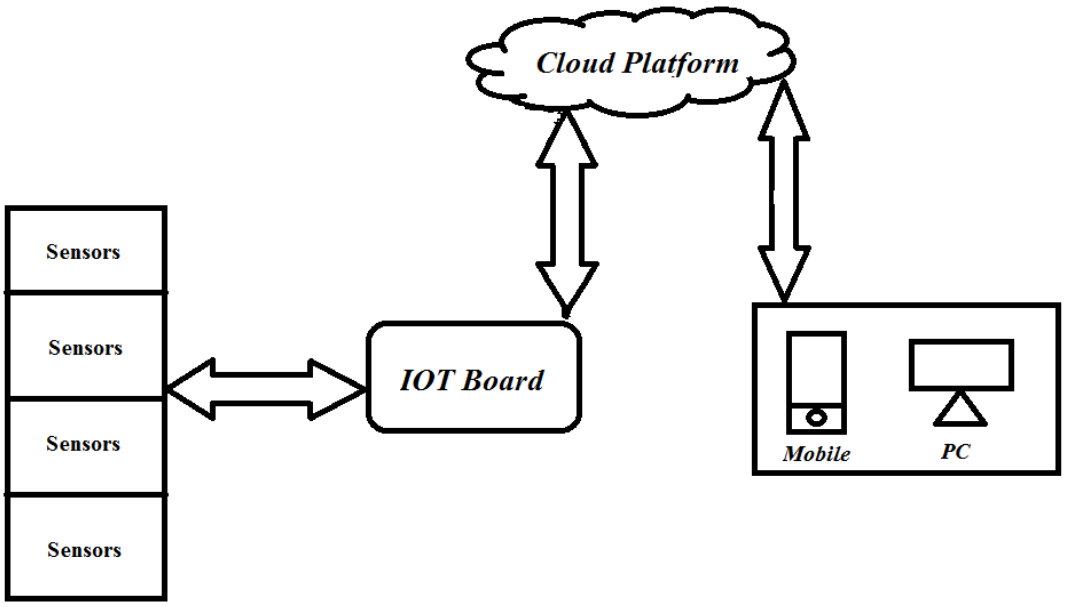


Figure 12 System Architecture

5.3 Functional Description:

Sensors:

Sensors are the way of collecting data from the environment which can be further processed and send for more processing.

Data Preprocessing:

Data preprocessing is the process of data transformation from raw data into labeled data after applying various preprocessing techniques like handling null values, Data standardization and sorting it so we can achieve the desired output for making predictions and results.

IOT Board:

The IOT Board is an open-source microcontroller board which is used to connect different devices together and devices with internet, it contains chips, and digital and analogue pin for receiving and transmitting data between devices and to the internet. (In our case we are using Arduino and Node-MCU).

Cloud Platform:

Cloud is something which we can say internet-based data center where we can store our data. Here through IOT board we are sending our data to cloud and storing there.

User-Interface:

User interface is something through which user can interact with our system with ease. Such as with app or website using PC.

5.4 Detailed System Designing

5.4.1 Classification

Our proposed system is classified into hardware components and a mobile application.

- Each user has a unique password and username to access the system.
- Admin will add and remove the users from the system.
- User is able to access the system using application with correct authentications.
- Admin/developer of the system is responsible for maintaining the database.
- User can access all the data using mobile app.

5.4.2 Definition

Our system is combination of different sensors which collect data from soil and send the data to the server and the user will be able to get the data from the server by using our app without even knowing the background coding of the system.

5.4.3 Responsibilities

The major responsibility of the system is to provide the accurate data to the user in less time. And the responsibility of the developer is to maintain the database and the proper functioning of the system. While the user is responsible to use the system to get the proper outputs from the system for what it is designed in a good way to get it running.

5.4.4 Constraints

By using this system, the user will get the real time data from its land and the major assumption or limitation for the system is the availability of the internet connection all the time.

5.4.5 Composition

Our hardware system is the composition of different components which includes:

- Arduino Board.
- Node-MCU Board.

- DHT11 Sensor.
- MQ135 Sensor.
- Rain Sensor.
- NPK Sensor.
- I2C display.
- MAX485.
- Buck Converter.
- Bread-Board.
- Jumper Wires.

5.4.6 User/Interaction

User can directly start the system and can see the displayed valued from the system using the screen. For getting the values in the app, user have to login to the system with authentic credentials such as user name and password. After logging-in the user will have the options to do multiple things such as he can monitor the land, can predict the crop according to the land condition, or can check the nutrient values required for the specific crop. He can also be able to change the credentials of his account.

5.4.7 Resources

Our system is not using any extra resource. However, the app is using the part of memory on user's phone. And overall, the internet connection is needed for the whole system including android app.

5.4.8 Processing/Working of System

- **Data Fetching:** In this phase the data is collected through the sensors from environment and land.
- **Data Pre-processing:** After fetching data pre-processing has been done on the fetched data to make it useable.

- **Data receiving board:** After pre-processing the data is sent to the IOT board, in our case we are using the Arduino board for collecting data from sensors after that the data is send to the Node-MCU board to transmit it through the internet.
- **IOT cloud:** From node data is sent to the cloud using wi-fi module of node. In our case we are using the firebase cloud to store our data from our system.

- **User Interface:** From firebase we are fetching our data using an android application to show it to our user.

5.4.9 Detailed Subsystem Design

This section includes the detail of the system using diagrams. The Diagram presented here are:

- Use Case Report.
- Use Case Diagram.
- Data Flow Diagram.
- Architecture Diagram.
- Block Diagram.
- Class Diagram.
- Activity Diagram.

5.4.9.1 Use Case Report:

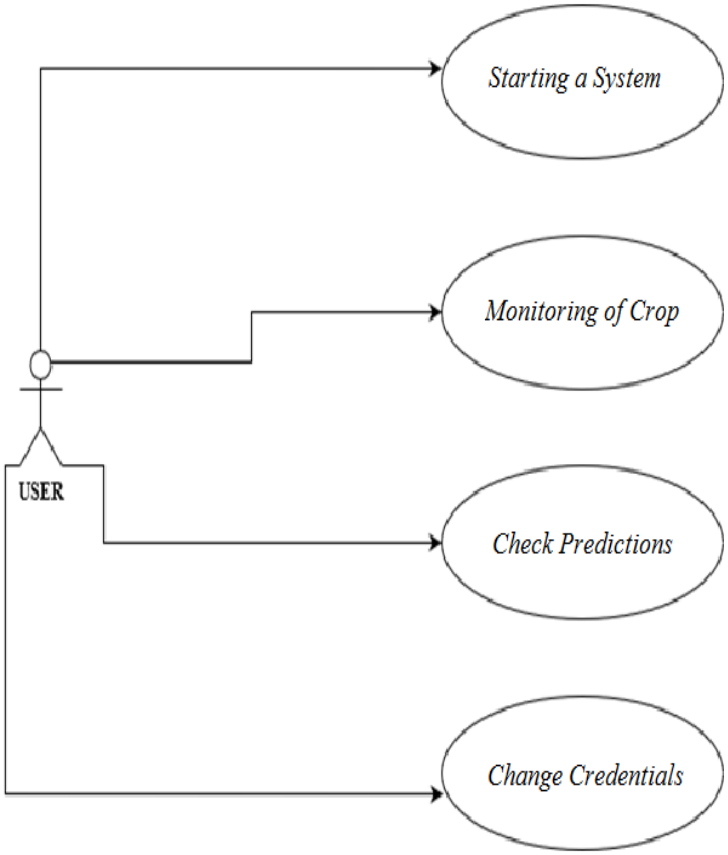


Figure 13 Use Case Report of Application

5.4.9.2 Use Case Diagram:

Figure 14 Use Case Diagram for system

5.4.9.3 Data Flow Diagram:

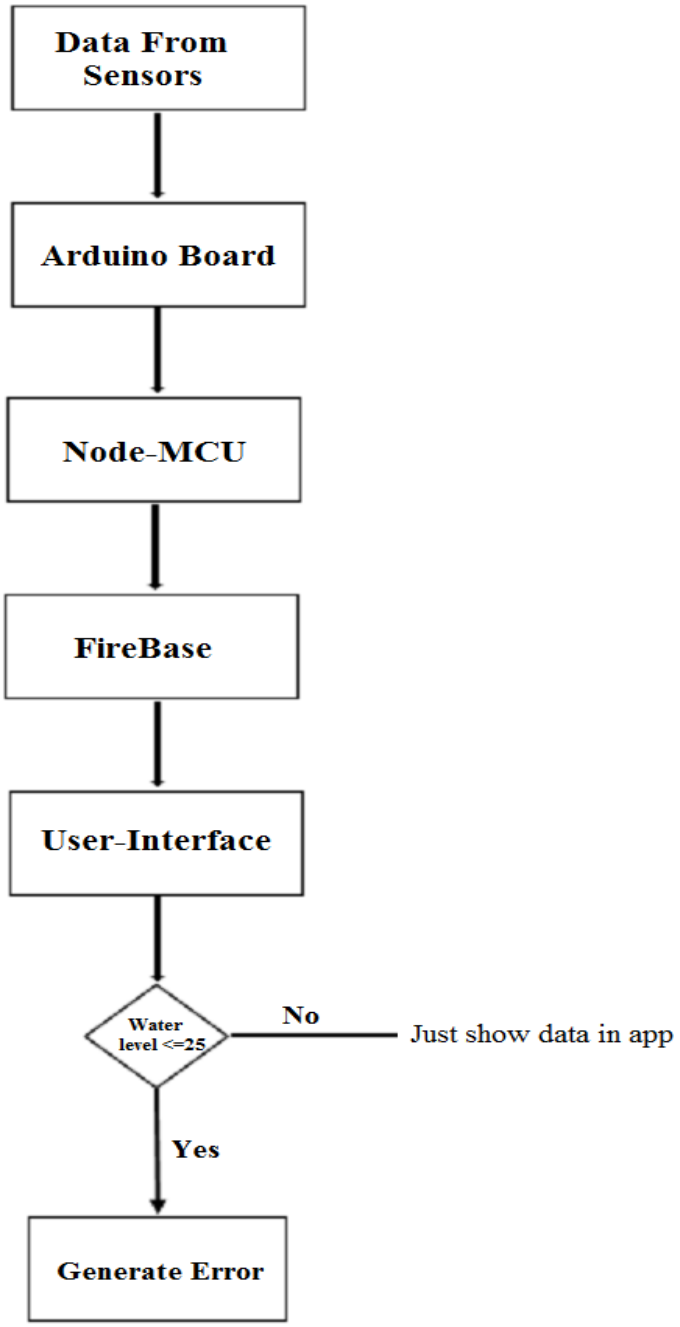


Figure 14 Data Flow diagram for system

5.4.9.4 Architecture Diagram:

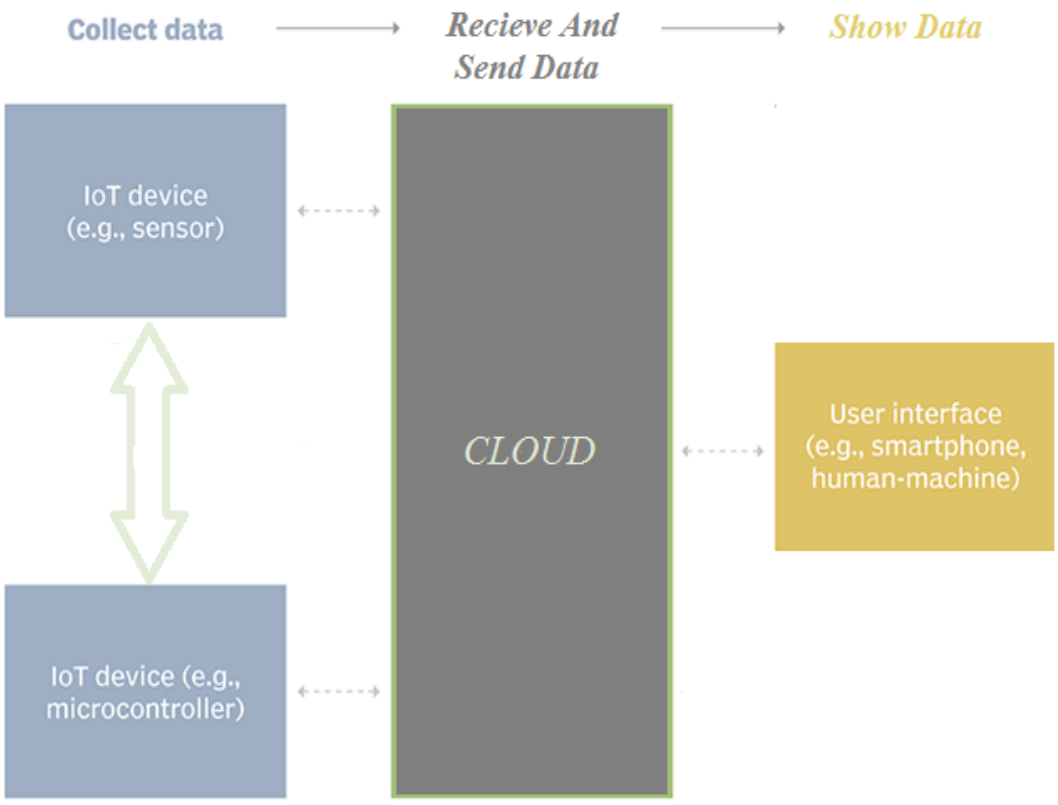


Figure 15 Architecture Diagram of System

5.4.9.5 Block Diagram:

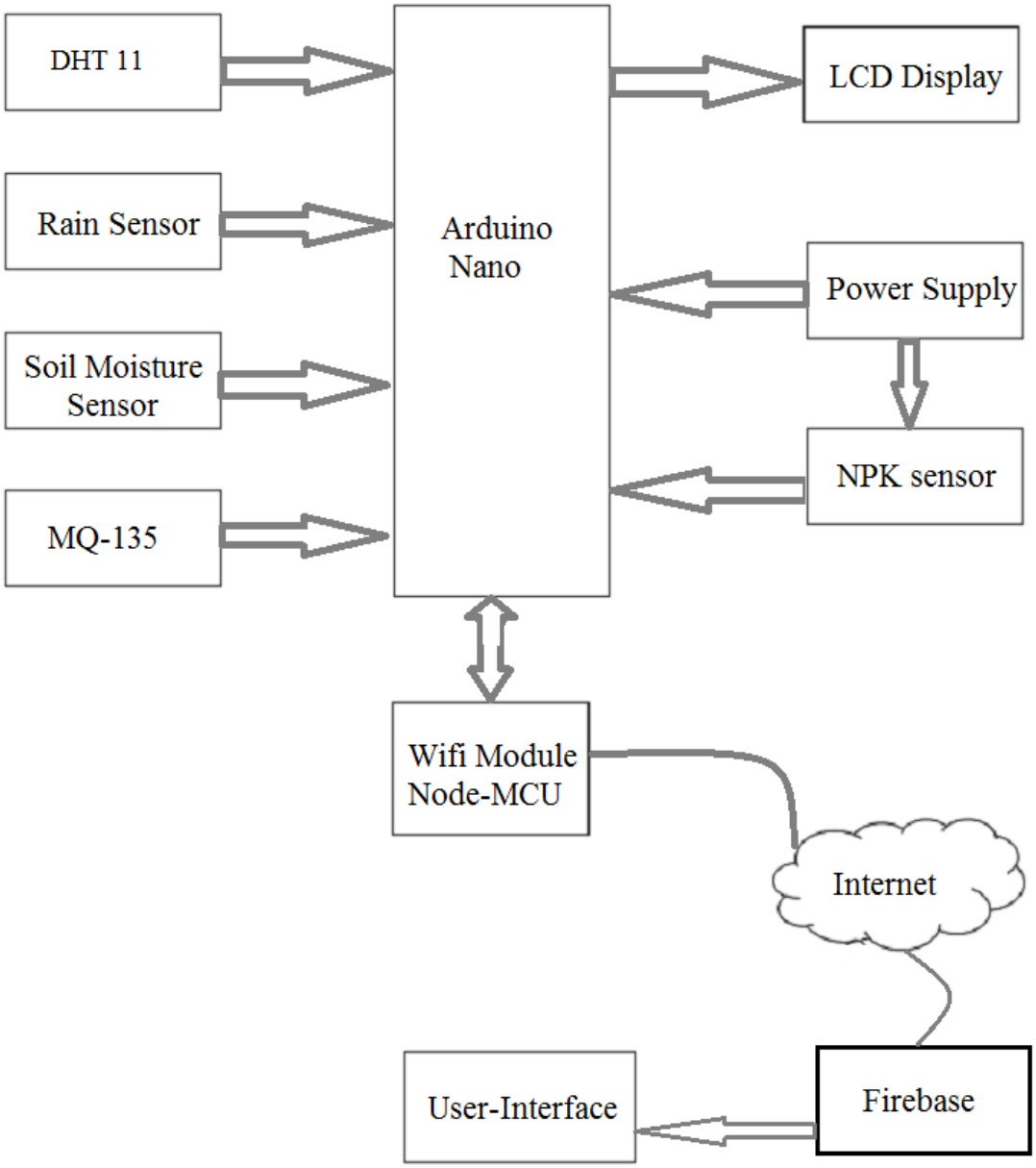


Figure 16 Block Diagram of System

5.4.9.6 Class Diagram:

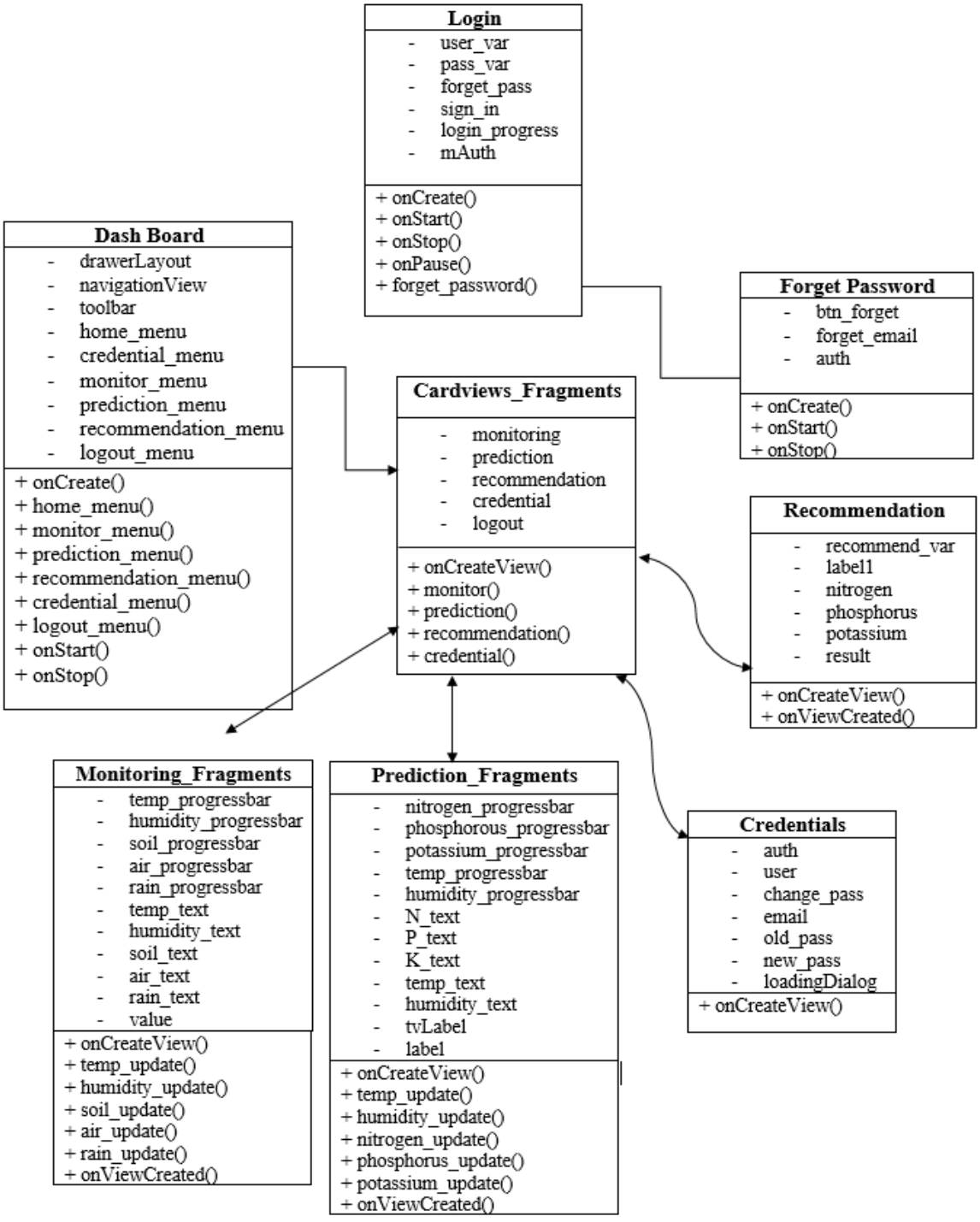


Figure 17 Class Diagram

5.4.9.7 Activity Diagram:

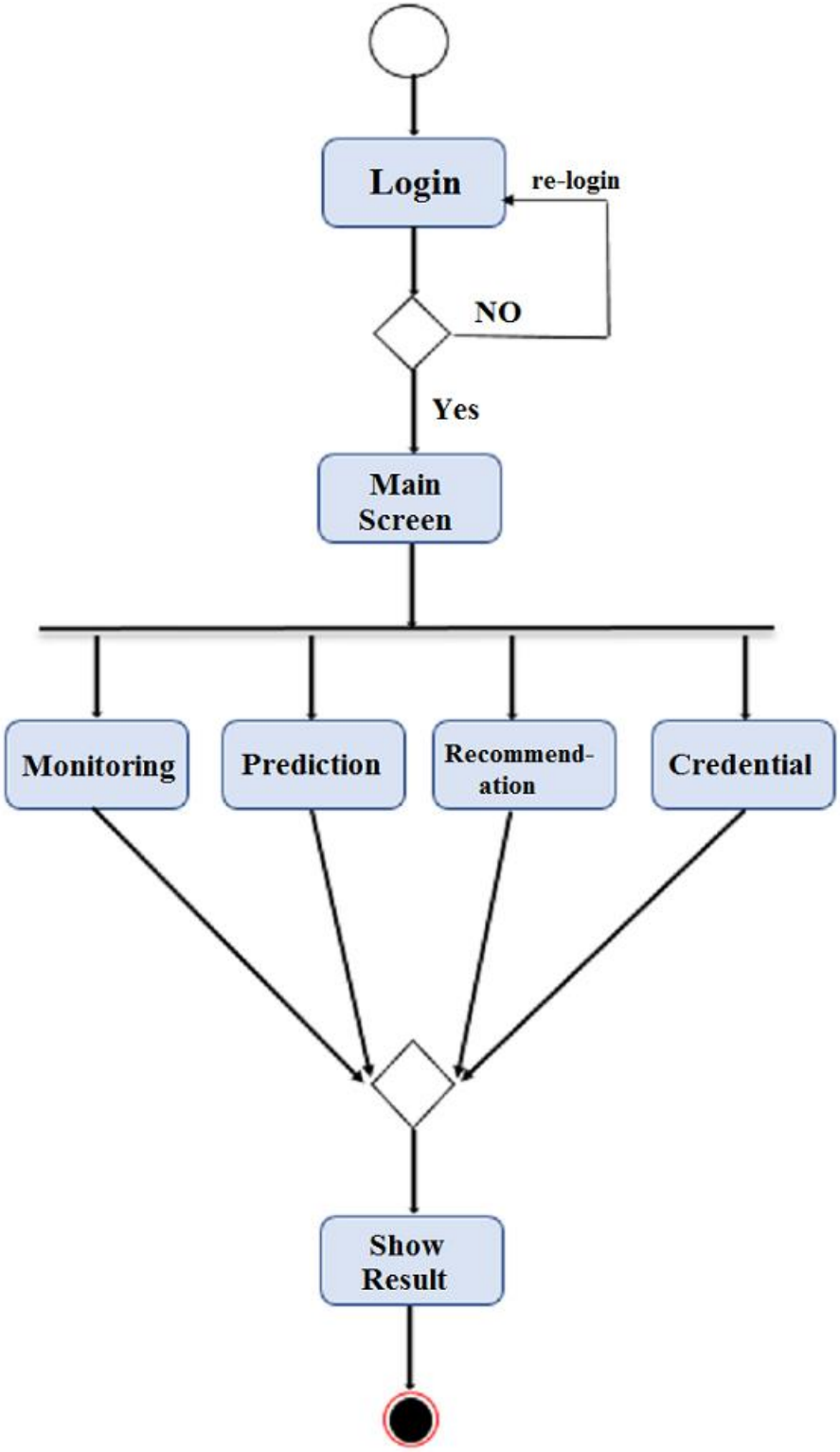


Figure 18 Activity Diagram

Chapter no 6

Implementation and Testing

6.1 Tools

- Arduino IDE.
- Android Studio.
- MS Office.
- Smart Phone.

6.2 Testing Methods

In this process we are going to see how we are going to test our system in different environment.

6.3 First Testing

First, we need to login into the system by providing right login details and with proper internet connection.

Purpose:

To ensure the credibility of the system that no one unauthorized person can access the system.

After that we are getting our data from sensors to our server and then in our app.

Scenario:

To get the data we have to start the system first and after that we have to put the soil sensors inside the soil and start checking the received data on our APP.

Environment:

The environment for our system is the land where we can easily test our system. Here we are using some quantity of soil for testing.

Pre-Requisite:

Before receiving data, we have to login first.

Strategy:

- Login with right credentials.
- Then select the required option from the given option on the main screen.
- On next screens start seeing the data coming from sensors.

Expected Results:

- The data will available on required screen in proper format.
- System will show data to user according to his requirement.

Screenshot are attached in the below section.

Observations:

- System is running properly.
- App is showing proper data coming from sensors.
- Sensors are fetching data with accuracy.
- Data is uploading to the server accurately and fast.

6.4 Second Testing

Scenario:

To get the data we have to start the system first and after that we have to put the soil sensors inside the soil and start checking the received data on our APP.

Environment:

The environment for our system is the land where we can easily test our system. In this case we perform testing in garden.

Pre-Requisite:

Before receiving data, we have to login first.

Strategy:

- Login with right credentials.
- Then select the required option from the given option on the main screen.
- On next screens start seeing the data coming from sensors.

Expected Results:

- The data will available on required screen in proper format.
- System will show data to user according to his requirement.

Screenshot are attached in the below section.

Observations:

- System is running properly.
- App is showing proper data coming from sensors.
- Sensors are fetching data with accuracy.
- Data is uploading to the server accurately and fast.
- Showing proper predicted crop according to the values set in the database.

Chapter 7

Results and Discussion

7.1 Results

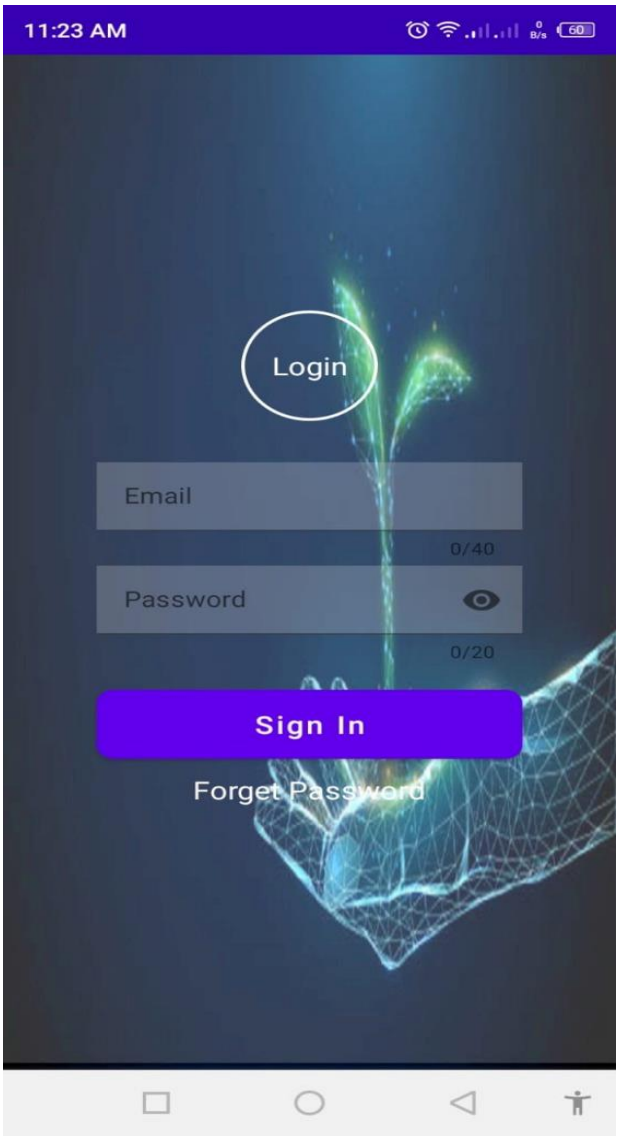


Figure 19 Login Screen

After login user will move to that screen and from that screen the user can move to any other required screen (where he want to go). Whenever the data will change from the system the user will get a alert just like seen in the given image below.

Figure 20 Main Screen

When the water value will go down from the set threshold it will generate warning message.

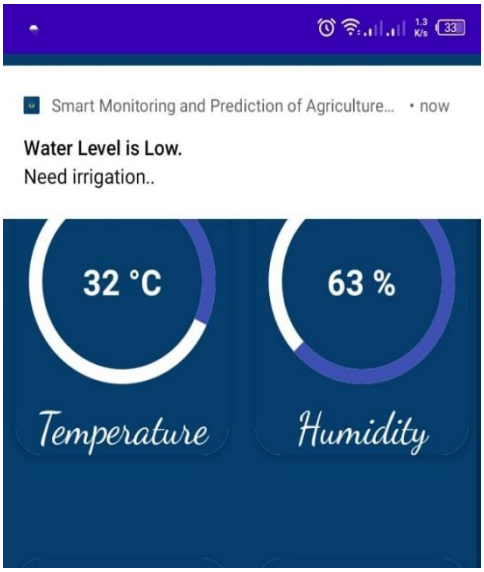


Figure 21 Alert Message

This the Monitoring screen of our app where the user can easily monitor the current condition of the land.

Figure 22 Monitor test

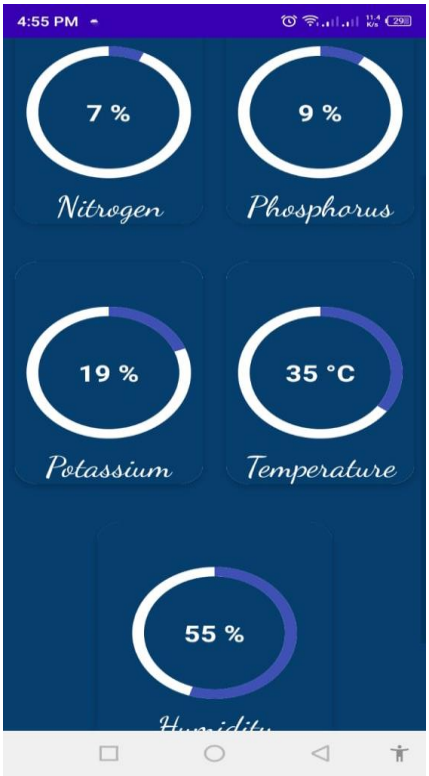


Figure 23 Prediction test

This image shows if there is no record found according the nutrient values present in the land.

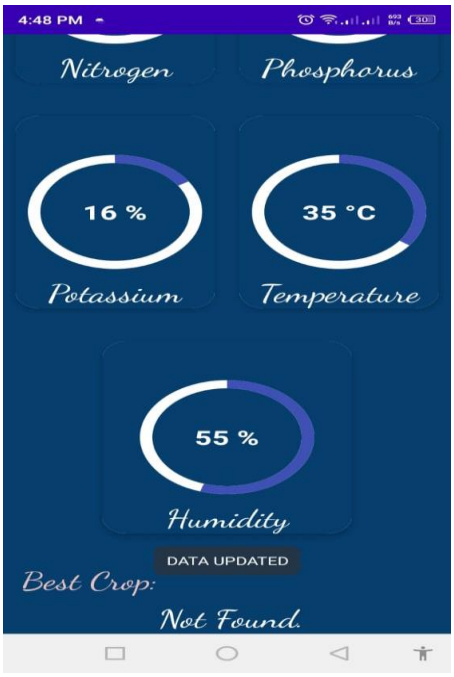


Figure 24 Prediction test

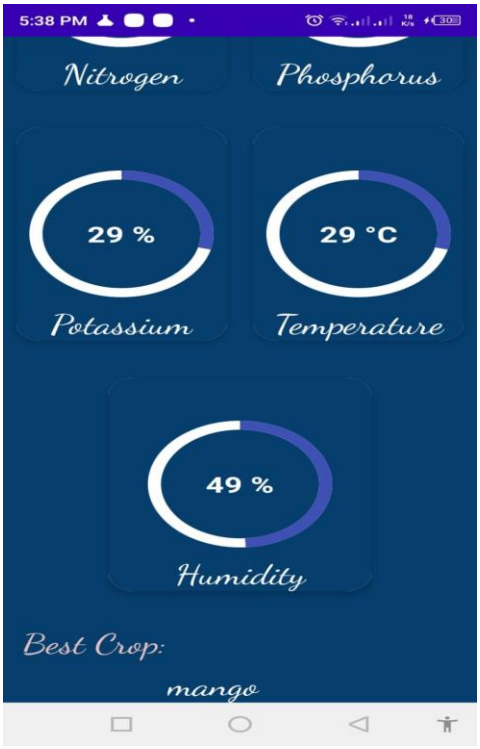


Figure 25 Prediction test

This image shows the error message generated if the app is not connected to the internet.

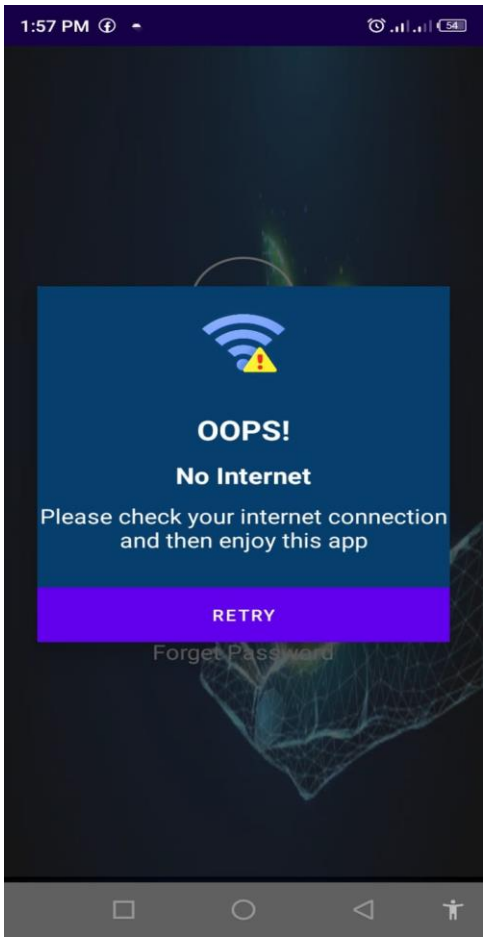


Figure 26 Internet error

Chapter 8

Conclusion and Future work

8.1 Conclusion

The proposed system is an IOT based system with App functionalities which deals with Monitoring of agricultural lands with ease and with the extended functionality, of getting prediction of crop according to the land conditions, there will be no need to perform expensive soil test. The proposed system helps in monitoring of land more accurately with best possible accuracy and less time consumption with less resources. It saves the farmers time to monitor their lands manually by providing them an automated system to do that. The farmers can view their land condition with a mobile app from anywhere and anytime. The system will automatically get data from lands with accuracy and then the processing of data would be done after that the data will be sent to user to get updated with the condition of their lands. And the system is able to alert the user if there is shortfall of water in land. Another amazing feature is added to the system where the user can get the required land needs according to specific selected crop with more accuracy.

8.2 Future work

In future, we are thinking of creating and connecting a complete responsive website for our system of Monitoring and Prediction of agriculture. Secondly, the range of prediction can improve to large extent by adding more crops data to our database. Furthermore, the scope of the project would escalate by adding more operations such as weather prediction etc.

Chapter 9

References

9.1 References

- **"A Survey on the Role of IoT in Agriculture for the Implementation of Smart Farming".** By Shoaib Farooq, Adnan Abid, Kamran Abid 2019.
- **"Agriculture monitoring system"** By N. M. Z. Hashim, S. R. Mazlan … in October 2015.
- **Blog**: www.**mathaelectronics**.com/how-to-measure-soil-**nutrients**-using-arduino-soil-**npk**-sensor.
- **Blog:** www.**biz4intellia**.com/blog/5-applications-of-**iot**-in-**agriculture.**
- **"IOT based SMART FARMING SYSTEM".** By Yasir Faheem, Mrs. Taniya Sarkar in December 2018.
- "**IOT Based Monitoring in Smart Agriculture".** By Anupama Hongal, M. p. Jyothi in 2017 (by ICRAECT).
- "**IOT Based Smart Agriculture**". By Dr. Manasi M. Patil in 12 December 2019 (by IJERT).
- **"Rural Development of Pakistan with IoT",** By Muhammad Usman, Wajid Ali 2019.
- **"Smart Agriculture Using IOT Multi-Sensors".** By Mai Minh Man, Tan-Y Nguyen in 23 August 2019.
- **"Smart Agriculture Using Internet of Things".** By Ibrahim Mat, Ahmad Nizar Harun, Ismail Mat Yousaf in 21 Nov 2018.