IoT Based Smart Agricultural System with Crops Selection

By
Hasibur Rahman
ID: 181-15-1777

Naim Istiak Masum
ID: 181-15-1793

Mahmudul Hasan
ID: 181-15-1920

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

Supervised By
Ms. Tania Khatun
Senior Lecturer
Department of CSE
Daffodil International University

Co-Supervised By
Mr. Tajim Md. Niamat Ullah Akhund
Lecturer
Department of CSE
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

JANUARY 2022

APPROVAL

This Project titled "**IoT Based Smart Agricultural System with Crops Selection**", submitted by Hasibur Rahman **ID No.** 181-15-1777, Naim Istiak Masum **ID No.** 181-15-1793 and Mahmudul Hasan **ID No.** 181-15-1920 to the Department of Computer Science and Engineering, Daffodil International University. This is a partial fulfilment of the requirements for the degree of B.Sc. in Computer Science and Engineering that has been accepted as satisfactory and approved as to its style and contents. The presentation has been held on 13 January 2022.

BOARD OF EXAMINERS

Mohammad Monirul Islam **Internal Examiner**
Senior Lecturer
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Md. Mahfujur Rahman [MMR] **Internal Examiner**
Senior Lecturer
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Swakkhar Shatabda **External Examiner**
Associate Professor,
Department of Computer Science and Engineering (CSE)
United International University (UIU), Dhaka, Bangladesh

DECLARATION

We are declaring that, this project has been completed by us under the guidance and the supervision of **Ms. Tania Khatun, Senior Lecturer, Department of CSE** Daffodil International University. And we also like to mention that this project or related any part of this project has not been submitted anywhere for any award or any certificate or any competition.

Supervised by:

Tania Khatun

____

Tania Khatun
Senior Lecturer
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Co-Supervised by:

Tajim Md. Niamat Ullah Akhund

____

Mr. Tajim Md. Niamat Ullah Akhund

Lecturer
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Submitted by:

Hasibur Rahman

____

Hasibur Rahman

ID: 181-15-1777
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Naim Istiak Masum

Naim Istiak Masum

ID: 181-15-1793
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Mahmudul Hasan

Mahmudul Hasan

ID: 181-15-1920
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

ACKNOWLEDGEMENT

We are extremely grateful to our supervisor Ms Tania Khatun, Senior Lecturer of Daffodil International University and co-supervisor, Mr Tajim Md. Niamat Ullah Akhund, Lecturer of Daffodil International University. Behind this project, we had to deal with some implementing problems, at those moments the encouragement and guidance of our supervisor mam were really incomparable. Her excellent scholarly guidance and encouragement and energetic supervision have made it possible to complete this project. It was not possible to complete without her endless support.

We are very thankful to our co-supervisor sir, for his deep knowledge of IoT, which encourage us and help us a lot in many related problems.

Our heartiest thanks to the project committee of Daffodil International University for letting us a chance to have this project. We are also thankful to some of our classmates for their support and encouragement.

At the end and most importantly our heartiest gratefulness to the Almighty Allah for His blessing. And uncounted respect to our parents for their heartiest support.

ABSTRACT

Bangladesh is an agricultural country and the backbone of our country's GDP (Gross Domestic Product) depend on agriculture. Agriculture is a fundamental part of our country. Not only a specific country, day by day the need for agricultural goods is increasing. Most of the country there are using old tools and analogue methods in agriculture even we are living in the digital era. As a result, we are facing less productivity and wastage of resources. Digital methods can be a possible solution to increase more productivity and less wastage of resources. Now IoT devices with science and technology are working on this and dealing with these problems. Our approach is to make it in more effective ways. With our system, a farmer can be monitoring his field from anywhere at a very low cost. Also, have an auto irrigation system that will help to use sufficient water. Even the farmer can able to control the irrigation systems manually with his mobile app from anywhere. It will also show the possible crops that are suitable for that land after storing some data and analysis on those data. Our approach will help to reduce water wastage and make it easy to monitor the field very accurately and gives suggested crops for the field.

TABLE OF CONTENTS

List of Figures

CHAPTER 1
Introduction

1.1 Introduction

In introduction, we will describe our system briefly and give a complete overview of the system.

We are now in the modern era from our country's perspective our country is an agricultural country. But our farmers do not have much knowledge about modern technology. At the end of the day, we have to depend on them. Day by day our population is growing. Very normally it is getting hard to deal with food, for that sometimes the market prize rate became high other hands the farmers don't get a proper prize also. And for that modern problem, we have to think of effective ways to deal with those modern problems. If our farmers can use and work-related with modern technology then it will be more effective. With our approach model, a farmer can be monitoring his lands easily and get an idea for which crops is suitable for his land.

Now, some of the farming and agriculture projects and activities are on prediction or weather forecast. There is a chance of failing the system. It can be any system though. Since we are approaching a system that not only depends on a prediction but also a farmer can monitor his land on his way, most importantly the system can be controlled from anywhere with an android device. The approach project we are using with IoT devices mainly.

IoT

IoT means the Internet of things means the hardware devices that are embedded with sensors or software or related technologies to connect and share data with one to another devices or systems through the Internet. Very first, of this IoT name appears independently in 1999 by Kevin Ashton of Procter & Gamble and that concept was about radio frequency identification, which allows it to connect with another device. Later on, in the year between 2008 and 2009, the internet of things grew with a proper feature that connects with other devices with the internet. Continuously it is growing. Nowadays this IoT is being used in many important fields such as Agriculture, Smart home, Eldercare, Medical and healthcare, Transportation, Building and home automation, Environmental monitoring, Military applications and so on.

So, in this project, IoT technology will be related to the agricultural system to make agriculture more efficient.

IoT in Agriculture and our approach

Nowadays IoT is used in agriculture fields to monitor, predict, forecasting. Our approach is on monitoring and predicting with some effective ways. The values of soil moisture, air humidity, the temperature will be shown to the user with any browser and also in the mobile app. The system has an automatic irrigation system for specific crops. Also, a user can control irrigation by his mobile app. The main feature is the user can implement his system on the field before seeding and our system will show the median value of air humidity and temperature and suggest which crops are suitable for this land.

1.2 Motivation

When we get our semester break, we go to our village home and we see that the cultivation system of our country is analogue. The farmers work hard but they don't get good enough results. The system of irrigation is manual, for this they can't sleep they must keep their eyes open. Even a manual system is having a big chance of water wastage. And the farmer can't realize which kind of crops they have to cultivate. When we are going to digitize our country, we must keep our eyes on the agricultural system. As CSE students, we want to be a part of those people who are digitizing Bangladesh.

Therefore, from this thinking, we want to make our country's agricultural system digital. Through this approach, we are expecting a solution to those problems with automated irrigation and monitoring methods that enable farmers to get more accurate information about the land and gives idea that which crops are suitable for his land, that can be more productive and efficient with limited resources.

1.3 Objectives

The main objectives of our project are to make sure that a farmer can be monitoring his field with a mobile phone from home even anywhere. It will help to reduce wastage of water and enhance more production of crops by irrigating properly. Even a farmer can control irritation with a mobile phone manually from anywhere. Data store in a cloud server and analysis them to get the suitable crops for that field.

1.4 Expected Outcome

Our approach project will be able to suggest which kind of crops the farmer needs to cultivate for his land. And the irrigation system will be automated and also can be controlled manually with his mobile device. The farmer can be touched with his land by knowing the moisturizer, temperature without going to the land. The main theme is the cultivation system can be controlled and monitored digitally by the farmer with a mobile and automated irrigation system that will reduce water wastage.

1.5 Report Layout

CHAPTER 1: INTRODUCTION (About the Project, Motivation, Objective, expected outcome, Report layout**)**

CHAPTER 2: Research and Literature Review (Developing the Site, Works and Background Studies, Framework**)**

CHAPTER 3: System Requirements and Methodology (Requirements, Specification, Methodology**)**

CHAPTER 4: Structure Design, Implementation and Review (Development Methodology, Used Language and Technique, Diagram**)**

CHAPTER 5: Limitation and Future Scope (Limitation, Implication for Further Study)

CHAPTER 6: Summary, Conclusion (Summary of the Study, Conclusion**)**

CHAPTER 2
Research and Literature Review

2.1 Background Study

The Internet of Things is growing day by day. In the survey to the United Nations, in 2050 the world population will be reached in 9.7 billion. For that, there will be needed more production rate about 69% on global agricultural goods. For the increasing rate of food demand towards to face with ever-shrinking of arable land.[13] According to Andrew Meola, the farming industry will be more important than any other time before in the next decades.[12] Dealing with those issues, now many farming companies are trying to use the help of internet of things technology to get more accurate information about their crops and lands. Expecting more productive rate and efficiency. Those techniques can be the way to analyses and store more data for future modern farming. Now some developing country whose are using data to analyses and develop more efficient technology to get more production rate, like Morocco. Not only those countries now researchers are analyzing and trying to figure out the more efficient ways and development with the internet of things technology.[12]

There are some research papers on this field and related to approach some different ways with success and limitation rate.

In the paper of Anand Nayyar, Er. Vikram Puri on IoT Based Smart Sensors Agriculture Stick for Live Temperature and Moisture Monitoring using Arduino, Cloud Computing & Solar Technology [14], and this paper describes an IoT-based smart stick that allows monitoring on farming from different parameters. This stick indicates the farmer to get information about real-time temperature and soil moisture data. This agricultural IoT stick is a great way to move on a smart monitoring system with live feeds on different sensors. This monitoring system can be controlled with smartphones, tablets, laptops etc. and data can be stored in cloud computing which is the way to analyze those data by agricultural experts.

In the paper of Chandan Kumar Sahu and Pramitee Behera, A Low-Cost SmartIrrigation Control System.[1] The author offers a system where the direction and flow of water are controlled and monitored. The DHT11 and a soil moisture sensor are used to use it. This system also offers a way to choose the direction of flow of water, and this information is sent to the farmer's phone and email. And there has also options of switch on and off the motor using these related methods. This paper also approaches a prototype to implement several sensor nodes in numerous places all through the field. In this paper there also indicate about the proposed model enhances the effectiveness and reliability of the old irrigation system.

In the paper of Duan Yan-e, Design of Intelligent Agriculture Management Information System Based on IoT [2], the authors proposed an IoT application that uses data via wireless sensors to give agricultural and crop information to the farmers. These methods ensure a suitable range of fertilizing on that land for specific crops. In this way, the cost of extra fertilizer is minimized, so only the amount needed for healthy plant growth is properly, leading to more production.

In another paper by F. Karim, F. Karimb and A. Frihidab, a Monitoring system using the web of things in precision agriculture [3], and IoT application is described that uses WSNs (Wireless Sensor Networks) and a monitored interface to develop an alerting system that controls plant water stress. The objectives are accomplished by monitoring the impact on soil conditions, and the system informs the farmer via SMS when a certain threshold is reached. In, a tricky IoT application in irrigation technology is described. The system's main objective is to create an IoT-based platform for precision irrigation that deals with issues such as adaptability, deployment, and complexity by using cameras, actuators and ZigBee models to resolve problems as adaptability, deployment, and complexity.

Most of those papers are on monitoring and some of them are on prediction and it is also noticeable that the farmers alert is based on GPS mobile net or Bluetooth module and a very small number of Wi-Fi modules. Our approach is to connect with a live server and from anywhere with internet users or farmers can access and monitor all the things. And also control manual irrigation system manually.

2.2 Scope of the problem

Our approach system is like a prototype but we are trying to represent it in a very realistic way. Moreover, we have to face some problems, some of them are ignorable and some of them are not.

1. We use two different API tokens with our implantation code which needs more delay time to load properly.
2. We use NodeMCU, for several time of motor on and off NodeMCU does not work properly and need to restart.
3. Sometimes soil moisture does not give appropriate value.
4. Blynk app still not totally stable for that need delay before a command.

2.3 Challenges

Our approach system is based on IoT which means we have to focus on both hardware and programmable code. In hardware, we need to deal with sensors and devices and we are using NodeMCU, for this development board we need to implement code with Arduino IDE. In code two different API tokens of different servers, one to store all of our data and another is for controlling the system with a mobile phone. In a data server, the main factor is to visual data in public channels and analysis with MATLAB to return crop names conditionally.

CHAPTER 3

System Requirement and Methodology

3.1 Introduction

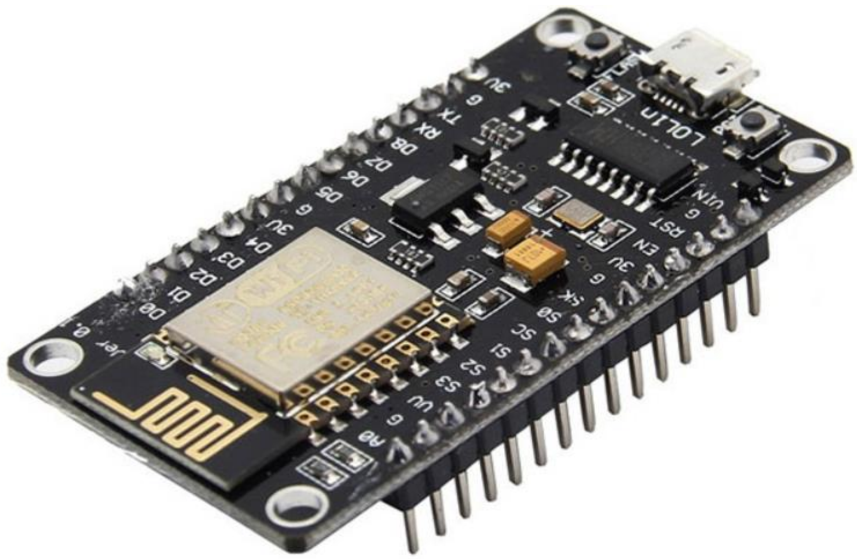
In this system requirement and methodology chapter, we will try to discuss about our approach system's hardware devices, methodology and data process parts.

3.2 Requirements

1. NodeMCU with ESP8266
2. DC Motor
3. One Channel Relay Module for DC motor
4. Battery – 9v
5. DHT11 – Temperature and Humidity Sensor
6. FC-28 or YC-69 Soil Moisture sensor
7. Jumper Wires
8. Bread board
9. Arduino IDE
10. Android Phone

3.2.1 NodeMCU

NodeMCU is one kind of development board with some features, it is a combination of microcontroller, Wi-Fi module, microprocessor and some necessary pin to control and manipulate IoT devices. In NodeMCU we need to implement code with Arduino IDE to develop a system or program.



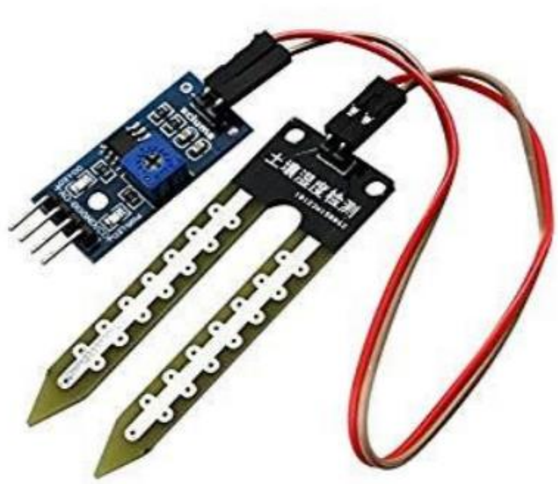
3.2.1 Fig:NodeMCU

NodeMCU Specification

Microcontroller	Tensilica 32-bit RISC CPU Xtensa LX106
Serve Voltage	3.3V
Input Voltage	7-12V
Digital I/O Pins (DIO)	16
Analog Input Pins (ADC)	1
UARTs	1
SPIs	1
I2Cs	1
SRAM	64 KB
Flash Memory	4 MB
Clock Speed	80 MHz

3.2.2 Soil Moisture Sensor

In this sensor there have electrodes parts, when these electrodes get a slight charge then electrical resistance happens and get a rate of that resistance. If the sensor is pulled from soil, the resistance rate increase and shows maximum value. In the soil, it reduces resistance by getting water level and the value decrease.[4]



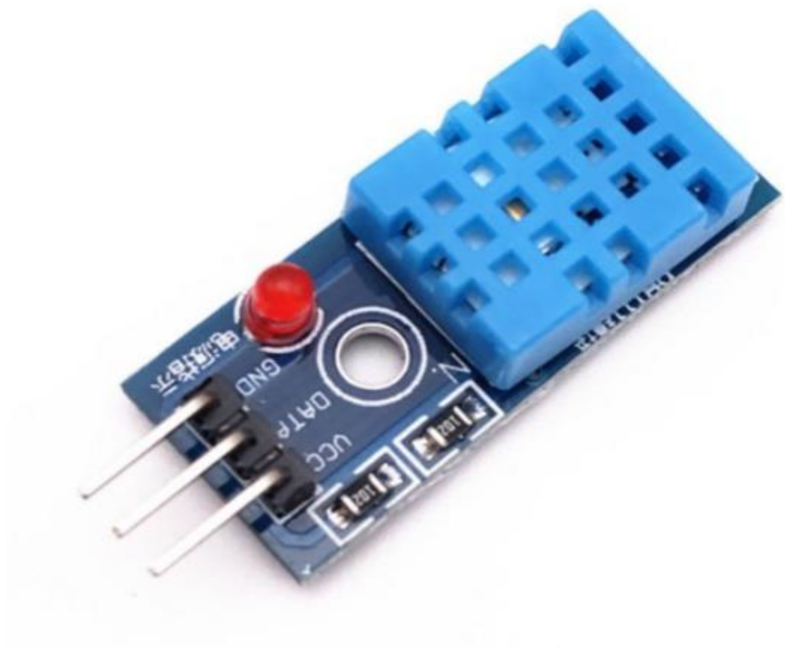
3.2.2 Fig: Soil Moisture Sensor

Soil moisture sensor specification

Voltage	3.3V – 5V
Operating Current	20 mA
Operating Temperature	10ºC to 30ºC
PCB Size	3cm x 1.5cm
Moisture	0~100%, 8-bit

3.2.3 DHT11

The DHT11 is a digital temperature and humidity sensor. It measures humidity and temperature of a certain area with a capacitive humidity sensor and a thermistor. It output can read with digital pin (no need analog input pins to read data). It is simple to use, and have library to program in a system easily.



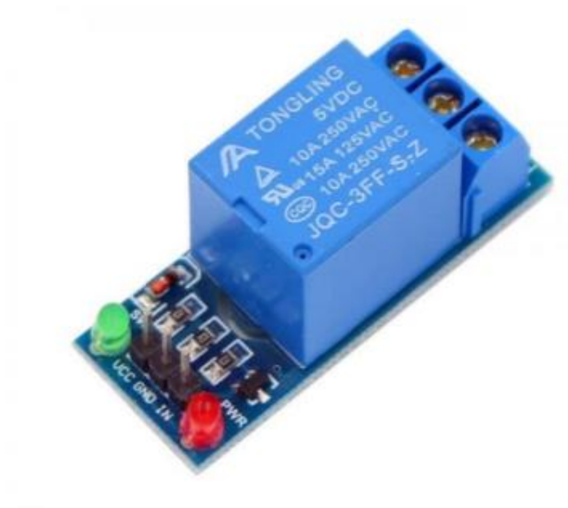
3.2.3 Fig: DHT11 Sensor Module

DHT11 Module specification

Operating Voltage	3.5 V to 5.5 V
Operating current	0.3 mA (measuring), 60 uA (standby)
Output	Serial data
Temperature Range	0°C to 50°C
Humidity Range	20% to 90%
Resolution	Temperature and Humidity both are 16-bit
Accuracy	±1°C and ±1%

3.2.4 Relay Module – 1 Channel, 5V

Basically, relay is one kind of switch but can control with very low volt. Main it has an electromagnet coil to on off switch. When a relay get signal is open the switch with magnetic coil, and when can't get signal it reverse the magnet. Relay module is the setup with relay with features port to connect wires.



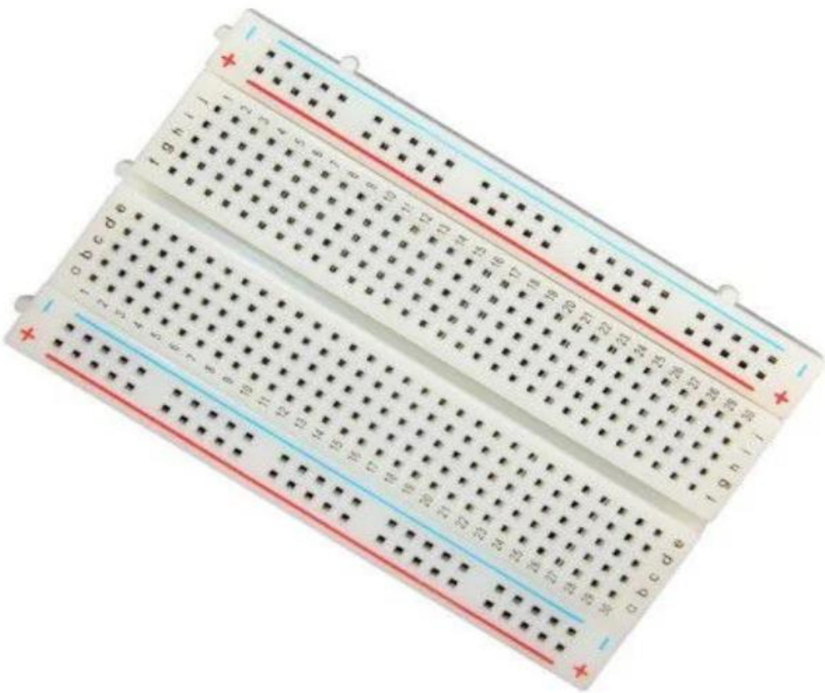
3.2.4 Fig: Relay Module

Relay Module Specification

Control Voltage	5V DC
Relay Contact Current Capacity at AC250V	10A
Relay Contact Current Capacity at DC30V	10A
Max. switching current	20mA
Size	43mm x 17mm x 17mm
Operating Temp	-40 °C to 80 °C
Humidity	35% to 80%RH

3.2.5 Breadboard

Breadboard is one kind of development board which is used to implement electronics components like resistor, transistor, LED, dc motor, Arduino, NodeMCU etc. It is very useful to connect jumper wires with those electronics components.



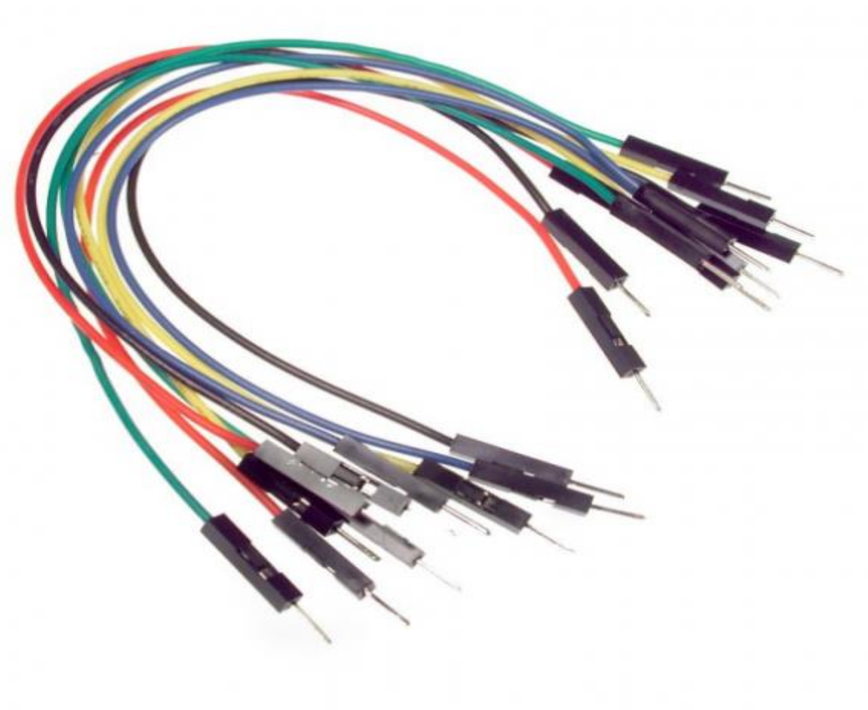
3.2.5 Fig: Breadboard

Breadboard Specification

Type	Plug-in breadboard
Dimensions	3.29 x 2.15 x 0.33″ (83.5 x 54.5 x 8.5mm)
Self-Adhesive 400 Points breadboard	Also known as half size breadboard
Voltage	5-15 V
Current	1 A
Material	Phosphor bronze nickel plated

3.2.6 Wires

Jumper wires are used to connect electronics components with breadboard development board. There are some kind of jumper wires, male to male, female to female, female to male etc.



3.2.6 Fig: Jumper Wire

3.2.7 DC Water Pump Motor

DC (direct current) motor is an electric machine that converts electrical energy into mechanical energy. That means it converts the direct current flow into mechanical rotations. There are some levels of DC motor on based of voltage flow like 3v, 5v, 6v etc.

3.2.7 Fig: Water Pump Motor

Water Pump Motor Specification

Operating Voltage	3 to 6 V
Operating Current	130 to 220 mA
Flow Rate	80 to 120 L/H
Maximum Lift	40 to 110 mm
Continuous Working Life	500 hours
Driving Mode	DC, Magnetic Driving
Material	Engineering Plastic
Outlet Outside Diameter	7.5 mm
Outlet Inside Diameter	5 mm

3.3 Methodology

Our system will collect data from the field with sensors (temperature, soil moisture, air humidity).

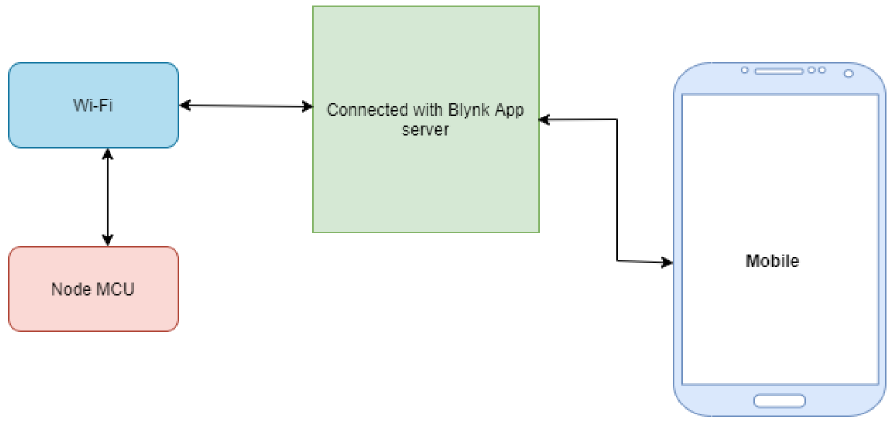
The code was implemented with Arduino IDE. When soil moisture reaches a certain value, the water pump will be started and when it reaches proper value, it will turn off the water pump automatically for particular crops. The value will be set on the program as per which crops the farmer planted.

This whole system will be connected with a cloud server (ThingSpeak) using API to visualize data. So that, a farmer can monitor and view all the values of temperature sensors, soil moisture sensors, air humidity with this cloud server's visual part with any browser. Here we analyze all data that we get and find out the median value of temperature, air humidity and show those values in the visual part of that site. From those median values, we can make conditions to match with crops values so that we can get crops name that are suitable for that weather. The median values will be matched with some value of crops to get which crops can be perfect with this field (from BAMIS we can get the needed value).[5]

And most importantly farmers can control irrigation systems manually with the android app Blynk.

3.3.1 Blynk

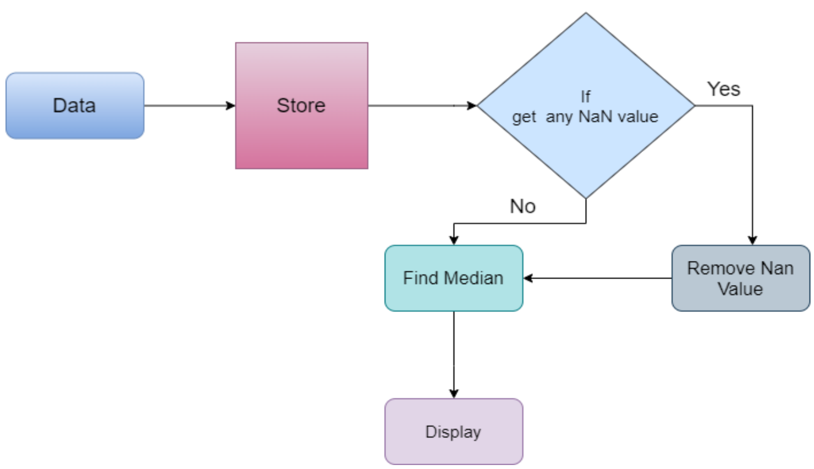
Blynk is a mobile platform that provides applications for iOS or Android devices to control different microcontrollers like Arduino, NodeMCU etc. The library and sever of Blynk is open source. It connects the system board with the mobile app through an API token. Therefore, the system connects with the server of Blynk and at the same time, the mobile app connects with the Blynk server respect with the same API token. This is how the Blynk app connected with the system. From anywhere it is possible to control the system through the internet.



3.3.1 Fig: Blynk Server Diagram

3.3.2 ThingSpeak

ThingSpeak is an open-source IoT and cloud platform for live visual data and provides MATLAB capability for analysis. To connect this cloud server with the system or IoT devices need a unique API key. Through this API key module or system can upload sensors data into that server and this ThingSpeak server shows those data in different visual ways. ThingSpeak also connects with MATLAB ide, so with those data users can predict or do the calculation with MatLab libraries. For every system, there have different channels and this channel can be public and private. With public channel mode, anyone can visualize and monitor data from anywhere with the internet.

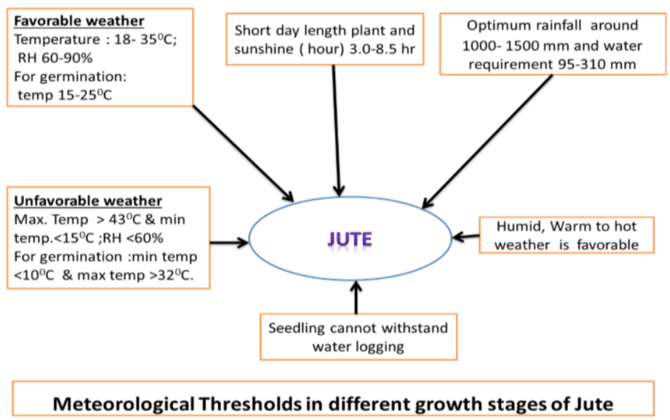


3.3.2 Fig: ThingSpeak Server Diagram

3.3.3 BAMIS

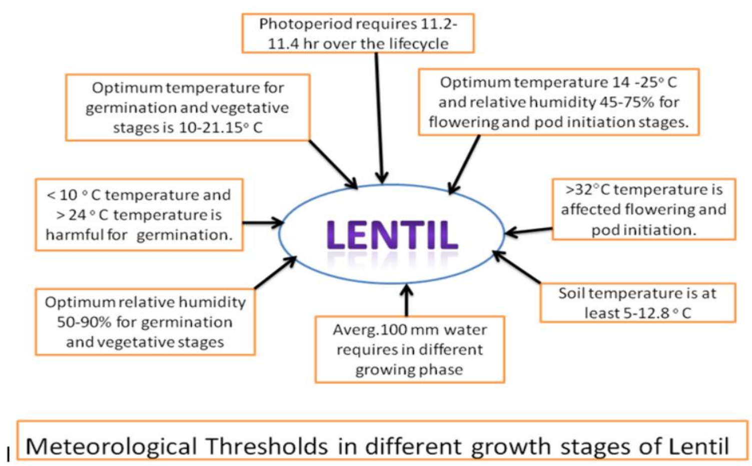
The full meaning of BAMIS is Bangladesh Agro-Meteorological Information Portal. This agro meteorological site contains weather and important information about major crops. From this site, we collect data that we needed.

Jute [6]



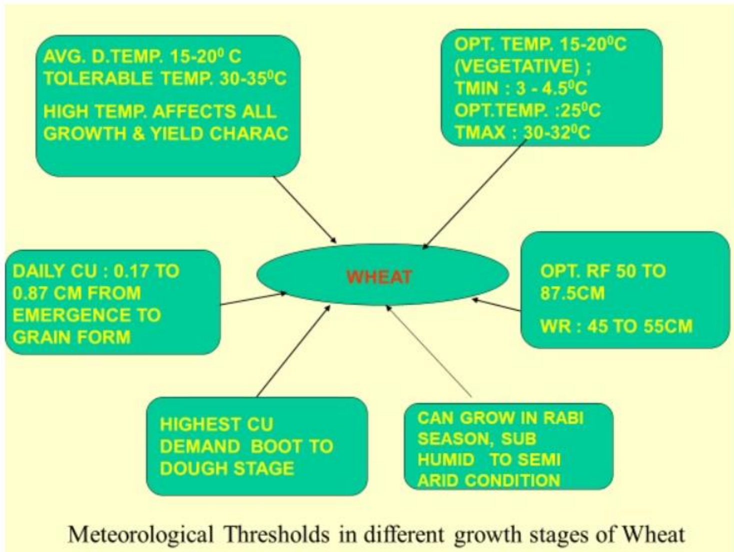
3.3.3.1 Fig: Data of Jute

Lentil [7]



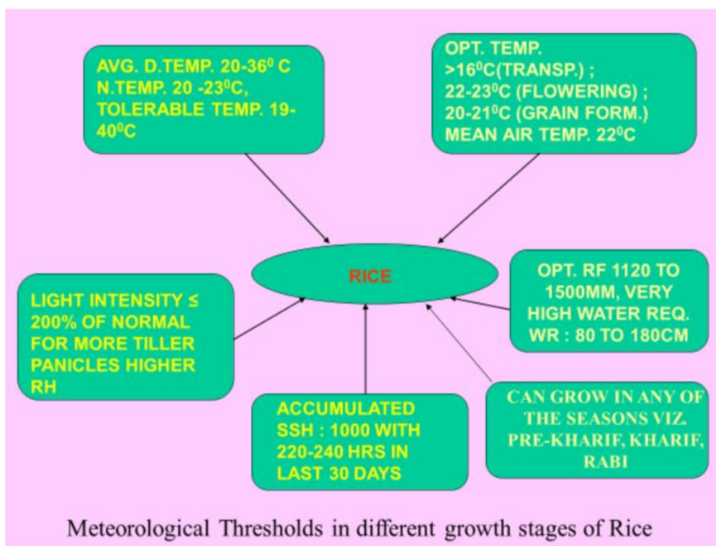
3.3.3.2 Fig: Data of Lentil

Wheat [8]



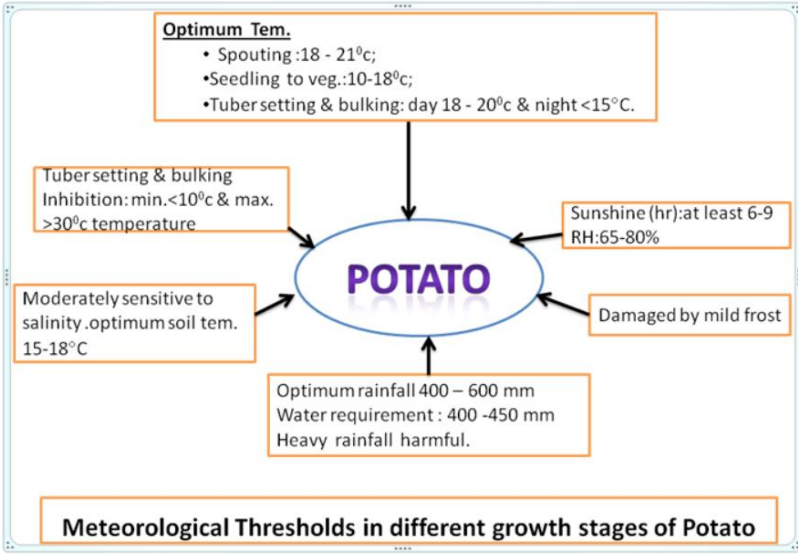
3.3.3.3 Fig: Data of Wheat

Rice [9]



3.3.3.4 Fig: Data of Rice

Potato [10]



3.3.3.5 Fig: Data of Potato

So we select five major crops of Bangladesh to develop condition for our predict algorithm. From those references, we gather all valid data for our final implementation.

Table of crops data with Temperature and Humidity:

Crop Name	Average Temperature (°C)	Average Humidity
Wheat	15-20	Less than 65
Paddy	20-36	Greater than 66
Potato	18-21	65-80
Lentil	14-25	45-75
Jute	18-35	Greater than 60

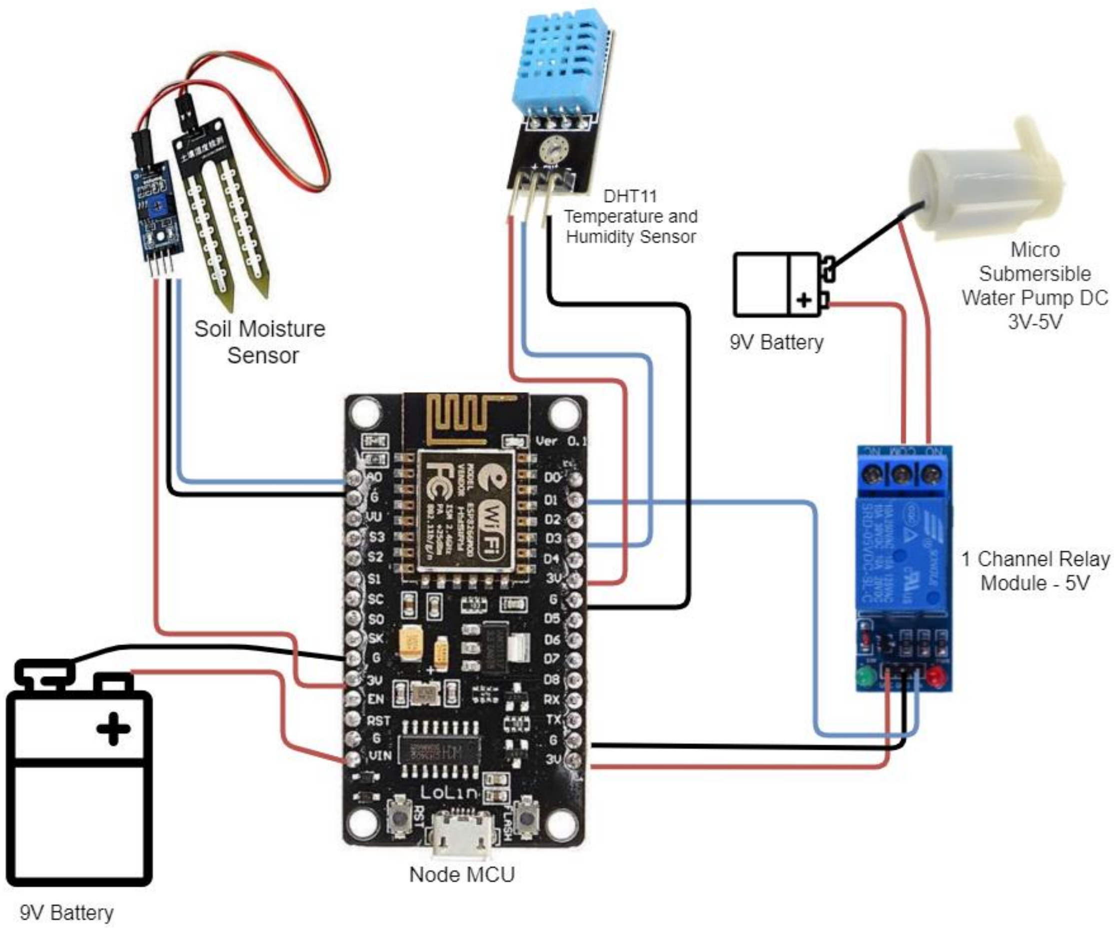
CHAPTER 4

Structure Design, Implementation and Review

4.1 Introduction

In this section, we will try to show the implementation methods, circuit diagram, flow chart, block diagram, code review and algorithm that we use.

4.2 Circuit Design



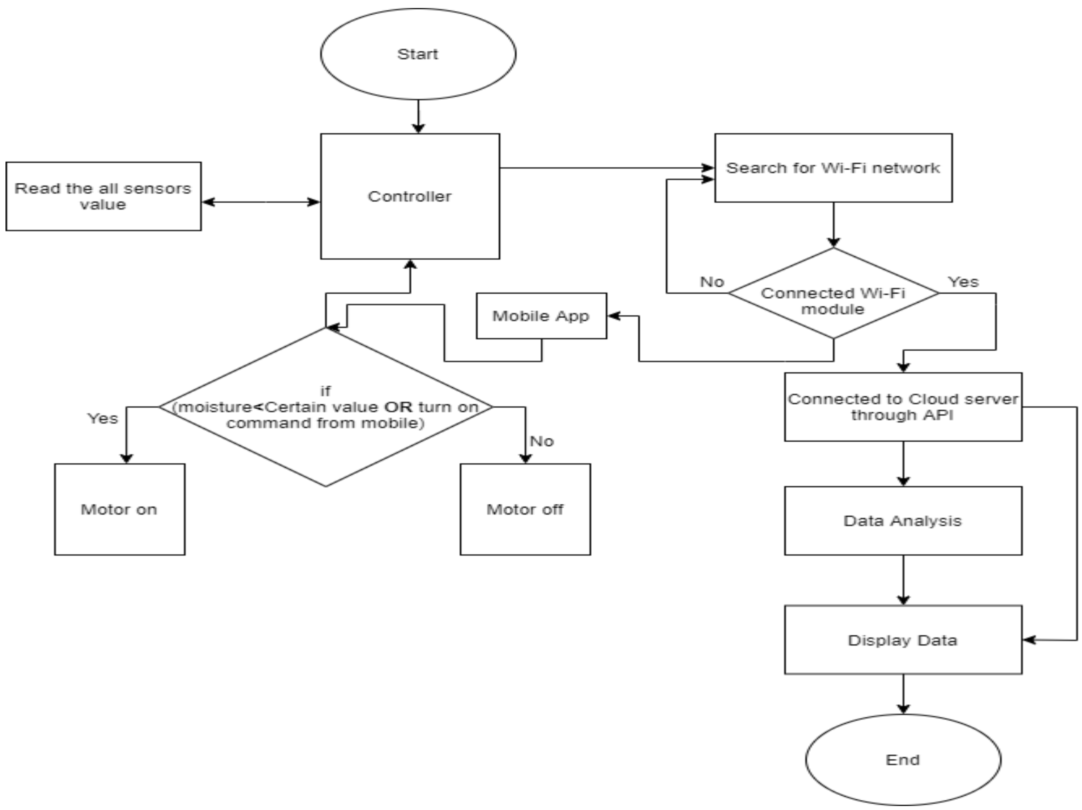
4.2 Fig: Circuit Design

In circuit diagram, it represents our whole project circuit connection. We used two batteries, one for powering the Node MCU and another is for the motor. With the motor, we need to use a relay module otherwise it will damage our NodeMCU board. And soil moisture and DHT11 sensor are power-up generally from Node MCU and connect and share signal and data from specific pins.

4.3 Features

1. Read temperature.
2. Read humidity of air.
3. Read soil moisture value.
4. Sent data into cloud server.
5. Automatic system to turn on and off motor.
6. Manual system to turn on and off motor with android phone from anywhere.

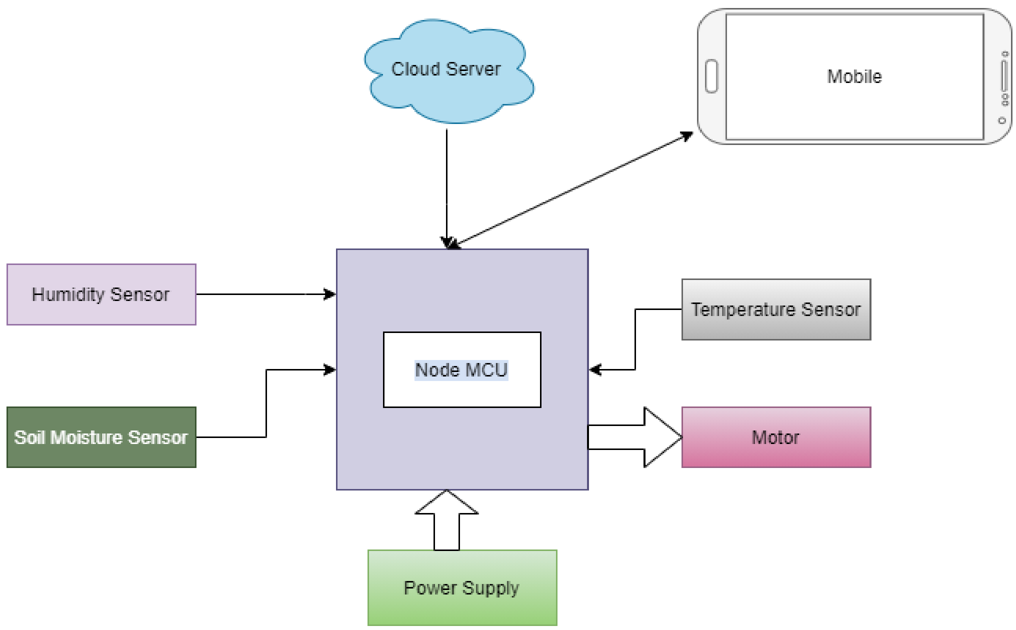
4.4 Flow Chart



4.4 Fig: Flow Chart

As per the flow chart, we can start our flow chart, first of all, read data from all sensor, then the data will go to the controller, the controller work as a processor, when data will go, the data controller, then first motor on or off and motor on or off will be 2 way. The first way which data are collected for moisture if less than the data a certain value then motor on. On the other hand, cannot get a certain value then motor off. Also, the motor can be controlled with the mobile app. So for this first connected a network. When the network will be connected the mobile app server starts working. Then we can command for motor on or off as manually. There is visual data analysis or data display for this search Wi-Fi when getting Wi-Fi then connected Wi-Fi module. In the meantime connected to a cloud server through API. Then if want to display data we can do this way. Alternatively, data analysis to do. Then display data and end of the system.

4.5 Block Diagram



4.5 Fig: Block Diagram

In that, diagram a power supply supplying power to Node MCU. Humidity sensor, soil moisture sensor, temperature sensor they all sense data and send those data to Node MCU. If those data match with our algorithm then it will be on the motor, otherwise it will remain off the motor. We have a cloud server, we communicate mobile and the Node MCU through this cloud server. From the mobile we can controlled the motor through Node MCU.

4.6 Algorithm

We implement our program in Arduino IDE. This system is a continuous process. The basic algorithm pseudo given below,

System Algorithm

Step1 - Connect with cloud server and Blynk server.

Step2 - Read sensors value if fail then retry.

Step3 - Server connection ok then Upload data and go to Step5.

Step4 - Server connection not ok then retry.

Step5 - If automatic mode off then go to Step12.

Step6 - If automatic mode on then go to Step7.

Step7 - If moisture value >= 1020, motor off with relay command.

Step8 - Else if moisture value < 1020 && moisture value >= 600, motor on with relay command.

Step9 - If moisture value < 700 && moisture value >= 370, ok.

Step10 - Else if moisture value < 370, motor on with relay command.

Step11 - Go to Step2.

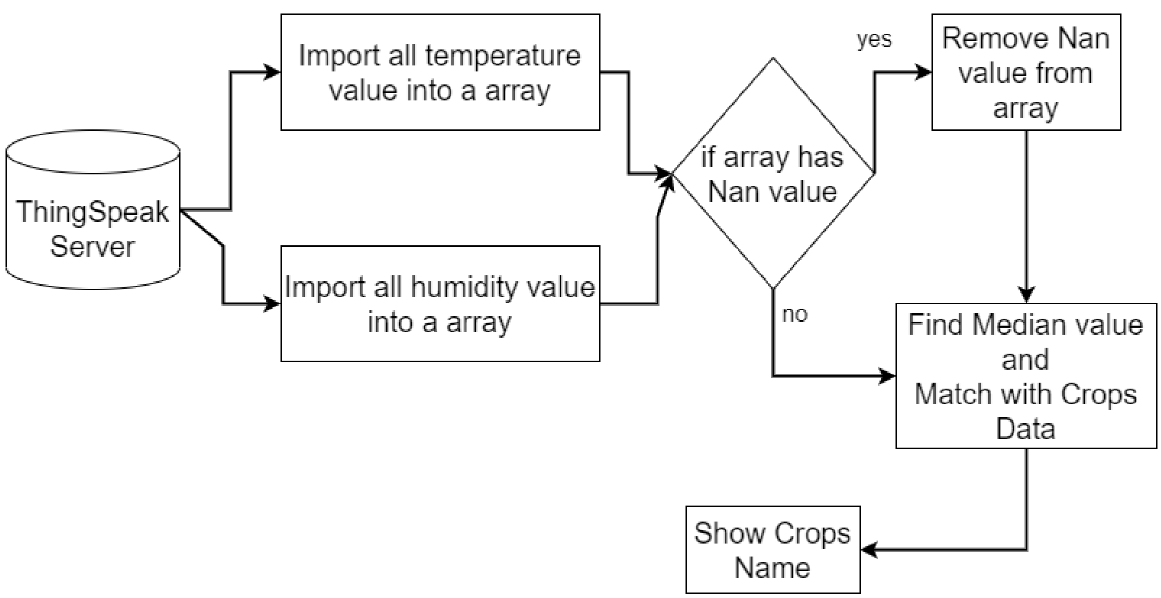
Step12 - If virtual pin is high then turn on motor with relay command.

Step13 - If virtual pin is low then turn off motor with relay command.

Step14 - Go to Step2.

ThingSpeak MATLAB - For finding **median value** of temperature and humidity,
We used to find median value for simple prediction. There have also some methods like, find average value, mean value.
If one day's temperature is very high or very low then result has very high effect on that. However, it is not good to predict. In median value is more accurate because it return the middle value from the whose data set, which is more appropriate for prediction.

Step1 – Read value from channel id and store in a new array.
Step2 – If array has no Nan value then go to Step4.
Step3 – Remove Nan values from array.
Step4 – Sort array.
Step5 – If array size is odd then go to Step7.
Step6 - If array size is even then go to Step9.
Step7 – Median value is ((array size + 1) / 2)th value of the array.
Step8 – Median value is ((array size/2)th + ((array size/2)+1)th value of the array) / 2
Step9 – return median value



4.6 Fig: MATLAB analysis flow diagram

4.7 Code Review

4.7.1 Main Program - Program code implemented in Arduino IDE.

For this system, we need some library to use function. Here we need to include header file for DHT sensors open-source library as DHT.h and for our NodeMCU's Wi-Fi module and its activity control we need to include ESP8266WiFi.h header file. And for Blynk app's control and commination properties we need to include its library header file BlynkSimpleEsp8266.h for ESP8266 Wi-Fi module.

After that, we define the sensors pin number in respected variables. For DHT sensor we define 0 as a GPIO 0 pin which is NodeMCU's 3no pin.[11] We use flag variable to check automatic and manual mode for the system. With apiKey we assign the API write key for ThingSpeak server. And ssid and pass contains a routing network to connect for internet service. Auth variable contails the API key for Blynk app server.

WiFiClient function is an Arduino based library function for esp8266 to check properties of connecting specific IP address and port. We need to check the connection port to create condition. If we get server as 80 then it is sure the internet connection of Wi-Fi module is ok. Otherwise not.

In Arduino the main two function is loop and setup. We setup all necessary things like whose pins are OUTPUT and whose are INPUT. The baud rate of serial monitor, devices initializing command. Setup internet connection and so on.

BLYNK_WRITE is for blynk app functions. In parameter we put the virtual variable that we define it in the mobile app to switch HIGH or LOW pulse. This function get which value get from that variable.

WidgetLED function is also for Blynk app, which write the state of LED in the app. It can control from program to app blink.

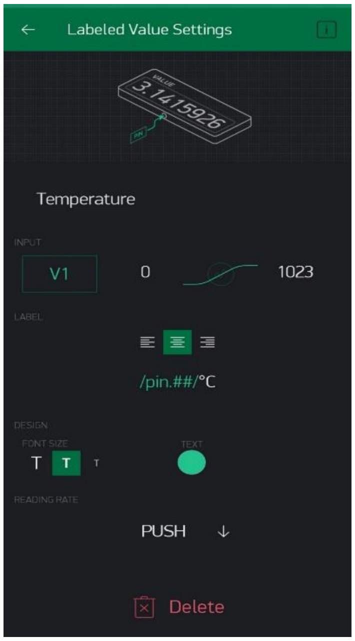
In loop function here is the main part of program that written. Blynk.virtualWrite used to read value in to specific virtual pin for blynk app display.

We implement code as follow the algorithm that we designed.

4.7.2 **ThingSpeak MATLAB -** Code of MATLAB analysis

To get data from ThingSpeak server we used thingSpeakRead function, which contains some specific syntax value in the parameter of it. To clean Nan value we used matlab-insider array function. To find median value we used median function of python matlab. It follow the same algorithm that we mentioned before.

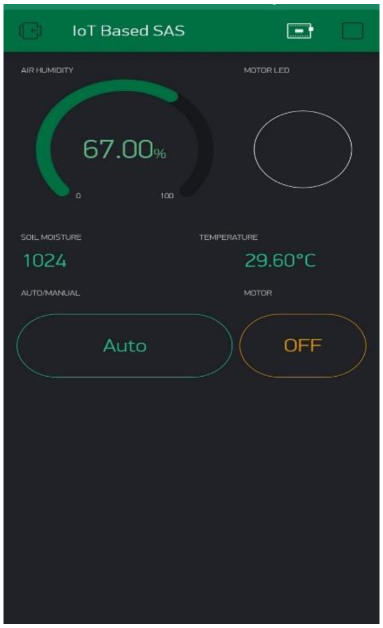
4.8 Interfaces of Blynk App



4.8 Fig: Blynk App setup

This interface is for setup Temperature API pin with Blynk server. Through this pin it will fetch temperature data from server that are store real time from sensor.

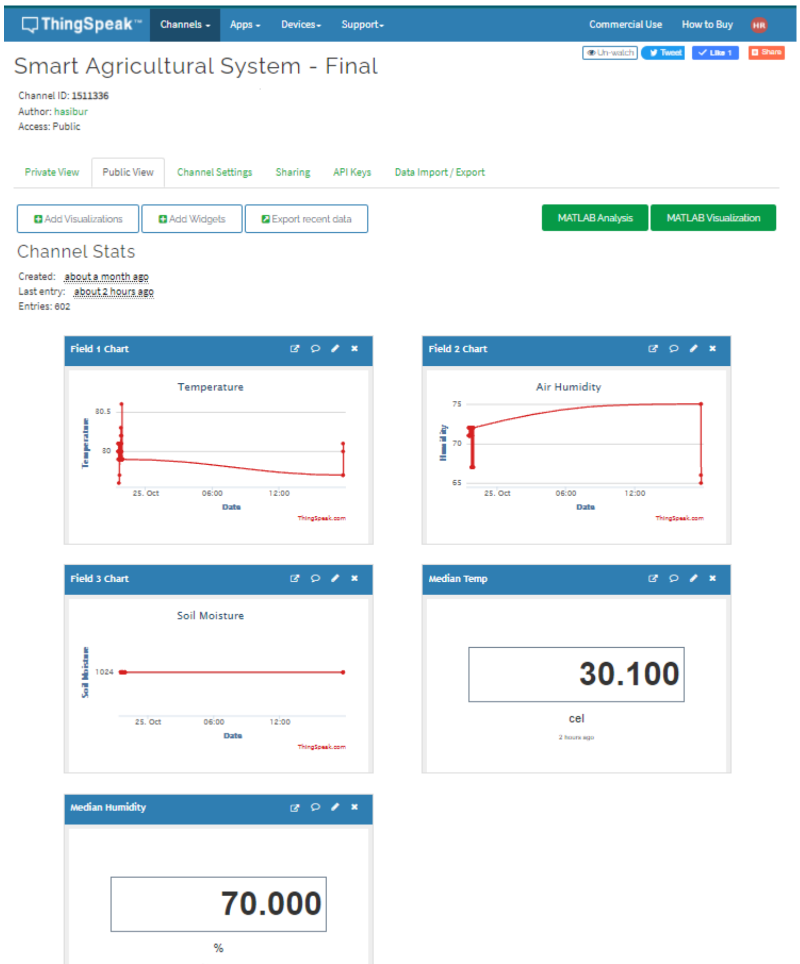
Blynk App Main Control and Monitoring Interface



4.9 Fig: Blynk App Main Interface

This is the main interface to control and monitoring full project. Here it will show real-time Temperature value, humidity value and motor status with LED indicator. Most importantly with auto/manual button, it can be controlled from this interface when the project is run.

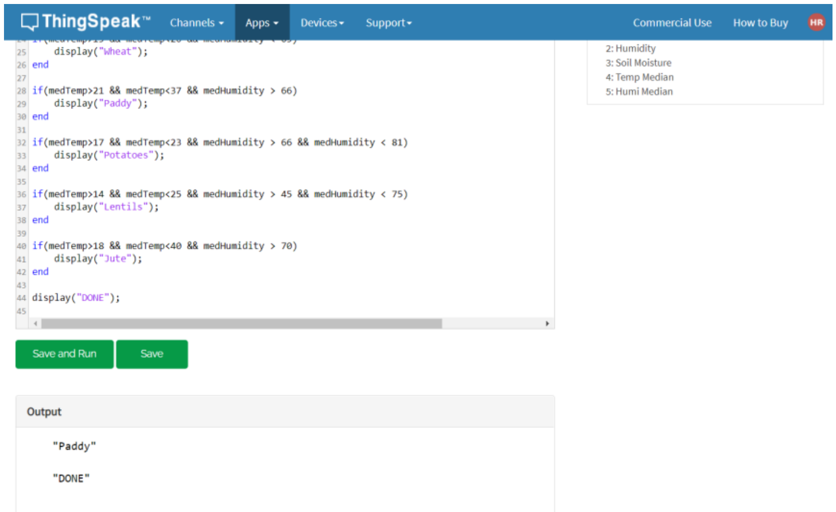
4.9 In ThingSpeak Server



4.9 Fig: ThingSpeak Server Main Interface

This is the main interface of ThingSpeak server where user can show visual of store data. All of data of temperature, humidity, soil moisture rate can be shown from here. Also from this server we can use calculation with our data to predict something.

4.10 Output of MATLAB



4.10 Fig: MATLAB Output

We store simple data of temperature and air humidity different days and get a result. After press save and run button, our algorithm will fetch data from server and find median value of temperature and air humidity and match with crops data. After matching one or more crops it will return one or more crops name that are suitable for this specific field.

CHAPTER 5

Limitation, Impact on Society, Environment and Sustainability

5.1 Limitation

In every devices, there have some limitation and our system has some limitation too.

1. In our system we used NodeMCU, for long time uses its can be damaged.
2. For Wi-Fi module ESP8266 it shows some data transfer problem for heavy use. We used two API to transfer and connect data, so we need delay between two operations.
3. Sometime soil moisture sensor value show wrong for some seconds.

There is no system that is 100 per cent accurate. Our system has those limitations but when we think of a major percentage, it is the very negotiable percentage of limitation and has good devices with the same approach. There are many sensors at different prices with good performance.

5.2 Impact on Society

It will definitely have positive impact on our society. Because by using our project people can monitor his land easily, that is why he will get more time for his other work. As a result, we need less labor to monitor land. Therefore, we can use this labor for other work and world can develop faster. In addition, we also can save our water and electricity from this approach.

5.3 Impact on Environment

Actually the impact of our project in environment is nor positive or negative. Chemical products have a lot of bad impact on the environment, which can be seen as a lot of damage to the environment. However, our project did not use any chemical products. Therefore, the environment will not have any effect on our project.

5.4 Ethical Aspects

On the view of ethical aspects, there can be arise about data accessibility, about electric power or unemployment of farmers.

This approach model is very controllable to make data private and public. In the matter of electricity because of our devices are run through current, in this fact every farming there need specific electricity and our approach is not very much consuming of electricity.
In the matter if unemployment of farmers because of automated system there need less farmer though but not too much less. Because our approach about irrigation and monitoring system that not affect unemployment of farmers.

5.5 Sustainability Plan

For sustainability, we need to implement this into real life project and encourage farmer for use this project. Specific and good quality of sensor are important to sustain the system we need to make sure that the farmer can buy this project easily. User-friendly interface makes more sustainability of uses. At last, need to always trying to update this project with better features.

CHAPTER 6

Conclusion and Future Scope

6.1 Conclusion

This project approaches the idea and implementation methods of the farmers to easy monitor way with smartphones. It extends with an automatic irrigation system. Moreover, the system can be controlled manually too. All of the sensors data can be stored in a cloud server and data can be analyzed by MATLAB to get the median value of temperature and air humidity to match with expected crops for the land. This method towards to a simple prediction that which crops is suitable for that land. Though this has some limitations because of devices, moreover it results in more effectiveness and productivity. This project can be one-step easy way to the footsteps of digitalizing on agriculture and smart agriculture.

6.2 Future Scope

Our system is a total fulfil system but it can be more efficient and more dynamic if we could add some methods,

1. We can use soil pH sensor. For crops, we need soil moisture rate and it can be more effective if we get pH level also.
2. If we can collect some valid data with temperature and humidity rate that will be a scope to implement machine learning approach.

CHAPTER 7

REFERENCES

References:

[1] P. B. Chandan Kumar Sahu, "A low cost smart irrigation control system," *Electronics and Communication Systems (ICECS),* pp. 1146 - 1152, 2015.

[2] D. Yan-e, "Design of Intelligent Agriculture Management Information System Based on IoT," in *2011 Fourth International Conference on Intelligent Computation Technology and Automation*, Shenzhen, China, 2011.

[3] F. K. A. F. Foughali Karim, "Monitoring system using web of things in precision agriculture.," in *Cognition and Ontology of GeoSpatial Systems, National Engineering School of Tunis, University Tunis El Manar, Tunisia.*, Tunisia, 2017.

[4] J. S. O. S. B. David J. Sample, "Understanding Soil Moisture Sensors: A Fact Sheet for Irrigation Professionals in Virginia.," in *Virginia Cooperative Extension - Publication BSE-198P,* Virginia, 2016.

[5] Bamis, "CROP Thresholds," [Online]. Available: https://www.bamis.gov.bd/en/thresholds. [Accessed 2 August 2021].

[6] Bamis, "CROP WEATHER INFORMATION - JUTE.," [Online]. Available: https://www.bamis.gov.bd/en/thresholds/1/all/10/. [Accessed 2 August 2021].

[7] Bamis, "CROP WEATHER INFORMATION – LENTIL.," [Online]. Available: https://www.bamis.gov.bd/thresholds/1/all/58. [Accessed 2 August 2021].

[8] Bamis, "CROP WEATHER INFORMATION – WHEAT.," [Online]. Available: https://www.bamis.gov.bd/thresholds/1/all/9. [Accessed 2 August 2021].

[9] Bamis, "CROP WEATHER INFORMATION - RICE.," [Online]. Available: https://www.bamis.gov.bd/thresholds/1/all/76. [Accessed 2 August 2021].

[10] Bamis, "CROP WEATHER INFORMATION - POTATO.," [Online]. Available: https://www.bamis.gov.bd/thresholds/1/all/52. [Accessed 2 August 2021].

[11] S. S. Rui Santos, "ESP8266 Pinout Reference: Which GPIO pins should you use?," [Online]. Available: https://randomnerdtutorials.com/esp8266-pinout-reference-gpios/. [Accessed 6 July 2021].

[12] M. A.-U. Z. S. A. M. E.-H. M. A. Muhammad Ayaz, "Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk," *Institute of Electrical and Electronics Engineers (IEEE),* vol. 7, pp. 129551 - 129583, 2019.

[13] A. Meola, "Smart Farming in 2020: How IoT sensors are creating a more efficient precision agriculture industry.," in *Businessinsider,* , 2021.

[14] V. P. Anand Nayyar, "Smart farming: IoT based smart sensors agriculture stick for live temperature and moisture monitoring using Arduino, cloud computing & solar technology," in *The International Conference on Communication and Computing Systems*, 2016.