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Automated Plant Communicator System Using IOT Technology

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Abstract: Agriculture is the backbone of our country and improving the agricultural growing demands of plants and vegetables with smart technology is the dire need of the hour. The agricultural lands have to be properly maintained with the basic necessary nutrient values in the soil. The soil have to be maintained with suitable conditions and appropriate parameters for the vegetation requirement. The integral parameters for the growth of vegetation are proper Temperature, Humidity, Light and water. The Automated Plant Communicator System Using IOT Technology is a framework which helps in sending notifications in the form of alerts to the mobile phones or electronic gadgets connected through Bluetooth Technology. The notifications are the key real time values received from the plants to analyse the moisture level of the Soil, Temperature and Light Intensity (applied for indoor plants). These indicators helps us to know the vegetation condition in one click.

Keywords: Arduino, Bluetooth, Smart phone, Temperature and Humidity sensor, Moisture sensor, LDR sensor**.**

I. INTRODUCTION

An agricultural farm requires several parameters to monitor the plant vegetation. The monitoring process of the vegetation cannot be directly done by the people all the time and so monitoring the plant vegetation requires a sophisticated system to notify the basic indicators required for plant vegetation such as Temperature, Light , Moisture to the farmers and thus supporting the agricultural system in an effective and efficient way. The traditional methods cannot reach an ideal solution and there by the productivity of plants will be affected. The main purpose of coming up with this project is to build a Plant Communicator in which Bluetooth module sends the information of different parameters according to the requirement, user can operate that are connected with circuit for controlling parameters (Temperature, Humidity, Light intensity and Water supply) and that too without any internet facility unlike other systems.

II. LITERATURE SURVEY

Sreeram Sadasivam., et.al, 2015 [1]of the most crucial jobs in any farming or agriculture-based environment is plant monitoring. The development of ambient intelligent systems has led to an increase in ambient intelligent-based products. Smart Homes and other related RFID-based technologies have developed during the past few years. Farming is made simpler by integrating such an ambient intelligence system with plant monitoring. The proactive management of the plant monitoring system is handled by Net Gadgeteer. In order for the user to control and view the status of the plant that is being monitored by the hardware device, the offered implementation works in conjunction with a cloud-based server and a mobile device (preferably an Android/iOS smartphone).

U.H.D. Thinura Nethpiya Ariyaratne., et.al, 2021 [2]The main issue is that people cannot constantly watch over their plants and defend their gardens. With our innovative system, gardeners can use our app from anywhere in the world to water their garden and keep an eye on vital signs like the health of the plants, soil moisture content, air humidity level, and local temperature. Plant growth, output, and the quality of agricultural products are significantly influenced by plant health. With the help of sensors like temperature, humidity, and colour, this study aims to develop an automated system that can detect illness in plants based on fluctuations in plant leaf health state.

(Prathamesh Pawa., et.al, 2022) [4]The majority of people rely on agriculture, which is the backbone of our nation. Water scarcity is the critical challenge in agriculture. Water is squandered because the resource is not properly utilized. The irrigation process can be mechanised to get around this. The utilisation of Internet of things in this industry will be helpful to reduce the wastage of water. Sensors are used to measure the temperature, humidity, and light, and based on the results, additional processing can be done. We suggest a system that will use various sensors to record all the information about the soil and temperature. Using network infrastructure, IOT enables remote sensing or control of items. As a result, accuracy, financial gains, and efficiency increase while human intervention decreases. The approximate moisture level of the soil is monitored and maintained using an automatic watering system. The control unit is implemented using an Arduino UNO as a microcontroller. The system makes use of sensors to measure the approximate temperature, moisture content, and humidity of the soil: temperature, moisture, and humidity.

(Chonmoy Dhar Dipto., et.al, 2020) [5] IOT is used to keep track of the plants' physical state in this situation. So, we need to keep a close eye on the plants' overall health. Temperature, light intensity, humidity, and soil moisture are a few environmental factors that have an impact on the health of the plants. We'll monitor how these variables impact the health of our plants. Information will be provided to the Arduino, who will then send that information to a cloud platform. Via a smart phone, users can examine the stored sensor value to see if there are any discrepancies. Any divergence results in the user receiving an alarm message. We'll keep an eye on our system's overall health in this way. By being aware of these environmental factors, we can determine what our plants need and then take appropriate action.

(Prof. Likhesh Kolhe., et.al, 2018) [6] IOT refers to the interconnection of physical objects that are embedded with electronics, sensors, software, and network connectivity in order to provide greater value and services by exchanging data with the product's maker. Using network infrastructure, IOT enables remote sensing or control of items. As a result, accuracy, financial gains, and efficiency increase while human intervention decreases. We will discuss the fundamental ideas of IOT as well as its potential in the future in this essay. IOT makes a substantial contribution to cutting-edge farming techniques. This value enables the system to avoid over- or under-irrigation by using the proper amount of water.

(Nihareeka Nath., et.al) [7]is renowned for its agriculture, and the key to farming is irrigation. The irrigation element needs to be taken care of. Having an adequate water supply is crucial for having optimum crop quality and productivity. Due to our inability to estimate soil moisture levels and humidity, manually determining the demand for water supply becomes challenging. This lowers the crop quality. We may control the water supply using the Blynk application by receiving the moisture and humidity content from the automated irrigation system. This method will be useful for both water conservation and agricultural growth monitoring. It would also be helpful to forecast the state of the plant based on the sensor readings.

(Riju Bhattacharya., et.al, 2019) [8]In order to alter the way we care for domestic plants, this research proposes to automate such a system. Important growth factors for plants include soil moisture, temperature, humidity, sunshine, and pH. The information used to monitor and manage plant growth is derived from the data gathered by the sensors based on the aforementioned characteristics. Soil moisture sensor and temperature sensor are used in the suggested system, and they are interfaced with the Node MCU microcontroller to allow us to remotely monitor the plants' ability to endure temperature changes and water them as necessary. The information used to monitor and manage plant growth is derived from the data gathered by the sensors based on the aforementioned characteristics. The user of the system can control it using an IoT-enabled smart phone. In this work, the issue of people being unable to render changes in shade and offer convenience in meeting timely water requirements is identified, and it tends to be automated.

(Kanadala Likitha., et.al, 2022) [9]One of the most crucial jobs in any setting based on agriculture is plant monitoring. In this essay, we talk about how to put in place a system for tracking plant health. This will examine several environmental factors that affect plants, such as temperature, humidity, and light intensity. Get the soil moisture as well. The Arduino Uno development boards transmit all of this data to the Ubidots IoT (Internet of Things) cloud platform.

(P. Pavani., et.al, 2022) [10]and plants can be affected by an inadequate water supply. This project can be used to develop a smart plant monitoring system. We mostly employed the NODEMCU, DTH11 Sensor, and Soil Moisture Sensor components in this project. It discusses the mechanism of the plant monitoring system. It provides data about temperature, humidity, and soil moisture. Many sensors, including the DTH11 sensor and the soil moisture sensor, can be used for this. It is suitable for plants and may promote both the beginning of improved plant growth and the regulation of water usage. When the soil moisture is extremely low, the motor turns on and pumps water to the plant; as soon as the soil moisture rises, the motor automatically turns off. The Blynk IoT App can display the metrics temperature, humidity, and soil moisture.

III. METHODOLOGY

Hardware Requirements

Board	:	Arduino UNO
Module	:	Bluetooth Module

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Wire	:	Jumping wires
Appliance	:	Serial Bluetooth Terminal

Software Requirements

Operating system	:	Windows 11
Language	:	Embedded C
Software	:	Arduino IDE
Documentation	:	Microsoft word

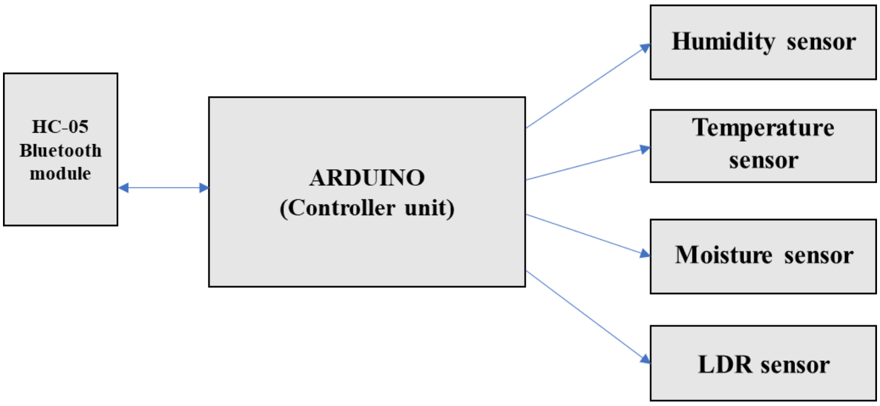

Figure 1 BLOCK DIAGRAM

The Arduino UNO is a standard board of Arduino. Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits. The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is IDE program based. It can run on both online and offline platforms.

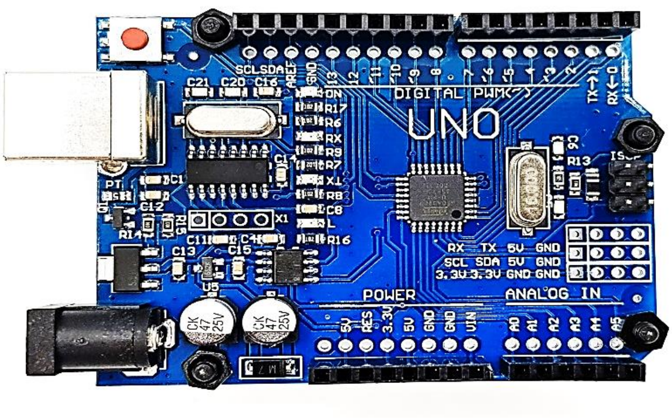

Figure 2 ARDUINO BOARD

An open-source electronics platform called Arduino is built on simple hardware and software. A motor can be started, an LED can be turned on, and something may be published online by using an Arduino board to receive inputs like light on a sensor, a finger on a button, or a tweet. The board's microcontroller can receive instructions from the user. Use the Arduino Software (IDE), based on Processing, and the Wiring programming language for this.

Advantages of Arduino
- Inexpensive
- Cross Platform
- Simple and Clear Programming Environment
- Open Source

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- Extensible Software
- Extensible Hardware

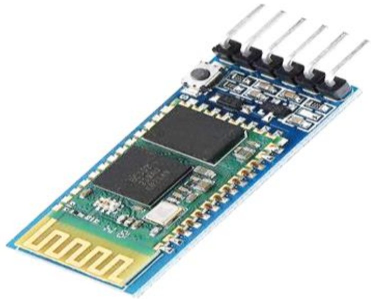

Figure 3 BLUETOOTH MODULE

The Bluetooth module services used here is HC-05 which is used for transparent wireless serial communication. A replacement for cable connectors the electronics are communicated with by HC-05 using serial communication. Typically, a short-range wireless connection is used to exchange files between small devices like mobile phones. It operates in the 2.45GHz range. Data can be transferred at a rate of up to 1Mbps over a distance of ten metres.The operating range of the HC-05 module is 4-6V of power supply. Baud rates of 9600, 19200, 38400, 57600, etc. are supported. The most important feature is that it may be used in Master-Slave mode, which prevents data from being sent or received from othersources.

Description of pins:

- **Enable - This pin is used to configure the AT command mode or the Data Mode (set high).**
- **VCC - This plugs into a +5V power source.**
- **Ground - Joined to the powering system's ground.**
- **Tx (Transmitter) - This pin serially sends the data that has been received.**
- **Rx (Receiver) - Utilized while transmitting serial data via Bluetooth.**
- **Status - Used to determine whether Bluetooth is operational.**

Modes of Operation

The HC-05 Bluetooth Module can be used in two modes of operation

- Command Mode
- Data Mode.

In Command Mode, communication with the Bluetooth module is done through AT Commands and in the data mode, the module is used to communicate with other Bluetooth devices.

JUMPING WIRES:

Figure 4 JUMPING WIRES

In order to link the parts of a breadboard or other prototype or test circuit internally or with external equipment or components without soldering, a jump wire is an electrical wire, or group of wires in a cable, with a connector or pin at either end (or occasionally without them - just "tinned"). A breadboard, a circuit board's header connector, or a piece of test equipment can all be used to create slots for the "end connectors" that hold individual jump wires. Male-to-male, male-to-female, and female-to-female jumper wires are the most common types. The wire's termination tip distinguishes each one from the other. Whereas female ends do not have a protruding pin and are used to plug into items, male ends do. The most typical and often utilized jumper cables are male to male.Jumpers are typically tiny metal connectors that are used to open or close circuit components. They have two or more connecting points that control a circuit board for an electrical system. They are responsible for setting up the motherboard and other computer devices.

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DTH11 sensor

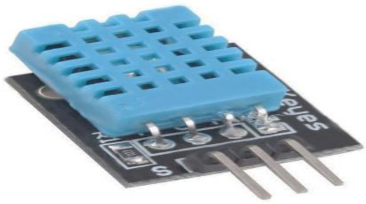

Figure 5 DHT11–TEMPERATURE AND HUMIDITY SENSOR

The DHT11 includes temperature and humidity sensors. Two electrodes with a moisture-holding substrate in between them are used to measure humidity. As a result, as the humidity varies, so does the resistance between these electrodes and the substrate's conductivity. The IC measures and processes the change in resistance, preparing it for reading by a microcontroller. On the other hand, a thermistor or an NTC temperature sensor are used to measure temperature using the DHT11 sensor. Because a thermistor is a variable resistor, its resistance changes as the temperature changes. These sensors are created through the sintering of semi-conductive materials (ceramic and polymers), which enable significant resistance variations with only modest temperature changes.

Moisture Sensor

Figure 6 SOIL SENSOR

The moisture of the soil is found using a soil moisture sensor. The electronic board on the right and the probe with the two pads that measure soil moisture make up this sensor's. According on the soil moisture level, the sensor's output voltage varies. whenever the soil is
Wet: A drop in output voltage occurs.
Dry: A rise in output voltage occurs.

LDR SENSOR

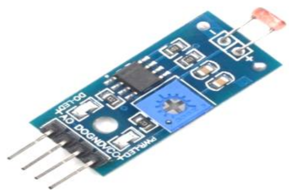

Figure 7 LDR SENSOR

A device whose resistance depends on the electromagnetic radiation that is incident is known as an LDR or photo resistor. They are therefore light-sensitive gadgets. They may also be referred to as photocells, photoconductors, or simply photoconductive materials. There are many various ways to represent an LDR; one of the most popular is depicted in the Figure 7.

IV. IMPLEMENTATION AND RESULT ANALYSIS

Steps To Connect:

Arduino Bluetooth Connection

1. Join the Bluetooth RX pin to the Arduino 8 pin.
2. Join the Arduino's 9-pin TX pin to the Bluetooth TX pin.
3. Join the GND pins of Bluetooth and Arduino together.
4. Join the Bluetooth VCC pin to the Arduino 5V pin.

Arduino Humidity Sensor Connection

1. Attach the Arduino's 5V pin and the VCC pin of the humidity sensor.
2. Link the GND pins of the humidity and the Arduino.
3. Connect Arduino pin A0 to the IN1 pin of the Humidity module.

Arduino LDR Sensor Connection

1. Attach the VCC pin of the Ldr to the 5V pin of the Arduino.
2. Join the GND pins of the LDR and the Arduino.
3. Connect pin A1 on the Arduino to the IN1 pin on the Ldr.

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Arduino Moisture Sensor Connection

1. Connect the VCC pin of the Moisture to the Arduino's 5V pin.
2. Join the GND pins of Moisture and Arduino.
3. Connect Moisture's IN1 pin to Arduino's pin A2.

Sample Code

```
#include<SoftwareSerial.h>
SoftwareSerial mySerial(8,9);
#include "dht.h"
#define dht_apin A0
const int dry = 595;
const int wet = 239;
dht DHT;
int sensorPin = A1; // select the input pin for LDR
int sensorValue = 0;
void setup()
{
 Serial.begin(9600);
 mySerial.begin(9600);
 delay(500);//Delay to let system boot
 Serial.println(",DHT11 Humidity & temperature Sensor\n\n");
 delay(1000);
}
void loop()
{
  DHT.read11(dht_apin);
  int sensorVal = analogRead(A2);//moister sensor A1
  int percentageHumididy = map(sensorVal, wet, dry, 100, 0);
  Serial.print(percentageHumididy);
  Serial.println("%");
  Serial.print("Current humidity = ");
  Serial.print(DHT.humidity);
  Serial.print("% ");
  Serial.print("temperature = ");
  Serial.print(DHT.temperature);
```

```
Serial.println("C ");
  mySerial.print(percentageHumididy,0);
  mySerial.print("%");
  mySerial.print(DHT.humidity);
  mySerial.print("%");
  mySerial.print(DHT.temperature);
  mySerial.print("C");

//ldr sensor
  sensorValue = analogRead(sensorPin); // read the value from the sensor
  Serial.println(sensorValue);
  mySerial.print(sensorValue); //prints the values coming from the sensor on the screen
  if(sensorValue > 500){
   Serial.println("insufficient");
   mySerial.print("Insufficient");
  }
  else{
   Serial.println("sufficient");
   mySerial.print("Sufficient");
  }
  delay(5000);
}
```

The Diagrammatic representation and the numbering format of the output screen shots represented below

1 – Soil Moisture Sensor
2 – Ldr Sensor
3 – Arduino Board
4 – Jumper Wires
5 - Laptop
6 – USB A to B cable
7 – Bluetooth Module
8 – Bread Board
9 - Demo kit box with Soil
10 – Temperature and Humidity Sensor

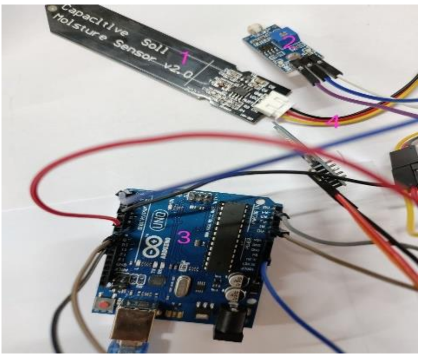

Figure 8 SENSOR CONNECTION

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The Figure 8 describes the sesnor connections of Soil Mositure Sensor and LDR sensor with the Arduino board. The connectivity established through jumping wires. The Figure 9 describes the Arduino code upload in the UNO board.

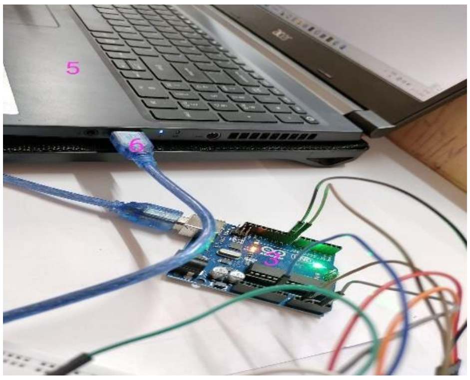

Figure 9 ARDUINO CODE UPLOAD IN BOARD

The Figure 10 demonstrates the connection of all sensors with the Bluetooth module and bread board. The Figure 11 shows the connectivity of sensors with the demo kit box with soil.

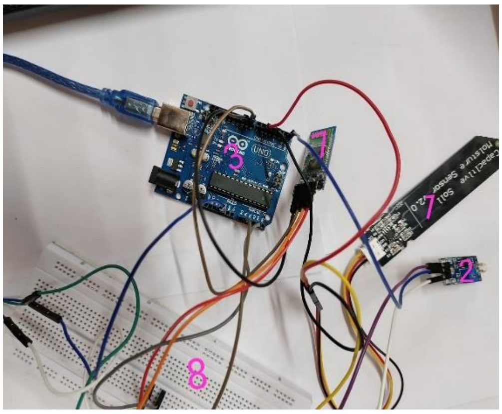

Figure 10 CONNECTION OF BLUETOOTH

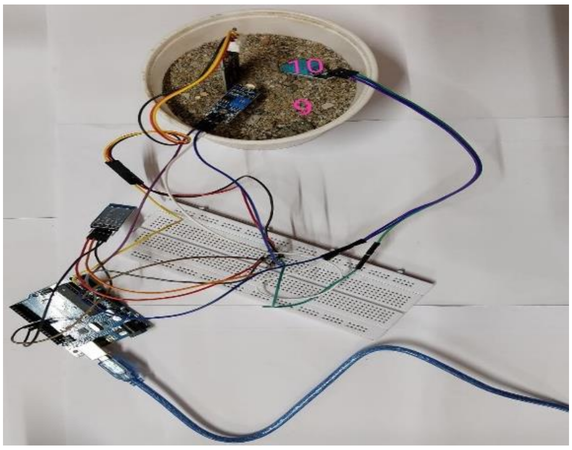

Figure 11 CONNECTION OF BOARD WITH SENSORS

The complete working sensors of this project connected with Bluetooth module for transfer of required data details are depicted in the Figure 12 and Figure 13 depicts the arduino ide code and Figure 14 refers to the sensors value in serial bluetooth terminal display.

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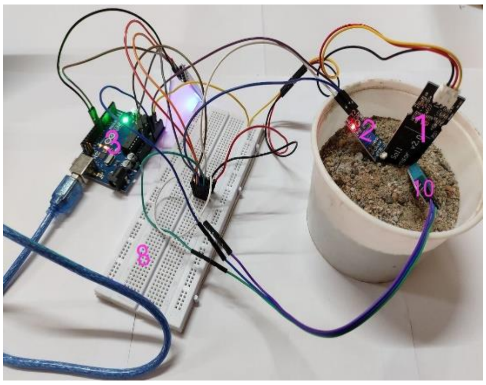

Figure 12 COMPLETE WORKING SENSORS WITH BLUETOOTH MODULE

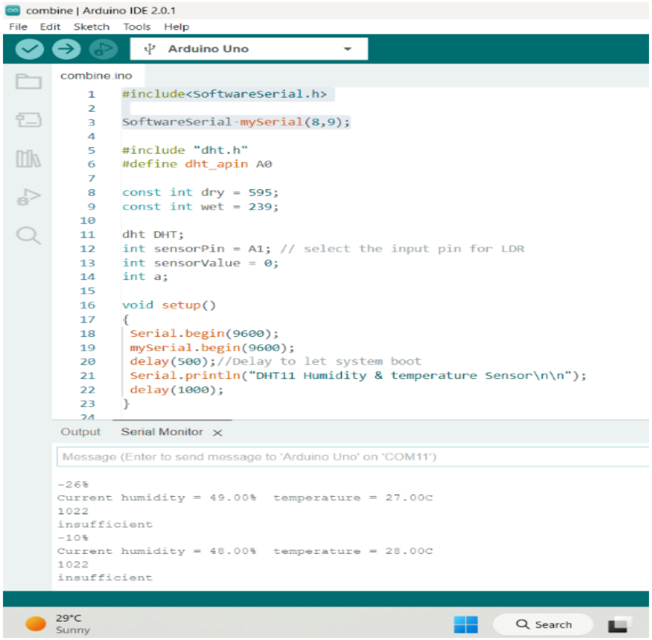

Figure 13 ARDUINO IDE CODE

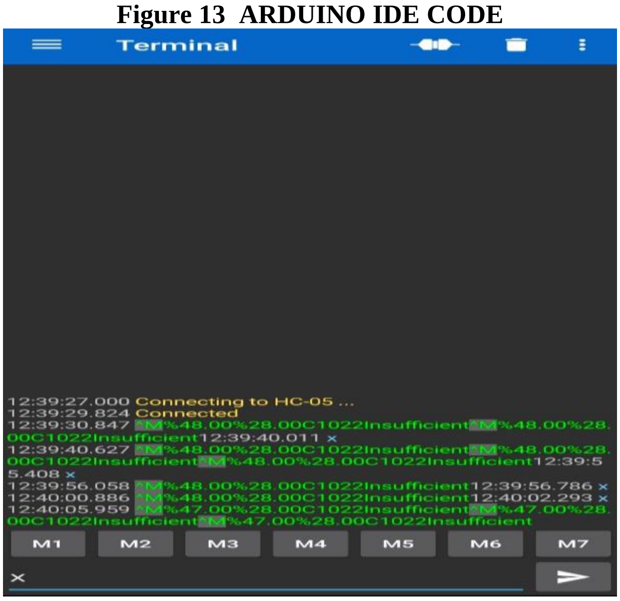

Figure 14 SENSORS VALUE IN SERIAL BLUETOOTH TERMINAL

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Table 1 : Sensor, Output Values and Threshold Ranges

Sensors	Signs	Output Values	Threshold Value
Temperature and Humidity sensor (DHT11)	C	28.00C	Vegetative phase: 25C Flowering phase: 28C Plants: 32C to 60C
		43.00C	
		20.00C	
		50.00C	
Moisture Sensor	%	48.00%	Vegetables: 41% to 80% Flowers and Plants: 21% to 40%
		55.00%	
		21.00%	
		32.00%	
Ldr sensor	Insufficient or Sufficient	1022 Insufficient	(800-1023) Insufficient (more than 1023) Sufficient
		1034 Sufficient	
		986 Insufficient	
		1052 Sufficient	
		1049 Sufficient	

Table 1 mentions the various type of sensors working process and its corresponding output details such as Temperature and humidity sensor relates to centigrade values and the outputs are displayed as 28.00C value formats and the Moisture sensor is represented as % format indicates the amount of moisture content available in the soil. If the plant is an indoor plant and occasionally it might require sunlight for its growth the LDR sensor takes the role of identifying whether the sunlight is sufficient enough or not. The Arduino, with its built-in ADC (analog-to-digital converter), then converts the analog voltage (from 0-5V) into a digital value in the range of (0-1023). With respect to the plants if the range is between 800 to 1023 then in indicates insufficient light source to the plant and if the range is greater than 1023 then there is sufficient light source to the plant.

V. CONCLUSION

The purpose of this paper is to design and build a working prototype of monitoring and sensing system for agricultural field. This system allows users to obtain temperature, humidity, light Intensity and soil moisture readings from the agricultural field area via their smart phone. This was achieved using Arduino Uno (microcontrollers) and a Bluetooth (HC-05) wireless module. This prototype is considered to be cost effective, user friendly and reliable system. The project had three main sections: monitoring, sensing system and wireless communication. Monitoring provided the real-time value of humidity, temperature, light intensity and soil moisture. Wireless communication connects the users to all the information regarding to his field. The system performed as designed and was able to perform all the objectives mentioned. The above mentioned prototype model can be extended to the real time environments.

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BIOGRAPHY

M.Nirmala, received the B.Sc Degree in Computer Science from Bharathiar University, MCA from Bharathidasan University and M.Phil from Bharathiar University. She has a total teaching experience of 20+ years. Her area of interest includes Networking, Simulation & Modeling, Machine Learning and Deep Learning. Received the Best Paper Award and Published in IEEE explore. She has published more than 15 International Journals, 10 International Conferences and authored 2 Books.

K.Pavithra received the BA English from Bharathidasan University and currently pursuing her Final Year MCA from Hindusthan College of Engineering and Technology, an Autonomous College, Affiliated to Anna University. Her area of interest included Machine Learning, Deep Learning and IOT.

Suresh Kumar P received the BE Degree from Maharaja Prithvi Engineering College and ME from Anna University, Coimbatore. He has total teaching Experience of 14+ years. He has published articles in many International Journals and Conferences and has published 5 Patents.

Dhivya G received the BCA from Ayya Nadar Janaki Ammal College and currently pursuing her Final Year MCA from Hindusthan College of Engineering and Technology, an Autonomous College, Affiliated to Anna University. Her area of interest included Machine Learning, Deep Learning and IOT.