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SMART FARMING SYSTEM FOR WHEAT CROP

COLLEGE OF
ELECTRICAL AND MECHANICAL ENGINEERING
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COLLEGE OF ELECTRICAL AND MECHANICAL ENGINEERING

DE-41 EE
PROJECT REPORT

SMART FARMING SYSTEM FOR WHEAT CROP

Submitted to the Department of Electrical Engineering
in partial fulfillment of the requirements
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in
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Sponsoring DS: **Submitted By: HAFSA**

CERTIFICATE OF APPROVAL

It is certify that the Project "Smart Farming System of Wheat Crop" was done by NC Hafsa under the supervision of Dr. Naeem ul islam

This project is submitted to the Department of Electrical Engineering, College of Electrical and Mechanical Engineering, National University of Sciences and Technology, Pakistan in partial fulfilment of requirements for the degree of Bachelor of Engineering in Electrical Engineering.

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Dr. Naeem ul Islam

DECLARATION

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I am thankful to my parents who are always there to support and encourage me throughout my all bachelor's study, specially the support and guidance they give me in this project completion process can never be forgotten. Thankyou Papa and Ammi.

I am hopeful this project will be valuable in Agriculture Sector of Pakistan and help us furnish our agriculture system.

ABSTRACT

The rapid advancement in technology has led to the development of fully automated systems that can communicate with each other, making processes more efficient and streamlined. The growing demand for efficient and sustainable agriculture practices, there has been an increasing focus on integrating advanced technologies into the farming industry. This project presents a state-of-the-art Intelligent IoT-based Automated Irrigation System that has the potential to revolutionize conventional agriculture in Pakistan. The system utilizes various sensors, including humidity, temperature, soil moisture and pH sensors, to collect real-time data of the wheat crop and that is then transmitted to a Raspberry Pi3 for analysis of threshold values at each crop stage. The real time values from the sensors will then check threshold and will predict the optimal soil conditions for irrigation of wheat crop, which will alert the farmer through Thing Speak Channel and GUI. The system also provides farmers with real-time updates on the irrigation status, offering them greater control over the irrigation process. Our proposed Smart Farming System offers an efficient, reliable, and cost-effective solution for smart farming for wheat crop production. This proposed system has a high demand in the agriculture industry due to its reliability, efficiency, and cost-effectiveness, which can significantly improve crop yield and enhance agricultural sustainability. Additionally, we present the results of our performance evaluation, demonstrating the system's feasibility and effectiveness. Our research aims to contribute to the sustainable development of agriculture, optimizing the use of resources and enhancing the global food supply chain.

SUSTAINABLE DEVELOPMENT GOALS

This proposed system will surely be high demanding in agriculture sector due to its reliability, efficiency, and cost-effectiveness, which can significantly improve crop yielding and enhance agricultural sustainability. This research also falls in Sustainable Development Goals (SGG's) set by a unanimous National Assembly Resolution in 2016. We have targeted 05-five Sustainable Development Goals in this project as:

1) Zero Hunger
2) No Poverty
3) Decent-work and Economic-growth
4) Responsible Growth and Consumption
5) Life on Land

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Chapter 1 – INTRODUCTION

Agriculture has always been a vital component of human existence, producing food, nutrients, and other essential resources. It has been the backbone of many economies around the world for centuries. With the advent of technology, there has been a paradigm shift in traditional farming practices towards modern and smarter ways. Smart farming, an emerging field of agriculture, aims to use technology and data to enhance farming efficiency, productivity, and sustainability. It necessitates the application of cutting-edge technologies such as the Internet of Things (IoT), artificial intelligence (AI), and bigdata analytics, to optimize crop yields, minimize resource wastage, and reduce the environmental impact of farming.The focus of this research is on wheat crop and smart farming practices for this crop. Wheat is one of the most widely cultivated cereal crops in the world and a staple food for many countries. However, traditional farming methods for wheat have been found to be inefficient, leading to reduced crop yields, increased resource wastage, and environmental degradation. Smart farming, with its innovative technologies and techniques, provides a promising solution to these challenges Wheat is a crucial staple crop worldwide, providing a significant source of nutrition and food security. Our proposed Intelligent IoT-based Automated Irrigation System is designed to collect real-time data from various sensors, including humidity, temperature, and soil moisture sensors, to ensure optimal crop conditions and promote efficient use of resources. The system then show the optimal soil conditions for irrigation, allowing the system to control the water pump accordingly. Furthermore, the system provides farmers with real-time updates on the irrigation status, providing them greater control over the irrigation process and enhancing their decision- making Wheat crops go through several growth stages. Each stage has specific water requirements, and failure to meet these requirements can significantly impact crop yield and quality. Our proposed system for wheat crop production has the potential significantly improve crop yield, reduce water usage, and enhance the overall sustainability of agriculture. The system offers a reliable, efficient, and cost-effective solution to address the challenges faced by conventional farming practices. Wheat is a staple crop that plays a crucial role in the global food supply chain, providing essential nutrients and food security to millions of people worldwide. To ensure optimal growth and yield of wheat, it is crucial to monitor the plant's growth stages and provide the necessary resources accordingly. Our proposed Intelligent IoT-based Automated Irrigation System collects real-time data from a range of sensors, including humidity, temperature, and soil moisture sensors, to monitor the plant's growth at various stages. The collected data is then transmitted to the Raspberry Pi3, which will be used to analyze the data and predict the optimal irrigation requirements at each growth stage. This system is designed to optimize the irrigation process for wheat production by providing precise amounts of water to the crop, ensuring optimal growth and resource efficiency. The proposed system offers farmers greater control over the irrigation process, allowing them to adjust the irrigation system to meet the wheat crop's specific needs at each growth stage, such as snowing, emergence, third leaf, and beyond. Moreover, the system provides real-time information to farmers, enabling them to make informed decisions and take prompt action, thus enhancing crop yield and productivity. This research paper aims to provide an in-depth analysis of the system architecture, the sensors, the Raspberry Pi3, and to predict the optimal irrigation requirements at different growth stages.

Chapter 2 – BACKGROUND AND LITERATURE REVIEW:

2.1 BACKGROUND:

In Pakistan, 60-70% of economy depends on agriculture and it safely be termed as spinal-cord of Pakistan and other agricultural countries. In Pakistan and most of other agricultural countries, the concepts of farming and irrigating crops are traditional and old inherited without the introduction of new concepts and latest technology.

The system of farming and irrigating crops in Pakistan and most of other agricultural countries requires new initiates with introduction of automated methods and latest technology. Lot of Research have so far been carried out in the world for bringing new technology in this sector of agriculture and irrigation.

The system utilizes various sensors such as: 1). Humidity sensor, 2).Temperature sensor, 3).Soil-moisture sensor and 4).pH sensor. All these sensors will collect real-time data of the wheat crop and send to Raspberrypi3 through Ardiuno Uno. A proper algorithm has been formed to monitor the data of theses sensors and send the required suggestions and current state of crop to the farmer through "Things-Speak-Channel" to work with GSM Module. If the soil-moisture values less than the threshold values, the system will automatically inform to farmer through "**Things-Speak-Channel**" and on "**GUI**".

This proposed system will surely be high demanding in agriculture sector due to its reliability, efficiency, and cost-effectiveness, which can significantly improve crop yielding and enhance agricultural sustainability.

2.2 LITERATURE REVIEW:

Several studies have already been conducted on smart irrigation systems for different crop

2.2.1 Intelligent IoT Based Automated Irrigation System

In Intelligent IoT Based Automated Irrigation System [3], they proposed a system with M2M communication. First they take data from Soil Moisture, Humidity and Temperature sensors through ardiuno, By serial communication they send this data from ardiuno to Raspberry pi.

In Pi3 algorithm been deployed for monitering soil conditions i.e dry, little dry, little wet and wet according to temperature and soil moisture level. The predicted output then send signal to ardiuno to turn-on the water pump accordingly. Lastly the recorded values of soil moisture, temperature level and predicted result send to cloud server for better access of farmer. Data flow diagram is shown in **Figure 1.**

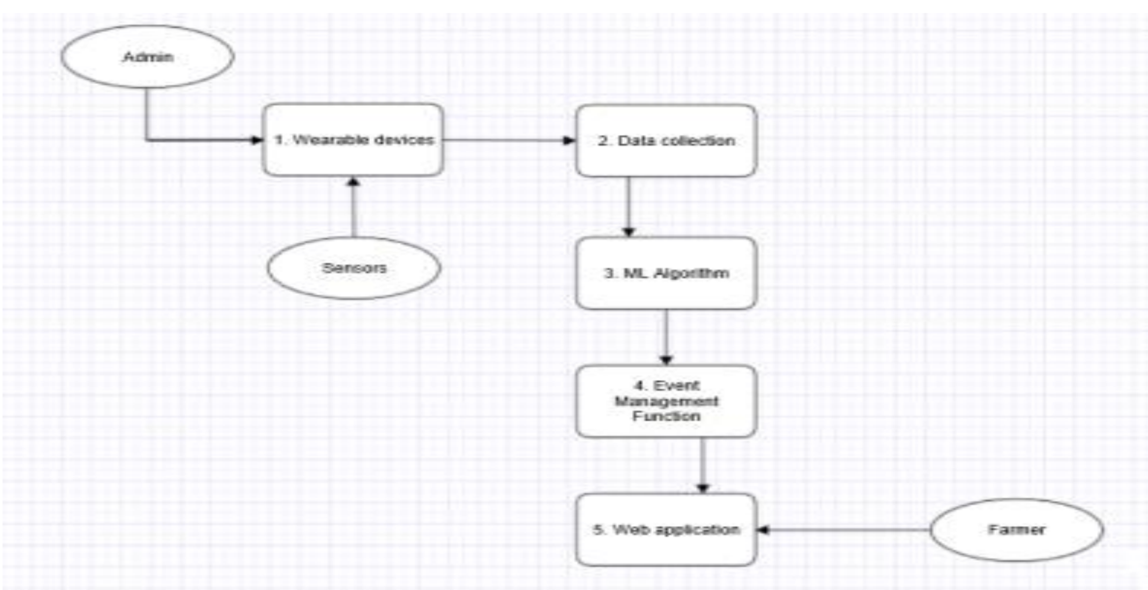


Figure 1

2.2.2 IoT Based Smart Irrigation System:

In IoT based Smart irrigation System [4], proposed system monitors Soil Moisture level through ardiuno uno and send this recorded data to Things Speak channel through GSM GPRS Module for graphs and to online database for the webpage for Moisture content level and pump status On/Off. Farmer can control the status of water pump ON/Off according to the recorded values of Soil moisture on webpage. Block diagram is given in **Figure 2.**

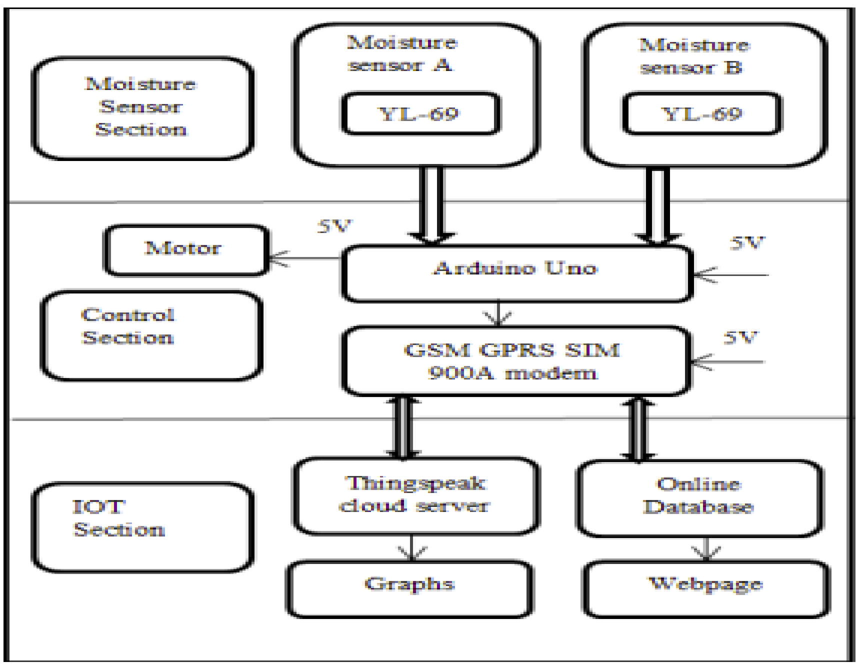


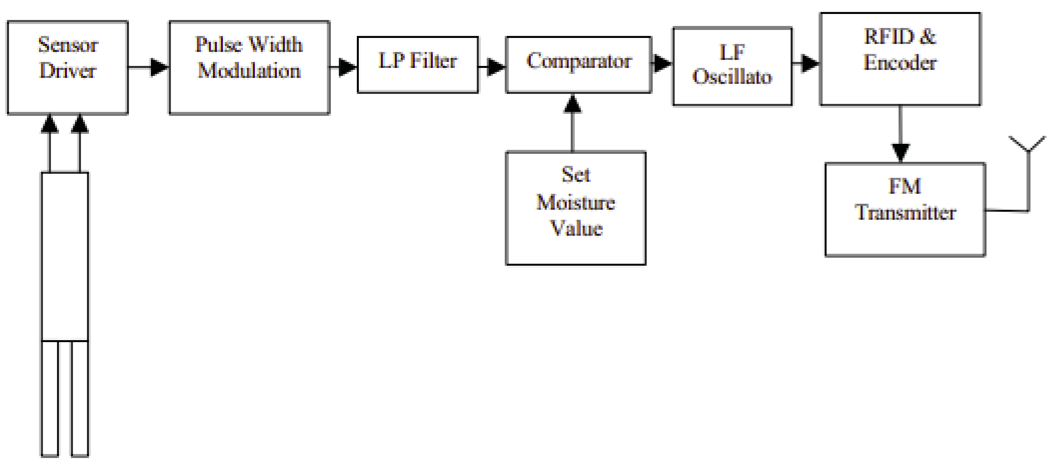
Figure 2

2.2.3 Smart Irrigation System of Wheat Crop in Saudi Arabia:

In smart irrigation system of wheat crop in Saudi Arabia[5], they proposed the wireless system of monitoring Soil moisture, Temperature and Humidity at different nodes which will be monitored by the Field Station. In this experiment they also draw wheat plant in their control system. The Field Station consists of FM receiver that receives the digital data send by different nodes identify the nodes and decode the transmitted information.

In this experiment they grow a wheat plant in monitored conditions and show their results as well.

But they not made this project IoT based just used an FM transmitter and receiver which send signal to mobile phone which are not much understandable for farmer for proper monitoring for crops. Block diagram is given in **Figure 3.**



: Block diagram of the sensor node of the implemented system

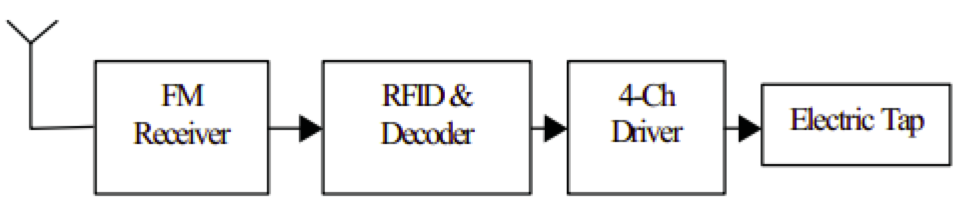


Figure 3

2.2.4 IoT Precision Agriculture Approach for Saffron Cultivation:

The system [6] model was designed for the artificial cultivation of saffron using hydroponic. By using solar energy to minimize energy capacity. The proposed system designed with saffron corms were in the emergence period.

This Model consists of different sensors and microcontroller. List of Sensors given below:

DHT22 Sensors
Ph Sensor
Water flow control Sensor
Load Cell Sensor

2.2.5 IoT based Automated Tomato Watering System:

In this Proposed System [7] ESP8266 will be programmed using the Arduino Integrated Development Environment (IDE) together with other supporting components. Later, the tools will run based on command messages that we send via telegram by using the Bot father feature on Telegram. In the circuit scheme as shown in Figure 5

we used two sensors, namely the DHT11 sensor to detect room temperature, and a soil moisture sensor to detect soil moisture rate in tomato plants. These sensors are very helpful for alerting the humidity level of plants or monitoring soil moisture.

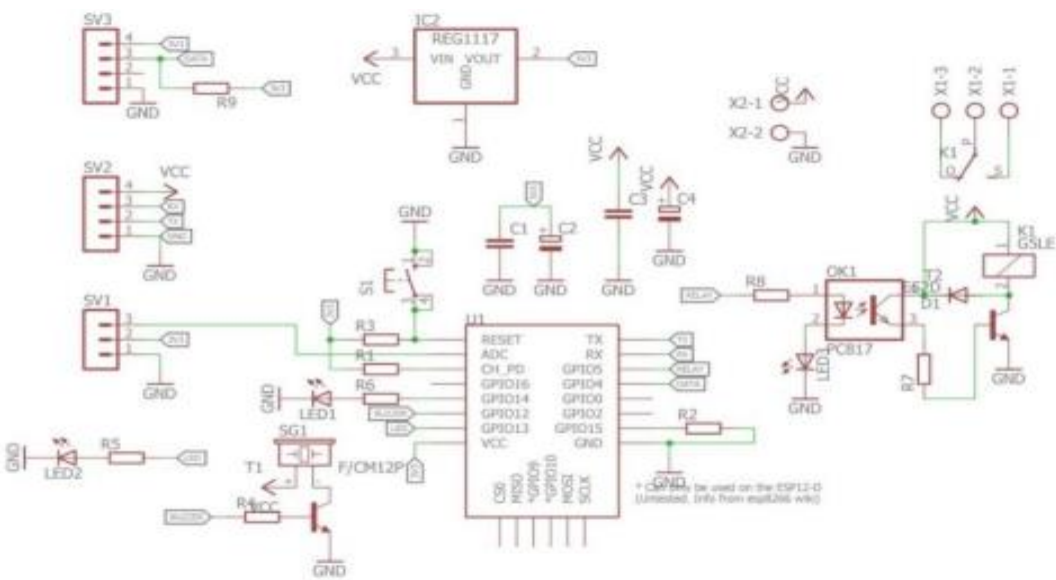


Figure 4

2.2.6 Monitoring of Air Temperature, Humidity and pH of the soil:

In this research [8], The pH sensor used to measure pH of the soil. Temperature and Humidity measured by DHT22.The Arduino as a controller, receives data from DHT22 and pH sensor and the results shown on LCD display.

The block diagram was shown in **Figure 6.**

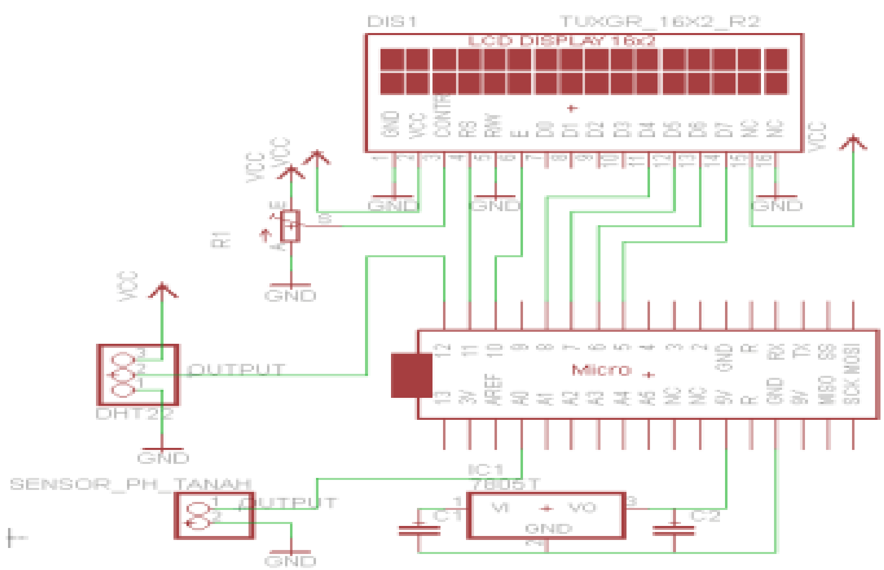


Figure 5

Chapter 3 – SYSTEM OVERVIEW

The proposed smart farming system for wheat crop is built upon the integration of following key components, namely the high-performance micro-controller Arduino Uno, Raspberry Pi3(Model-B), GSM Module (SIM 7600E-H 4G HAT), soil moisture level sensor, humidity sensor, temperature sensor and PH sensor. These vital elements are specifically chosen to ensure the smooth and efficient operation of the system, providing accurate and reliable data to optimize the wheat crop's.

In our proposed system we deploy this knowledge to recommend farmer which fertilizer should be used according to the pH value of soil which will increase the quality and quantity of crop as well.

Secondly, we used Temperature, Humidity, pH and soil moisture sensor for proper monitoring of crop.As we go through the Researches done by Pakistan Metrological Department for wheat crop from start to end [9] . They defined 10 major stages for proper growth of wheat crops as:

1) Snowing
2) Emergence
3) Third Leaf
4) Tillering
5) Shooting
6) Heading
7) Flowering
8) Milk Maturity

9) Wax Maturity
10) Full Maturity

These all 10 different stages have their own required days with required temperature and Soil moisture values, which we take from the research done by Pakistan Metrological Department for the Production of Wheat crop in Faisalabad Pakistan [9].

In Our proposed system we consider this knowledge and design an algorithm which will have all these 10 different stages to monitor Soil Moisture, Temperature and Humidity and pH values for required days of each state and updates the farmer on Things speak Channel through GSM Module.

Chapter 4 – METHODOLOGY

Automated irrigation can be achieved by leveraging the latest technologies, such as sensors, micro-controllers, Bluetooth, and web-application. Using coding threshold values of each stage of the crop growth is set. After selection of phases by the farmer depending on the number of days for each stage update the values and will show alert if it crosses the threshold. It will show red color if it above the threshold and blue if it the sensor value is below it. To keep the costs low, we utilized soil moisture sensors, temperature sensors, and humidity sensors to continuously monitor the field. These sensors are connected to an Arduino board, which processes the data and transmits it wirelessly to the user. With this data, the user can make informed decisions about when and how much to irrigate, thus optimizing crop yield while minimizing water usage. Thing Speak Channel will be used at the user end to analyze the results. Theses sensors continuously measure the levels of moisture, humidity, pH and temperature in the field, then this data is then transmitted wirelessly to the user. The user can then use this data to determine whether the levels are within acceptable thresholds and make any necessary adjustments to the irrigation system.

4.1 Wheat Crop Growth Stages:

As we go through the Researches done by Pakistan Metrological Department for wheat crop from start to end [9]. They defined 10 major stages for proper growth of wheat crops as:

11) Snowing
12) Emergence
13) Third Leaf
14) Tillering
15) Shooting
16) Heading
17) Flowering
18) Milk Maturity
19) Wax Maturity
20) Full Maturity

These all 10 different stages have their own required days with required temperature and Soil moisture values. Following figure shows the stages of wheat crop during each stage.[9]

Phase	Days	Soil Moisture(%)	Temperature©
Snowing	9	40-50	12-25
Emergence	13	45-55	14-25
Third Leaf	13	45-55	9-25
Tillering	40	60-75	9-25
Shooting	27	55-65	13-25
Heading	12	55-65	15-28
Flowering	19	65-75	15-28
Milk Maturity	15	50-60	15-28
Wax Maturity	7	55-65	15-28
Full Maturity	8	40-55	15-28

Figure 6

4.2 System Architecture:

4.2.1 Data Flow Diagram of Algorithm:

The overall diagram of the algorithm is given as:

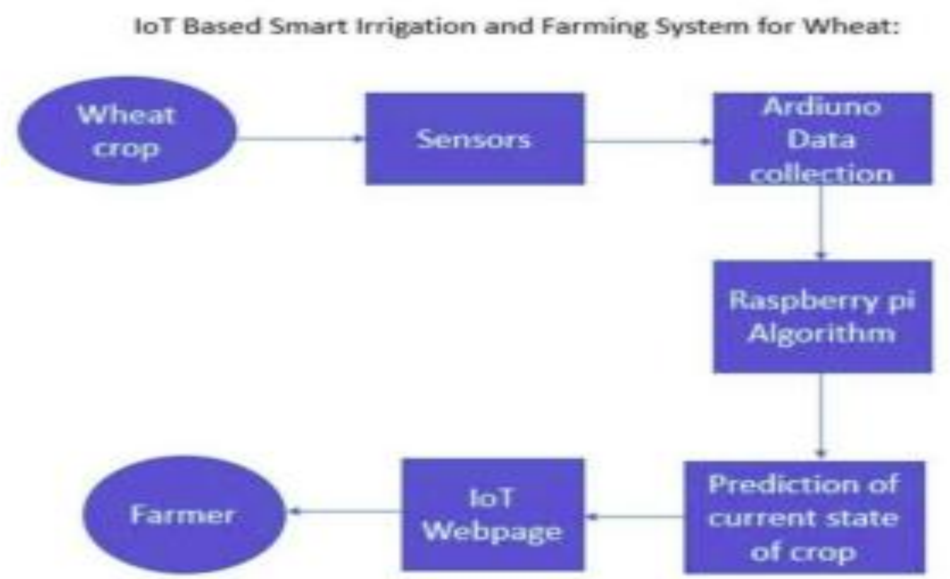


Figure 7

Communication between the Arduino board and Raspberry pi 3 through Serial Communication. To ensure optimal performance, we store the threshold values for soil moisture, temperature, pH and humidity in both the **GUI** and at **Thing Speak Channel**. As environmental and climatic conditions change, sensor readings will vary accordingly. For example, soil moisture levels may differ significantly between summer and winter seasons, as will temperature and humidity values. By taking into account these variables, we establish fixed threshold values that account for the unique characteristics of each situation.

4.2.2 Block Diagram :

Block Diagram of the system is given as:

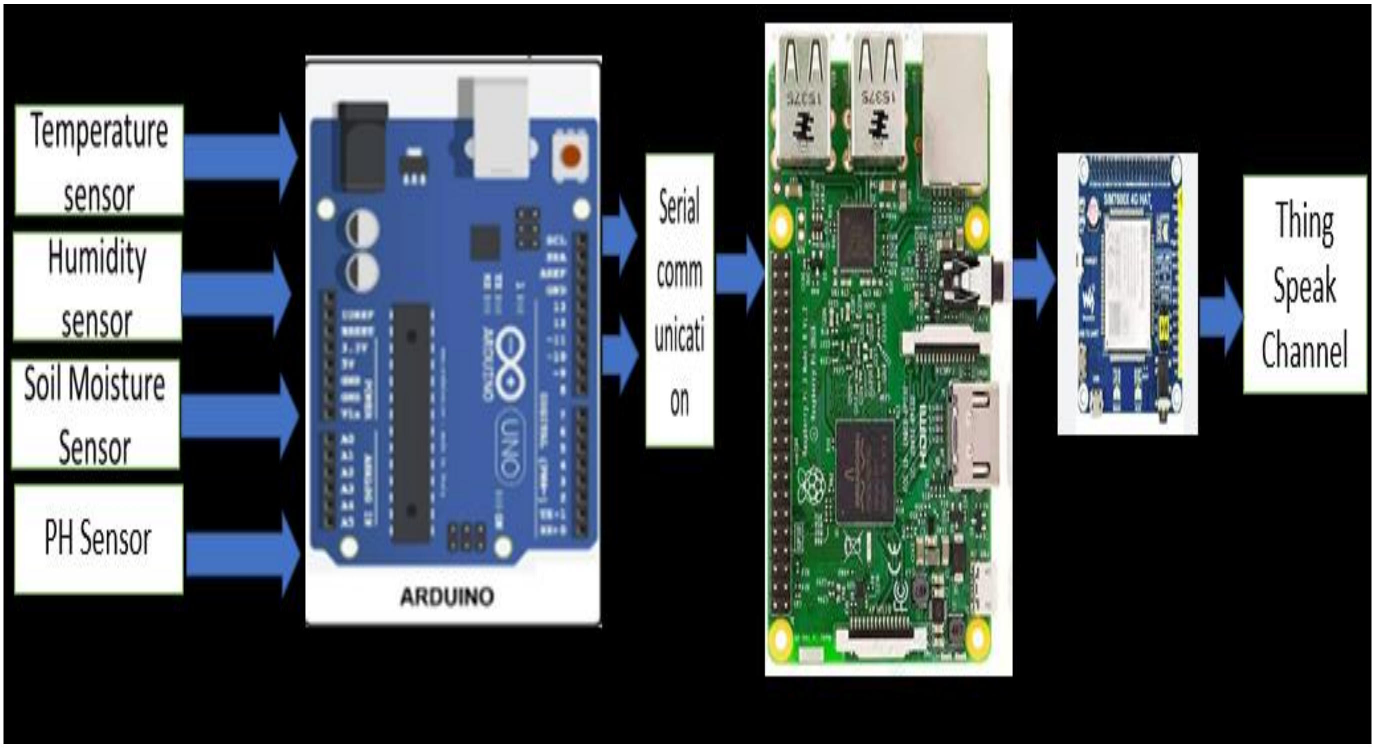


Figure 8

The system utilizes various sensors such as:

1). Humidity sensor
2). Temperature sensor
3). Soil-moisture sensor
4). pH sensor

All these sensors will collect real-time data of the wheat crop and send to Raspberrypi3 through Ardiuno Uno. A proper algorithm has been formed to monitor the data of theses sensors and send the required suggestions and current state of crop to the farmer through "**Things-Speak-Channel**" to work with GSM

Module.

4.3 HARDWARE COMPONENTS:

All the hardware components we used in this project is given as:

- Sensors we used

1. PH sensor
2. Temperature
3. Humidity Sensor
4. Soil Moisture Sensor

- Ardiuno Uno
-
- Raspberry pi 3 (Model B)

- GSM Module (SIM 7600E-H 4G HAT)

4.3.1 Ardiuno Uno:

Arduino Uno is highly efficient microcontroller with ATmega328P specifications. With 14 digital input and output pins, 6 analog inputs. Simply connect it to a PC/Laptop with a USB cable or power it with a battery to get started. An Ardiuno IDE should be downloaded in the PC/Laptop to program the Ardiuno.

Arduino Uno used in smart irrigation to automate the irrigation process and optimize water usage. In this Project it collects data on soil moisture, temperature, humidity and pH sensors and send this data to Raspberry pi 3 through Serial Communication which use this data to match with the threshold after which it alerts the farmer if it crosses the threshold.

ARDUINO UNO

Figure 9

4.3.2 Raspberry pi 3 (Model B):

The Raspberry Pi 3 Model B is the third generation Raspberry Pi, with the RAM of 1GB. It has 04-USB ports, 01-HDMI connection, Camera port. You will need a microSD-Card with raspberry pi software already downloaded to finally run the Raspberry pi.

After successfully receiving data from Arduino Uno using serial communication, raspberry Pi3 will perform its role. Its processing power is used to perform data analytic on the collected data, which helps in making informed decisions about future irrigation schedules and optimizing wheat Crop and inform the farmer of current condition of Crop on GUI as well.

RASPBERRY PI 3 (MODEL B)

Figure 10

4.3.3 GSM MODULE (SIM 7600E-H 4G HAT):

SIM 7600-H 4G HAT is an 4G GSM Module specially designed to work for raspberry pi. Sim 7600E can connect with raspberry pi through Serial Communication and can communication with raspberry pi through AT commands. 4G Registered Sim with appropriate package should be plugged in GSM Module.

In this project we use GSM Module for providing internet connection to Raspberry pi.

Figure 11

4.3.4 <u>SENSORS:</u>

For this system, there are four sensors that are used for collecting data which are:

- Soil Moisture senor,
- temperature sensor,
- humidity sensor
- PH sensor

4.3.4.1 <u>Soil Moisture Sensor:</u>

Soil sensors are devices that measure various properties of soil, such as moisture content, temperature, and nutrient levels. These sensors are important tools for agriculture, gardening allowing farmers to optimize crop yields, conserve water, and maintain soil health. Soil sensors can be connected to a data logger or a wireless network to collect and transmit real time data on soil conditions.

In this project we use Soil Moisture Sensor for monitoring the moisture content in soil and predicting the current condition of crop.

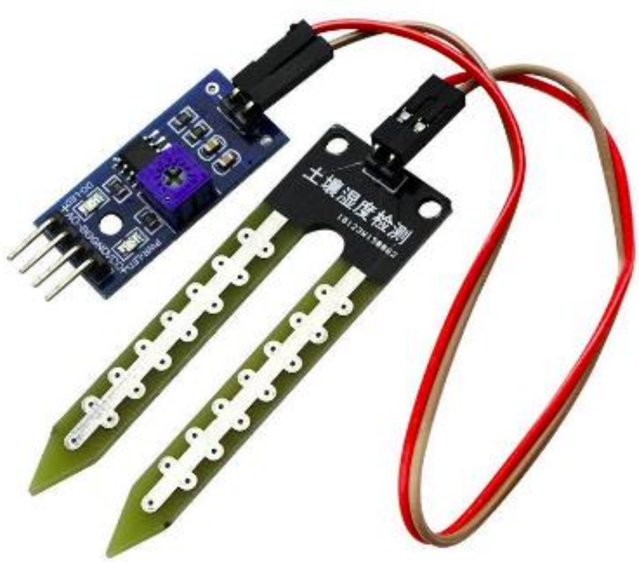


Figure 12

4.3.4.2 **Temperature Sensor:**

Temperature sensors are devices that measure the temperature of a controlled environment (i.e air). They are used in a wide range of applications, including industrial processes and weather monitoring. Temperature sensors can be connected to a data wireless network to collect and transmit real-time data on temperature.

4.3.4.3 . **Humidity Sensor:**

Humidity sensors are devices that measure the amount of moisture or water vapor in the air. They are used in a variety of applications, including HVAC systems, weather monitoring, and industrial processes.

In this project we use DHT22 sensor to measure both the temperature and humidity of the crops. DHT22 measures humidity with the accuracy of 2-5% (0-100%),DHT22 measures temperature with the accuracy of "+- 0.5 C" (-40 to 80) degree centigrade.

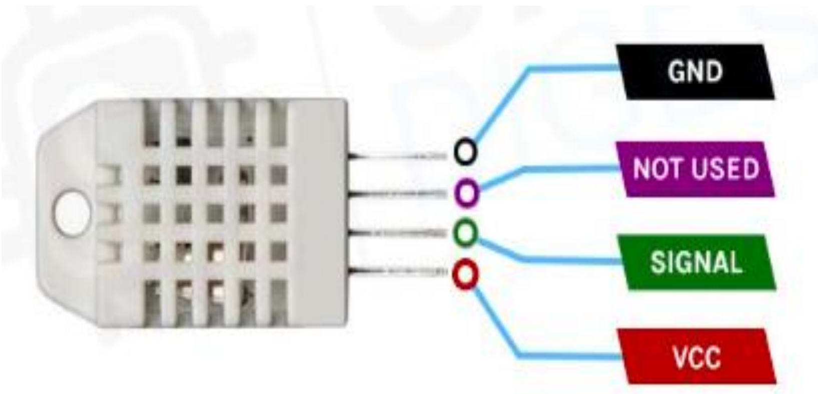


Figure 13

4.3.4.4 . **PH Sensor:**

pH sensors are devices that measure the pH of a solution and predicts acidity and alkalinity of the solution. They are commonly used in agriculture, food processing, and environmental monitoring. pH sensors use electrodes to measure the concentration of hydrogen ions in a solution, which determines its pH value. pH sensors can be connected to a data logger or a wireless network to collect and transmit real-time data on pH. Calibration is an important step in using pH sensors to ensure accurate readings.

In this Project we use Analog pH sensor for the measuring the current pH of the soil. pH of the soil plays very important role in proper growth of the crop.
pH should remain the sweet band (5.5-7.5) for proper and good growth of crop.

4.3.3.4.1 What steps should be taken to lower the higher soil pH?

Soil pH is fixed cannot be changed. However, some steps can temporarily reduce the pH. In Pakistan mostly 02-two types of Fertilizers is being used namely: Urea and DAP (Di-ammonium Phosphate). DAP is alkaline in nature and DAP significantly lowered soil pH. Urea is acidic in nature and significantly higher soil pH .

In our proposed system we deploy this knowledge to recommend farmer which fertilizer should be used according to the pH value of soil which will increase the quality and quantity of crop as well.

Analog pH Sensor

Figure 14

4.4 Thing Speak Channel:

- Thing Speak is an open-source software, which allows users to collect data from different devices which can be connected to internet.

- Thing Speak can play an important role in Smart Farming for collecting data from different sensors which farmer can use for daily adaption of crops.

- In this project we build Thing Speak channel for 04-differnent sensors monitoring

- Humidity
- Temperature
- PH
- Soil Moisture

- It provides good graphic visualization of the readings and also show run-time readings in numerical form.

- Raspberry pi monitors readings from sensors and send the values to the Thing Speak Channel which can be visualize by the farmer.

- Thing Speak channel stores data of all fields, farmer can keep record of all days of different phases of crops.

- The results of Thing Speak Channel are shown in Figure 16-17.

GRAPHICAL VISULATION OF SENSORS READINGS:

Figure 15

NUMERICAL VISULATION OF SENSORS READINGS:

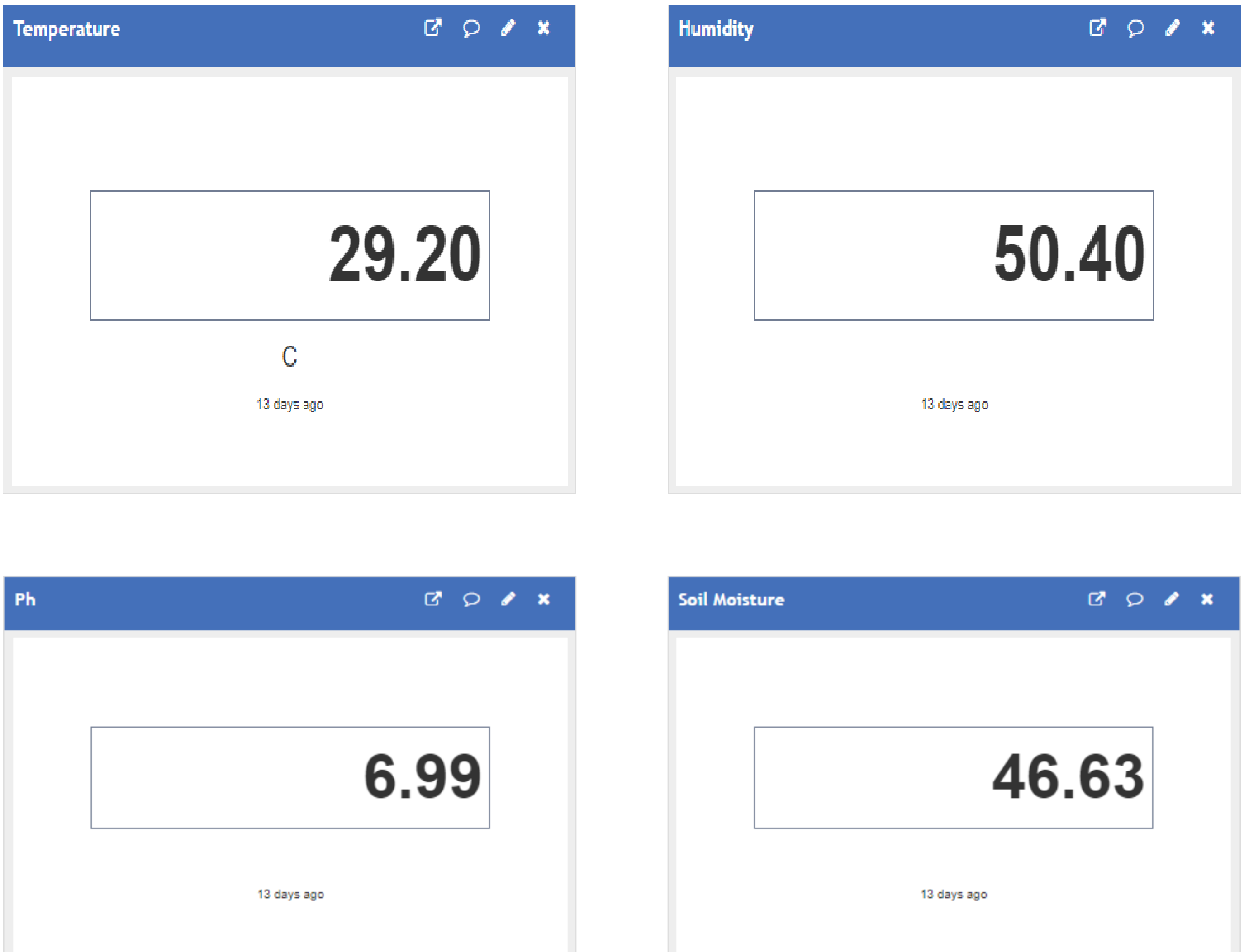


Figure 16

4.5 GUI ON RASPHBERRY PI:

We build proper GUI for better understanding of the project.

5.5.1 Main Features of GUI:

- Results button will automatically show the results of:

- Temperature
- Humidity
- pH
- Soil Moisture

- Values read by sensors on GUI in numerical in words form.

- It also automatically updates the suggestion of the crops as well checks the given thresholds according to the phase updates the results/ suggestion for the Crop.

- By Pressing Result Button it will automatically update the results on **Thing Speak Channel** as well.

- Remember this project only design for Wheat Crop and can only predicts results/suggestion for Wheat crops.

- Farmer can also select phase of the crop from 10-different phase of crop

  as given below:

i. Snowing
ii. Emergence
iii. Third Leaf
iv. Tillering
v. Shooting
vi. Heading
vii. Flowering
viii. Milk Maturity
ix. Wax Maturity
x. Full Maturity

- Conditions of Humidity, Temperature, Soil Moisture and PH automatically changes according to the given phase.

- Farmer can also select the timer for the given phase accordingly.

- GUI can also show the next field crops are going to enter.

- GUI also alert the farmer when the given timing of the phase is over.

- The results of GUI are shown in Figure 18.

GRAPHICAL REPRESENTATION OF GUI:

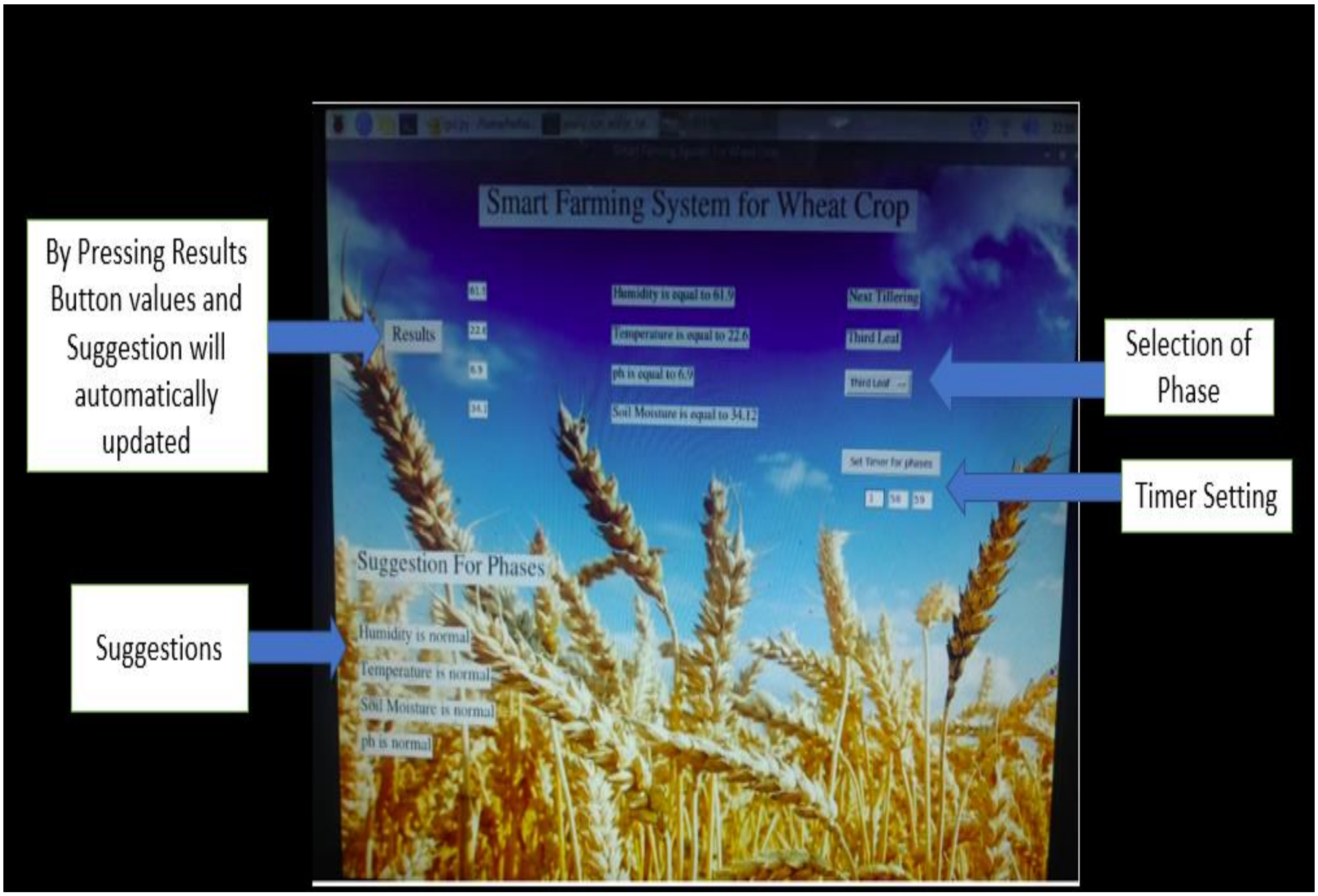


Figure 17

4.6 ALGORITHM DESCRIPTION:

- Phase Selection
- Timing update according to the phase
- Receive Humidity value
- Check for Threshold
- Update the Suggestion
- Update on Thing Speak Channel
- Receive Temperature value
- Check for Threshold
- Update the Suggestion
- Update on Thing Speak Channel
- Receive pH value
- Check for Threshold
- Update the Suggestion
- Update on Thing Speak Channel
- Receive Soil Moisture value
- Check for Threshold
- Update the Suggestion
- Update on Thing Speak Channel

Chapter 5 –RESULTS

5.1 Hardware Representation:

Connecting all sensors to Ardiuno:

- Soil Moisture Sensor
- Temperature Sensor
- Humidity Sensor
- PH Sensor

Through Serial Communication Ardiuno is connected to Raspberry pi in which threshold based algorithm is deployed.

GSM Module is connected to Raspberry pi through Serial Communication for Internet Connection.

GUI will be displayed to Monitor will shows all the Results and Suggestions of Crops.

All the Hardware representation will be shown from Figure 19-21

HARDWARE REPRESENTATION OF PROJECT:

Figure 18

HARDWARE REPRESENTATION OF PROJECT:

Figure 19

HARDWARE REPRESENTATION OF PROJECT:

Raspberry Pi 3 Model-B

Figure 20

HARDWARE REPRESENTATION OF PROJECT:

Ardiuno UNO with Sensors

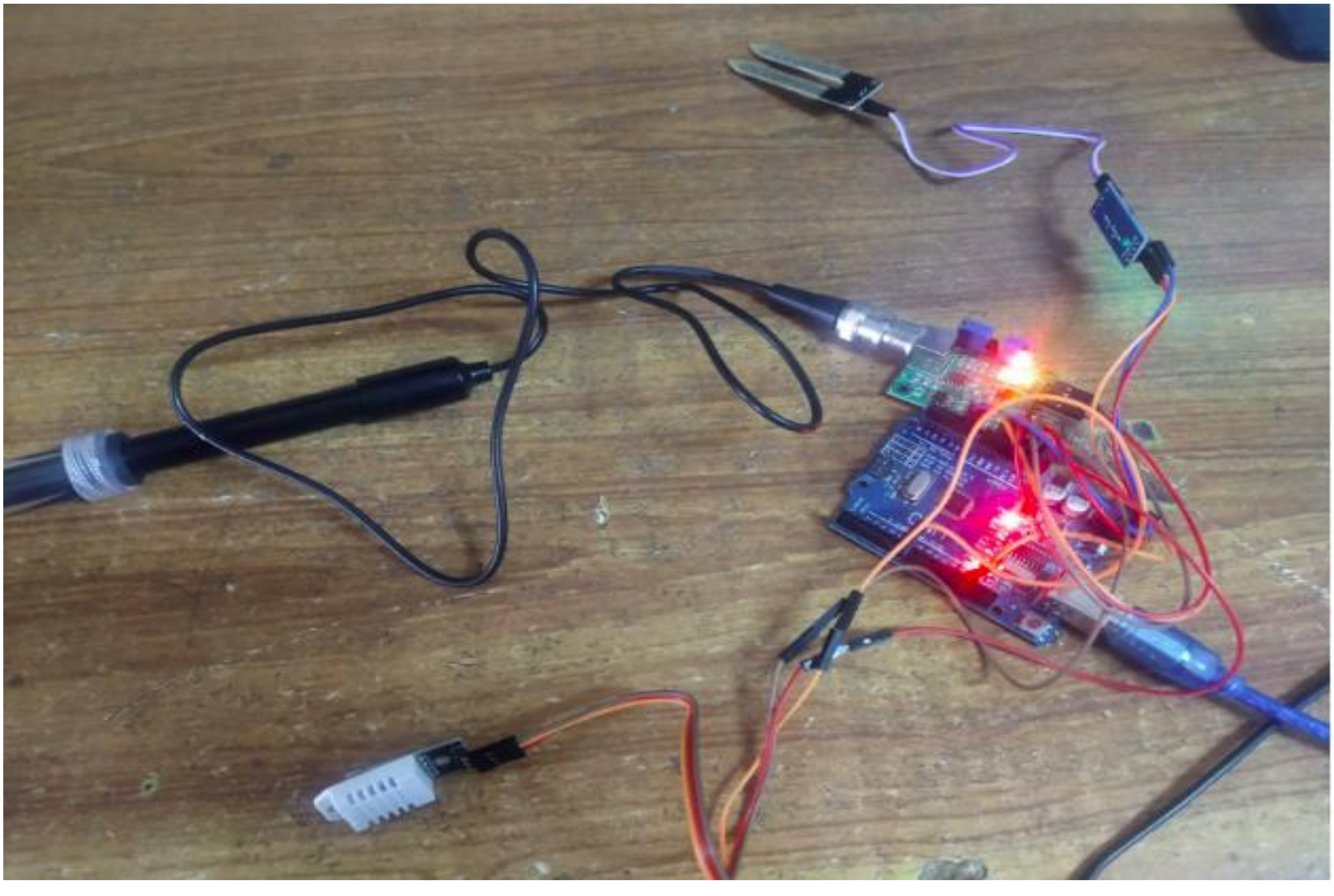


Figure 21

5.2 Software Representation:

In Software Representation we have:

- GUI on Raspberry pi
- Results on Thing Speak Channel

5.2.1 GUI ON RASPBERRY PI:

Figure 22

5.2.2 Channel on Thing Speak Channel:

GRAPHICAL VISULATION OF SENSORS READINGS:

Figure 23

NUMERICAL VISULATION OF SENSORS READINGS:

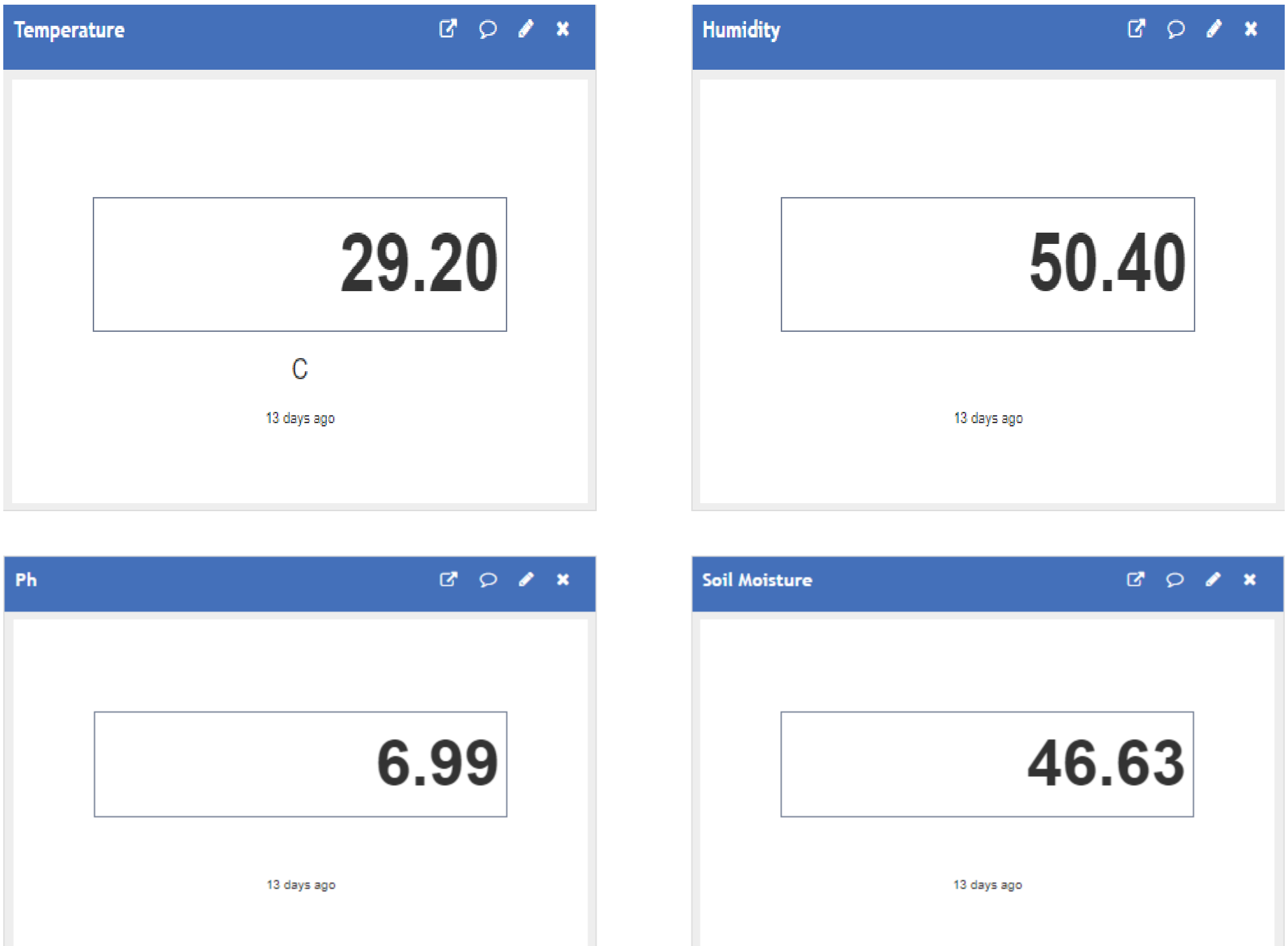


Figure 24

<u>**Chapter 6 –CONCLUSION**</u>

- As we all know agriculture plays an important role in survival of mankind and other living beings.

- Bringing modernization and improvement in this sector through technology is a need of hour.

- Our project is a little attempt to introduce modernization in this important sector through the use of technology and it would be gaining as under: -

  1. Increasing the production of crops.
  2. Implementing proper irrigation with less wastage of water.
  3. Better monitoring of the crops.
  4. Reducing the efforts of Farmer.

Chapter 7 – FUTURE WORK

7.1 CONTROLL OF WATER PUMP:

Water Pump can be deployed in future advancement of this project. If Soil Moisture level is less than the Threshold value then water pump automatically turn on until the threshold meets.

7.2 SMS/CALL ALERT:

If Sensors values does not meet the threshold then the SMS/Call alert should be done to farmer through GSM Module.

We can simply use AT commands to perform this operation.

7.3 WEATHER PREDICTION ALGORITHM:

Proper Weather Prediction Algorithm can be deployed in Raspberry pi for better understanding of the prediction of current conditions of Crop.

REFRENCES:

[1] hochang hachimi,‖saffron production set to exceed expectations in Afghanistan, salaam times, 24.dec.2018 https://afghanistan.asia- news.com/en_GB/articles/cnmi_st/features/2018/12/24/featu re-01. ―Sept, 15th 2019

[2] Almeida, Leandro da Silva et al. "Intelligence assessment: Gardner multiple intelligence theory as an alternative." Learning and Individual Differences 20 (2010): 225-230

[3] Shekhar, Yuthika, et al. "Intelligent IoT based automated irrigation system." *International Journal of Applied Engineering Research* 12.18 (2017): 7306-7320.

[4] Rawal, Srishti. "IOT based smart irrigation system." *International Journal of Computer Applications* 159.8 (2017): 7-11.

[5] Atta, Ragheid, Tahar Boutraa, and Abdellah Akhkha. "Smart irrigation system for wheat in Saudi Arabia using wireless sensors network technology." *International Journal of Water Resources and Arid Environments* 1.6 (2011): 478-482.

[6] Kour, Kanwalpreet, et al. "Monitoring Ambient Parameters in the IoT Precision Agriculture Scenario: An Approach to Sensor Selection and Hydroponic Saffron Cultivation." *Sensors* 22.22 (2022): 8905.

[7] Nurhasanah, Rossy, et al. "Design and Implementation of IoT based Automated Tomato Watering System Using ESP8266." *Journal of Physics: Conference Series*. Vol. 1898. No. 1. IOP Publishing, 2021.

[8] Sihombing, Yuan Alfinsyah, and Sustia Listiari. "Detection of air temperature, humidity and soil pH by using DHT22 and pH sensor based Arduino nano microcontroller." *AIP Conference Proceedings*. Vol. 2221. No. 1. AIP Publishing LLC, 2020.

[9] Imran, Ali et al. "Weather & Wheat Crop Development in Central Punjab (Faisalabad) (2014 - 2015)." (2015)

APPENDIX:

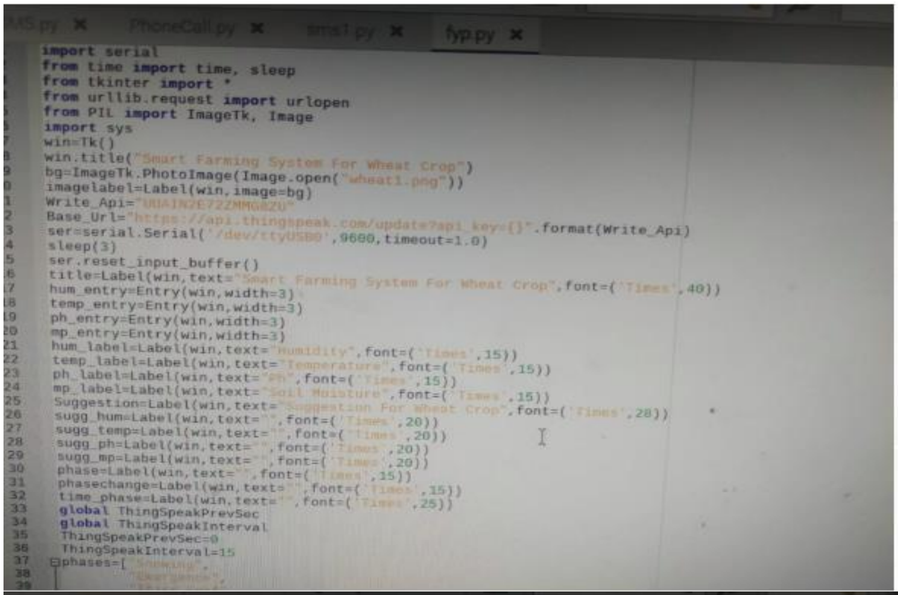
ARDIUNO CODE FOR SENSORS:

```
#include <DHT.h>;
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>

//Constants
#define DHTPIN 7   // what pin we're connected to
#define DHTTYPE DHT22   // DHT 22  (AM2302)
DHT dht(DHTPIN, DHTTYPE); //// Initialize DHT sensor for normal 16mhz Arduino


//Variables
int chk;
float hum;  //Stores humidity value
float temp; //Stores temperature value
const int sensor_pin = A1;
float calibration_value = 21.34 - 0.3;
int phval = 0;
unsigned long int avgval;
int buffer_arr[10];

float ph_act;

void setup()
{
    Serial.begin(9600);
  dht.begin();
```

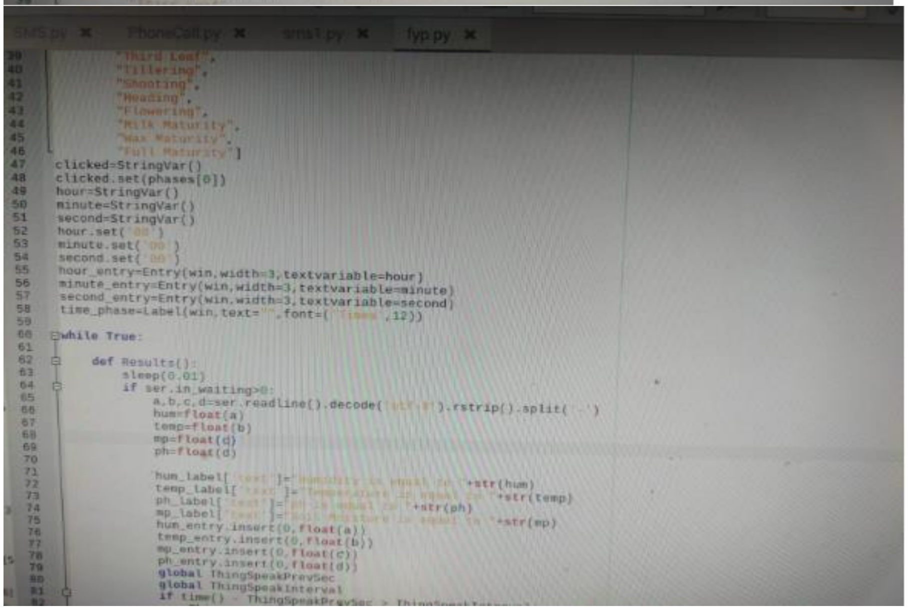
```
}

void loop()
{
    //Read data and store it to variables hum and temp

  float moisture_percentage;
  int sensor_analog;


  for(int i=0;i<10;i++)
{
buffer_arr[i]=analogRead(A0);
delay(30);
}
for(int i=0;i<9;i++)
{
for(int j=i+1;j<10;j++)
{
if(buffer_arr[i]>buffer_arr[j])
{
temp=buffer_arr[i];
buffer_arr[i]=buffer_arr[j];
buffer_arr[j]=temp;
}
}
}
avgval=0;
for(int i=2;i<8;i++)
avgval+=buffer_arr[i];
float volt=(float)avgval*5.0/1024/6;
ph_act = -5.70 * volt + calibration_value;
hum = dht.readHumidity();
  temp= dht.readTemperature();
  sensor_analog = analogRead(sensor_pin);
  moisture_percentage = ( 100 - ( (sensor_analog/1023.00) * 100 ) );
    //Print temp and humidity values to serial monitor

Serial.print(hum);
Serial.print("-");
Serial.print(temp);
Serial.print("-");
Serial.print(moisture_percentage);
Serial.print("-");
Serial.print(ph_act);
```

```
delay(3000);
}
```

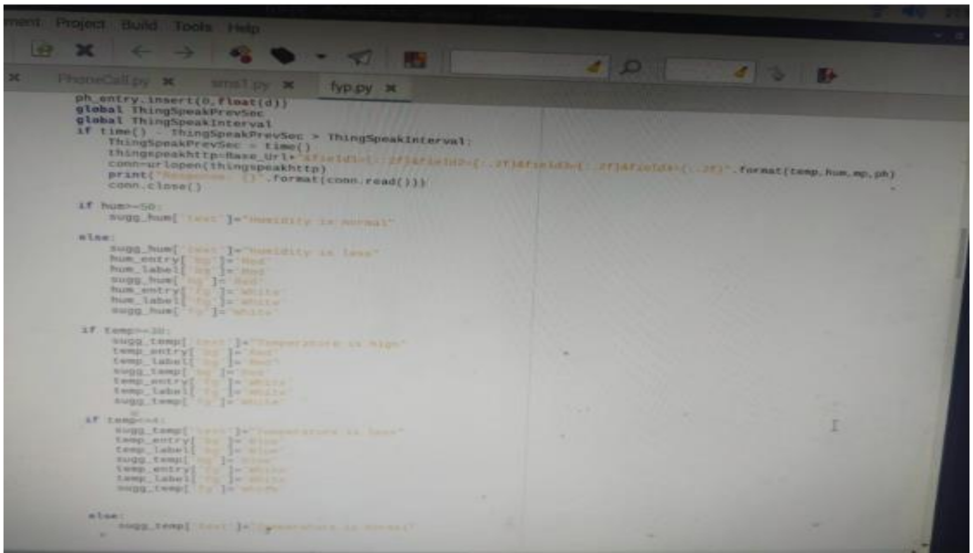
RASPBERRY PI CODE:

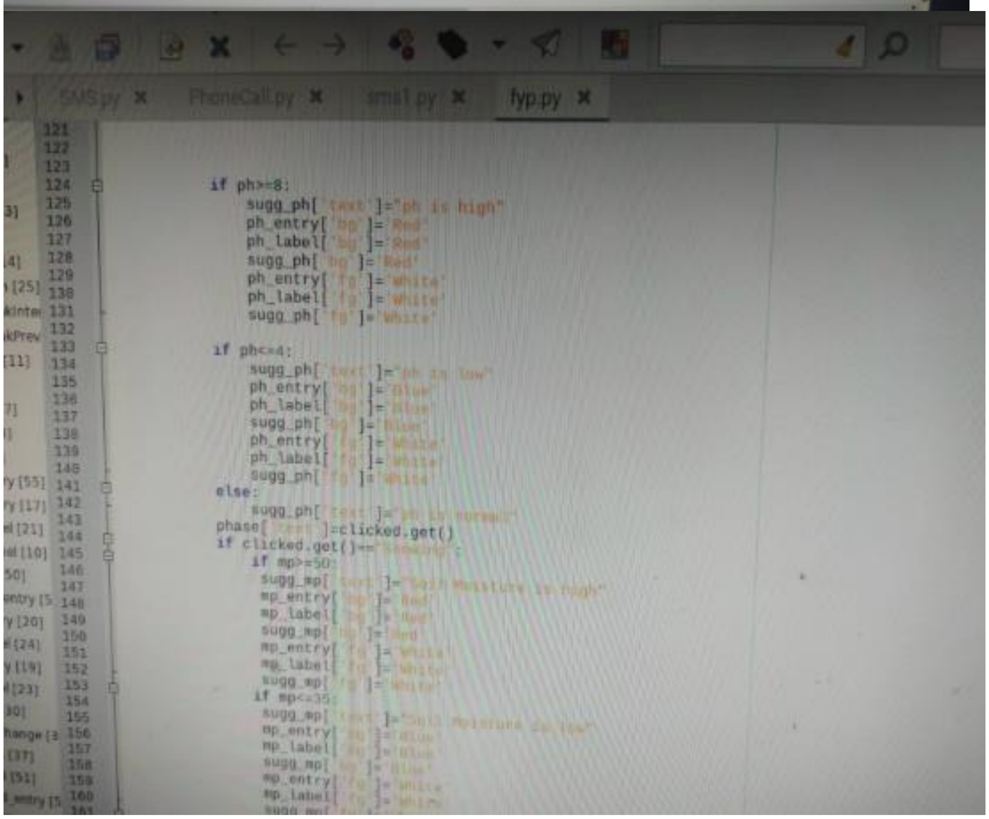


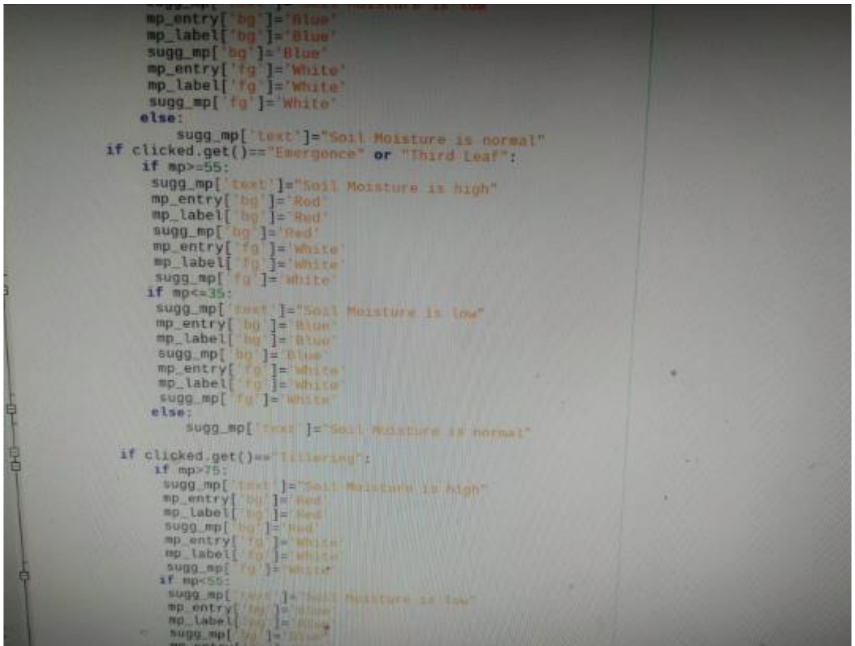
```
import serial
from time import time, sleep
from tkinter import *
from urllib.request import urlopen
from PIL import ImageTk, Image
import sys
win=Tk()
win.title("Smart Farming System For Wheat Crop")
bg=ImageTk.PhotoImage(Image.open("wheat1.png"))
imagelabel=Label(win,image=bg)
Write_Api="UUAIN2E72ZMMG0ZU"
Base_Url="https://api.thingspeak.com/update?api_key={}".format(Write_Api)
ser=serial.Serial('/dev/ttyUSB0',9600,timeout=1.0)
sleep(3)
ser.reset_input_buffer()
title=Label(win,text="Smart Farming System For Wheat Crop",font=('Times',40))
hum_entry=Entry(win,width=3)
temp_entry=Entry(win,width=3)
ph_entry=Entry(win,width=3)
mp_entry=Entry(win,width=3)
hum_label=Label(win,text="Humidity",font=('Times',15))
temp_label=Label(win,text="Temperature",font=('Times',15))
ph_label=Label(win,text="Ph",font=('Times',15))
mp_label=Label(win,text="Soil Moisture",font=('Times',15))
Suggestion=Label(win,text="Suggestion For Wheat Crop",font=('Times',28))
sugg_hum=Label(win,text="",font=('Times',20))
sugg_temp=Label(win,text="",font=('Times',20))
sugg_ph=Label(win,text="",font=('Times',20))
sugg_mp=Label(win,text="",font=('Times',20))
phase=Label(win,text="",font=('Times',15))
phasechange=Label(win,text="",font=('Times',15))
time_phase=Label(win,text="",font=('Times',25))
global ThingSpeakPrevSec
global ThingSpeakInterval
ThingSpeakPrevSec=0
ThingSpeakInterval=15
phases=["Snowing",
        "Emergence",
```



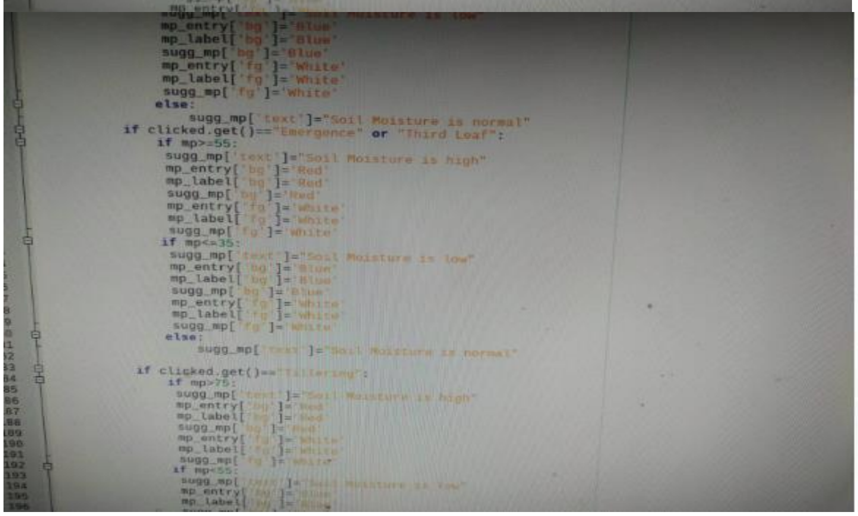
```
        "Third Leaf",
        "Tillering",
        "Shooting",
        "Heading",
        "Flowering",
        "Milk Maturity",
        "Wax Maturity",
        "Full Maturity"]
clicked=StringVar()
clicked.set(phases[0])
hour=StringVar()
minute=StringVar()
second=StringVar()
hour.set('00')
minute.set('00')
second.set('00')
hour_entry=Entry(win,width=3,textvariable=hour)
minute_entry=Entry(win,width=3,textvariable=minute)
second_entry=Entry(win,width=3,textvariable=second)
time_phase=Label(win,text="",font=('Times',12))

while True:

    def Results():
        sleep(0.01)
        if ser.in_waiting>0:
            a,b,c,d=ser.readline().decode('utf-8').rstrip().split(',')
            hum=float(a)
            temp=float(b)
            mp=float(d)
            ph=float(d)

            hum_label['text']='Humidity is equal to '+str(hum)
            temp_label['text']='Temperature is equal to '+str(temp)
            ph_label['text']='ph is equal to '+str(ph)
            mp_label['text']='Soil Moisture is equal to '+str(mp)
            hum_entry.insert(0,float(a))
            temp_entry.insert(0,float(b))
            mp_entry.insert(0,float(c))
            ph_entry.insert(0,float(d))
            global ThingSpeakPrevSec
            global ThingSpeakInterval
            if time() - ThingSpeakPrevSec > [illegible]
```


Project
Build
Tools
Help
PhoneCall.py
sms1.py
fyp.py
ph_entry.insert(0,float(d))
global ThingSpeakPrevSec
global ThingSpeakInterval
conn.close()

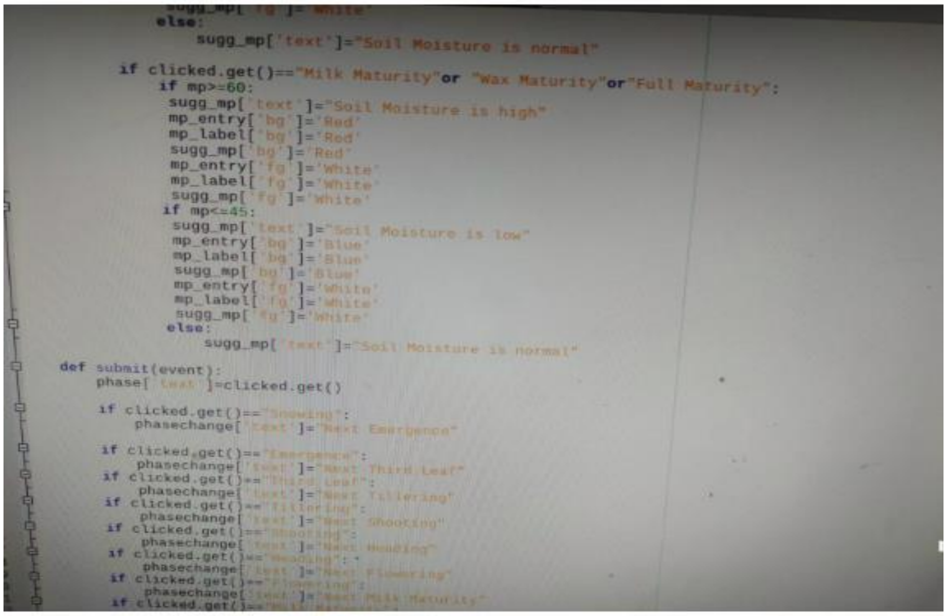

SMS.py
PhoneCall.py
sms1.py
fyp.py
if ph>=8:
sugg_ph['text']="ph is high"
ph_entry['bg']='Red'
ph_label['bg']='Red'
sugg_ph['bg']='Red'
ph_entry['fg']='White'
ph_label['fg']='White'
sugg_ph['fg']='White'
if ph<=4:
else:
phase['text']=clicked.get()
if mp>=50:
if mp<=35:



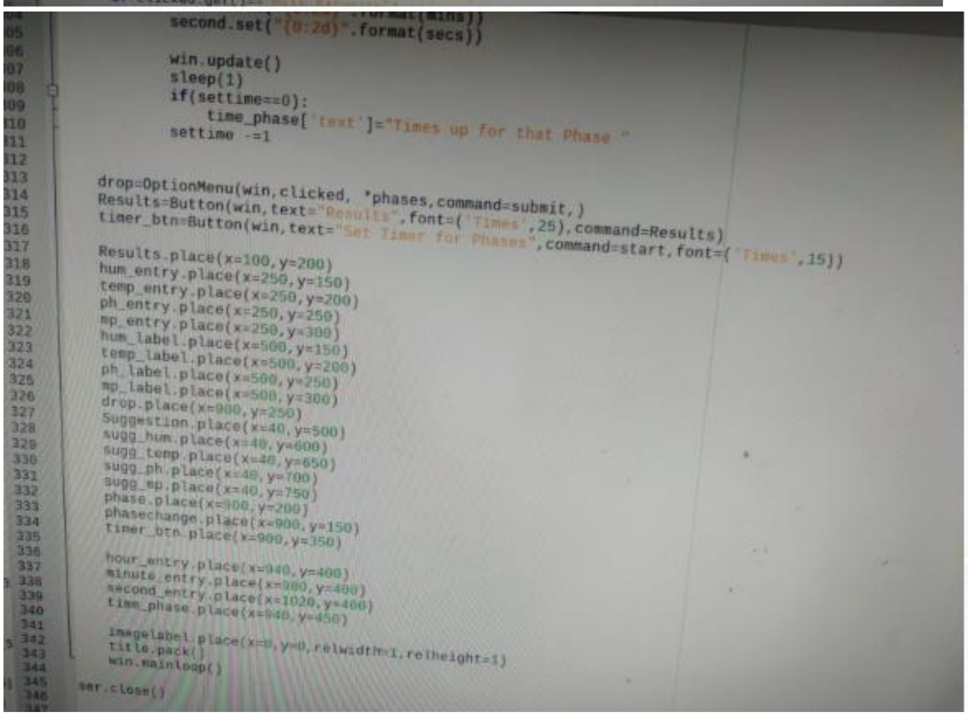
```
        mp_entry['bg']='Blue'
        mp_label['bg']='Blue'
        sugg_mp['bg']='Blue'
        mp_entry['fg']='White'
        mp_label['fg']='White'
        sugg_mp['fg']='White'
    else:
            sugg_mp['text']="Soil Moisture is normal"
if clicked.get()=="Emergence" or "Third Leaf":
    if mp>=55:
        sugg_mp['text']="Soil Moisture is high"
        mp_entry['bg']='Red'
        mp_label['bg']='Red'
        sugg_mp['bg']='Red'
        mp_entry['fg']='White'
        mp_label['fg']='White'
        sugg_mp['fg']='White'
    if mp<=35:
        sugg_mp['text']="Soil Moisture is low"
        mp_entry['bg']='Blue'
        mp_label['bg']='Blue'
        sugg_mp['bg']='Blue'
        mp_entry['fg']='White'
        mp_label['fg']='White'
        sugg_mp['fg']='White'
    else:
            sugg_mp['text']="Soil Moisture is normal"

if clicked.get()=="Tillering":
    if mp>75:
        sugg_mp['text']="Soil Moisture is high"
        mp_entry['bg']='Red'
        mp_label['bg']='Red'
        sugg_mp['bg']='Red'
        mp_entry['fg']='White'
        mp_label['fg']='White'
        sugg_mp['fg']='White'
    if mp<55:
        sugg_mp['text']="Soil Moisture is low"
        mp_entry['bg']='Blue'
        mp_label['bg']='Blue'
        sugg_mp['bg']='Blue'
```



```
        mp_entry['bg']='Blue'
        mp_label['bg']='Blue'
        sugg_mp['bg']='Blue'
        mp_entry['fg']='White'
        mp_label['fg']='White'
        sugg_mp['fg']='White'
    else:
            sugg_mp['text']="Soil Moisture is normal"
if clicked.get()=="Emergence" or "Third Leaf":
    if mp>=55:
        sugg_mp['text']="Soil Moisture is high"
        mp_entry['bg']='Red'
        mp_label['bg']='Red'
        sugg_mp['bg']='Red'
        mp_entry['fg']='White'
        mp_label['fg']='White'
        sugg_mp['fg']='White'
    if mp<=35:
        sugg_mp['text']="Soil Moisture is low"
        mp_entry['bg']='Blue'
        mp_label['bg']='Blue'
        sugg_mp['bg']='Blue'
        mp_entry['fg']='White'
        mp_label['fg']='White'
        sugg_mp['fg']='White'
    else:
            sugg_mp['text']="Soil Moisture is normal"

if clicked.get()=="Tillering":
    if mp>75:
        sugg_mp['text']="Soil Moisture is high"
        mp_entry['bg']='Red'
        mp_label['bg']='Red'
        sugg_mp['bg']='Red'
        mp_entry['fg']='White'
        mp_label['fg']='White'
        sugg_mp['fg']='White'
    if mp<55:
        sugg_mp['text']="Soil Moisture is low"
        mp_entry['bg']='Blue'
        mp_label['bg']='Blue'
```



```
        else:
            sugg_mp['text']="Soil Moisture is normal"

    if clicked.get()=="Milk Maturity"or "Wax Maturity"or"Full Maturity":
        if mp>=60:
         sugg_mp['text']="Soil Moisture is high"
         mp_entry['bg']='Red'
         mp_label['bg']='Red'
         sugg_mp['bg']='Red'
         mp_entry['fg']='White'
         mp_label['fg']='White'
         sugg_mp['fg']='White'
        if mp<=45:
         sugg_mp['text']="Soil Moisture is low"
         mp_entry['bg']='Blue'
         mp_label['bg']='Blue'
         sugg_mp['bg']='Blue'
         mp_entry['fg']='White'
         mp_label['fg']='White'
         sugg_mp['fg']='White'
        else:
            sugg_mp['text']="Soil Moisture is normal"

def submit(event):
    phase['text']=clicked.get()

    if clicked.get()=="Snowing":
        phasechange['text']="Next Emergence"

    if clicked.get()=="Emergence":
        phasechange['text']="Next Third Leaf"
    if clicked.get()=="Third Leaf":
        phasechange['text']="Next Tillering"
    if clicked.get()=="Tillering":
        phasechange['text']="Next Shooting"
    if clicked.get()=="Shooting":
        phasechange['text']="Next Heading"
    if clicked.get()=="Heading":
        phasechange['text']="Next Flowering"
    if clicked.get()=="Flowering":
        phasechange['text']="Next Milk Maturity"
    if clicked.get()==
```



```
        second.set("{0:2d}".format(secs))

        win.update()
        sleep(1)
        if(settime==0):
            time_phase['text']="Times up for that Phase "
        settime -=1


drop=OptionMenu(win,clicked, *phases,command=submit,)
Results=Button(win,text="Results",font=('Times',25),command=Results)
timer_btn=Button(win,text="Set Timer for Phases",command=start,font=('Times',15))
Results.place(x=100,y=200)
hum_entry.place(x=250,y=150)
temp_entry.place(x=250,y=200)
ph_entry.place(x=250,y=250)
mp_entry.place(x=250,y=300)
hum_label.place(x=500,y=150)
temp_label.place(x=500,y=200)
ph_label.place(x=500,y=250)
mp_label.place(x=500,y=300)
drop.place(x=900,y=250)
Suggestion.place(x=40,y=500)
sugg_hum.place(x=40,y=600)
sugg_temp.place(x=40,y=650)
sugg_ph.place(x=40,y=700)
sugg_mp.place(x=40,y=750)
phase.place(x=900,y=200)
phasechange.place(x=900,y=150)
timer_btn.place(x=900,y=350)

hour_entry.place(x=940,y=400)
minute_entry.place(x=980,y=400)
second_entry.place(x=1020,y=400)
time_phase.place(x=940,y=450)

imagelabel.place(x=0,y=0,relwidth=1,relheight=1)
title.pack()
win.mainloop()

ser.close()
```