WIRELESS AGRICULTURAL LAND MONITORING SYSTEM

A project report Submitted in partial fulfillment of

the requirements of the Degree of

Bachelor of Engineering

In

(Electronics Engineering) by

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May 2022

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WIRELESS AGRICULTURAL LAND MONITORING SYSTEM

In partial fulfillment of degree course in

ELECTRONICS ENGINEERING

2021-2022

UNDER THE GUIDANCE OF

Mrs. RENUKA CHIMANKARE

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Project Report Approval for B.E

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Declaration

We declare that this written submission represents our ideas in our own words and where other's ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not taken when needed.

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Place:

Acknowledgement

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Abstract

This study is a review of designing an Internet of Things (IoT) enabled platform for monitoring and controlling agriculture parameters through web-based applications for precision agriculture. Moreover, this study will develop a low-cost, high-performance, and flexible distributed monitoring system due to not incorporating expensive components such as high-end personal computers. Also, it offers full control of the system, not by constant manual attention from the operator but to a large extent by wireless sensors. Thus the review describes several designs of a smart monitoring system using intelligent techniques (wireless sensors). There are three principal components in this study, which are an electronic device, software development, and system prototype internet protocol layer. The purpose is to combine all three components to make a web application. Furthermore, the adoption of intelligent techniques in monitoring systems could reduce the concept of the usefulness of the system due to complicated manually monitoring and controlling processes.

***Keywords* –** Internet of things, Microcontroller, DHT 11, Soil moisture Sensor, Actuating Pump, PHP, MySQL.

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CHAPTER 1

1.1Introduction

In recent years, to improve crop production and quality of agricultural operations and to reduce labour's cost a concept "precision agriculture" that is remotely observing, measuring the environmental condition of the farm from anywhere, anytime by IoT has been attracting a lot of attention.

The IoT is a network of physical objects to exchange data with other devices and systems over the internet. By means of low-cost computing, the cloud, WSN, and mobile technologies, physical things can share and collect data with minimal human intervention. Wireless Sensor Network (WSN) technology is an essential component of IoT as it has great potential for monitoring different agriculture parameters with better accuracy. In a WSN-based system, the environmental information (e.g., temperature, humidity) is collected from a large number of sensor nodes installed in the. farm this information is transferred to the sink node using low-power wireless communications (e.g, ZigBee). ZigBee has emerged as the most promising standard owing to its low power consumption and simple networking configuration. Wireless-based smart sensors networks can combine sensing, computation, and communication into a single, small device that reduces the cost of construction, maintenance, size, and weight of the whole system.
In this study, Arduino and NodeMCU were used. The Arduino is an open- source electronics platform used to build electronics projects. It consists of a physical programmable circuit board that can be connected using a USB cable (i.e a microcontroller) and an IDE (Integrated Development Environment) that runs on a computer, which is used to write and upload computer code to the physical board. Arduino IDE uses a simplified version of C++, which makes it easy for a programmer to learn and understand.

Additionally, Ethernet Shield is used for providing IP services on Arduino and PC to be able to connect to the internet. Similar to Arduino, NodeMCU is also an open-source software and hardware development environment based on ESP8266. IT contains the pivotal elements of a computer: CPU, RAM, and networking (WiFi). That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

The system design consists of three layers: perception layer, network layer, and application layer, which provides users with various kinds of functions. The function of the perception layer is to provide all kinds of sensing data needed by the platform. With these data, users will have a better understanding of the state of their lands. The network layer is the link between the perception layer and the application layer. It implements the function that sends the sensing data generated by the perception layer to the database server located in the cloud.

These data will be stored in the database server later. Lastly, the application layer, contains an application server, a database server, and various kinds of clients.
The core function is processing the data stored in the database server located in the cloud, so as to realize remote monitoring. In addition, the platform will automatically determine the current state of land and inform users of the results in real- time. The primary aim of this study is to design a monitoring system using a wireless sensor network with the help of the internet where the presence of the farmers in the field is not compulsory.

CHAPTER 2

2.1 Problem Statement

The Traditional agriculture sector cannot meet the requirements of modern agriculture techniques which have high-yield ,high quality and high productivity which benefits the farmers, so it is very important to turn towards modernization using various sensors and actuators and predict the possible suitable condition for the crops and increase their productivity of the land . Using Iot application we can control the irrigation pumps, opening and closing of water and we can also get the real time data of the soil using them and which can thus increase the productivity and health of the crop.

2.2 Scope

To create a System which will allow a farm owner to monitor a farm land.

To build the system there will be 3 parts.

1. A device that can sense various parameters of land including moisture content of soil, Humidity of atmosphere and temperature of the soil and is capable of controlling actuating pumps according to the farm owner's configuration.

2. Server for collecting data from various devices deployed in the farm.

3. Web application f or remote view and control.

Device which is placed in the field will sense the temperature, humidity and moisture content of the soil and send the information to the data server. Then by using web application f arm owner or any user authorized by the f arm owner can view the data of different devices connected to the field and can control the actuator pumps and light connected to that device manually by using website.

Steps to follow from farmers perspective.

- The farm owner must have a good internet connection so as to connect our device to the website.
- Farm owners must correctly place the device in the proper region of the field.
- Sensors and actuators must be placed strictly according to their usage.
- The farm owner should do the login to the website using his own credentials to access the website for monitoring.
- Each of the devices has a unique number which differentiate them from each other.
- Using the unique key do a one-time registration of the device. After registration is done the device will be linked to the owner.
- Now he can monitor and analyze soil conditions and other parameters for higher crop yield.
- Now according to crop requirements, he can make changes to the surrounding conditions remotely from the website.

CHAPTER 3

3.1 Literature Survey

Many current researchers have been focused on analyzing collected data and display their results to its users to make a smart precision agriculture system. That can monitor collected data like temperature, humidity, soil moisture and present it to the users.

1. PAPER 1

PAPER: Wireless Sensor Network and Internet of Things in Precision Agriculture

AUTHOR: Farzad Kiani, Amir Seyyedabbasi

PUBLICATION: (IJACSA) International Journal of Advanced Computer Science and Applications

ISSN: Vol. 9, No. 6, 2018

Explains that the web of Things is one among the foremost popular subjects nowadays where sensors and smart devices facilitate the supply of data and communication. In IoT one among the most concepts in wireless sensor networks during which data is collected from all the sensors in a network. An architecture to watch soil moisture, temperature, and humidity on small farms is provided.

The sensor types used in the proposed system architecture are humidity, temperatures, and soil moisture. These sensor-based devices are deployed in the environment to sense and collect data. Data is collected by system nodes and transmitted to the server via the cross from probable other nodes and gateways. They used a custom-designed board called KIANI as a sensor node. The board has temperature and humidity sensors that sense different air humidity and temperature. Low-Power Sub-1GHz RF Transceiver Computing unit equips with Arduino Nano, ATmega328P are utilized in computing unit. In the power unit, a 1200mah 3.7v Li-ion rechargeable battery is used. RASPBERRY PI 3 is used as a gateway to send collected data from sensors to sever for processing and presentation information that users need.

The farm of 100*100 meters is divided into 4 parts, and each part has a node deployed in it. Data is obtained every one hour from devices, which are forwarded to the gateway. Where it is stored and then transferred to users through API. The implemented GUI has a user-friendly interface so the users can benefit from all means. The system will update the information hourly, from every region.

CONCLUSION: This project describes an automated agricultural monitoring system using IoT. This system will sense all the mentioned parameters and send the data to the user. The user will take controlling action according to it. This asset allows the farmer to enhance the cultivation during a way the plant need. It leads to higher crop yields and better quality crops.

2. PAPER 2

PAPER: Monitoring and Control Systems in Agriculture Using Intelligent Sensor Techniques: A Review of the Aeroponic System

AUTHOR: Imran Ali Lakhiar, Gao Jianmin , Tabinda Naz Syed, Farman Ali Chandio , Noman Ali Buttar , and Waqar Ahmed Qureshi

PUBLICATION: Hindawi, Journal of sensors

ISSN: Volume 2018, Article ID 8672769, 18 pages

Describes that Aeroponics is the new plant growing system of new-age agriculture. In the system, the plant cultivates under complete control conditions in the growth chamber by feeding a small mist of the nutrient solution in replacement of the soil. The paper gives significant knowledge about sensors like Temperature Sensors- which measure the real-time temperature reading through an electrical signal. Water sensors detect the liquid level PH sensors -to measure the acidity or alkalinity of a soil and many different sensors. The sensors sense their respective parameters and then convert them into electrical signals, the output of the sensors is connected to the Microcontroller. Then the microcontroller displays the information to the user and according to the user the parameters are controlled. Thus, the system helps the planter to keep a watch and control the aeroponic system using the mobile app. The review also provides a wide range of information that could be essential for plant researchers and provides a major understanding of how the vital parameters of aeroponics relate with plant growth in the system.

3. **PAPER 3**

PAPER: A monitoring system based on wireless sensor network and an SoC platform in precision agriculture

PUBLICATION: IEEE

AUTHOR: Jzau-Sheng Lin, Chun-Zu Liu

ISSN: 2008 11th IEEE International Conference on Communication Technology

The main goal of this paper is to develop a low-cost, high-performance, and flexible distributed monitoring system with increased functionality.

Wireless connection-based smart sensors network combines sensing, computation, and communication into a single, small device.

The three main wireless standards used namely: WiFi, Bluetooth, and ZigBee.

Firstly they used acquisition sensors for field signals, an MCU as the front-end processing device, and several amplifier circuits to process and convert signals of field parameters into digital data. Secondly, the Zigbee module was used to transmit digital data to the SoC platform in a wireless manner. Finally, an SoC platform, like a Web server additionally, was used to process field signals.

Then, a system was created in which field signal values are displayed on a Web page.

The whole system was successfully designed and tested.

CONCLUSION: A wireless-network field signal monitoring system in precision agriculture was proposed in this paper. Most field monitoring system applications use mobile devices and PC as the main monitoring device. They used a SOC platform as the Web server that effectively reduce cost and the physical size significantly.

4. PAPER 4

PAPER: AID: A Prototype for Agricultural Intrusion Detection Using Wireless Sensor Network

PUBLICATION: IEEE

AUTHOR: Sanku Kumar Roy, Arijit Roy

ISSN: 2015 IEEE International Conference on Communications (ICC)

Currently, Wireless Sensor Network (WSN) is used for solving numerous real-time problems. As WSN, sensor nodes sense some physical phenomena and transmit those sensed data to the sink or any centralized device through single- or multi-hop connectivity. After collecting the data, different opinions can be taken. Due to the resource-constrained nature of WSNs, WSNs are used in different fields Presently, WSN technology is extensively used for different purposes of agriculture to produce the crop with high volume and reduce the cost of yield. Theft in agrarian fields is a common issue these days and frequently there's substantial loss is incurred, which prevents effective product of crops. Considering this they designed a prototype that enables a farmer to receive text messages on his/ her cell phone and an alarm is actuated if a burglar enters into his/ her civilization field.

To apply the designed prototype, they developed AVR microcontroller-grounded wireless detector boards. Each of the boards contains two types of detectors – (a) Passive Infrared (PIR) and (b) Ultrasonic detector.
The major component of a board are: 1) Micro-controller ATMEGA324PA-PU 2) ZigBee (IEEE802.15.4) 3) Liquid Crystal Display (LCD 16X2) 4) Sensor

The AID architecture has four layers
Layer 1 consists of two sorts of sensing activities, i.e., sensing by Passive Infrared (PIR) and ultrasonic sensor. When an intruder enters the sector, the PIR sensor senses the intruder, and therefore the node is activated. Thereafter, the ultrasonic sensor measures the space of the intruder from the sector boundary. The sensed data from PIR and ultrasonic sensors are processed by the micro-controller present in Layer 2. After the detection of an intruder, the information is transmitted to the sink through single - or multihop connectivity, with the assistance of ZigBee (IEEE802.15.4). Routing of the knowledge from the node to the sink is that the responsibility of Layer 3. Finally, in Layer 4, the GSM technology is employed to get SMS to the farmer’s telephone, and simultaneously, an alarm is generated within the farmer’s house. By receiving the SMS and alarm, the farmer gets the knowledge about the doorway of an intruder within the field. Each of the boards has an indoor Electrically Erasable Programmable ROM (EEPROM) micro-controller, that helps to store any data temporarily they examined the AID by placing 20 sensor nodes over a square agriculture field, All the deployed sensor nodes were connected with one another through a wireless link to form a network.

CONCLUSION: a prototype for intruders detection using WSN was implemented, this prototype ensures the farmer about the detection of intruders in his/her field by sending SMS or generating alarm. Therefore, handed a low-cost and energy-effective complete result for intruder detection. In the future, they decide to develop an intrusion detection system for the agrarian field using learning automata. By doing so, the system can learn by itself, so as to descry intrusion within the agrarian field in an energy-effective manner.

PAPER	AUTHOR	PUBLICATION	E-ISSN	SENSORS & BOARDS
Wireless Sensor Network and Internet of Things in Precision Agriculture	Farzad Kiani, Amir Seyyedabbasi	(IJACSA) International Journal of Advanced Computer Science and Applications	Vol. 9, No. 6, 2018	Arduino Nano, ATmega328P and RASPBERRY PI 3
Monitoring and Control Systems in Agriculture Using Intelligent Sensor Techniques: A Review of the Aeroponic System	Imran Ali Lakhiar , Gao Jianmin , Tabinda Naz Syed, Farman Ali Chandio , Noman Ali Buttar , and Waqar Ahmed Qureshi	Hindawi, Journal of sensors	Volume 2018, Article ID 8672769, 18 pages	Temperature Sensors, Water sensors, PH sensors
A monitoring system based on wireless sensor network and an SoC platform in precision agriculture	Jzau-Sheng Lin, Chun-Zu Liu	IEEE	2008 11th IEEE International Conference on Communication Technology	WiFi, Bluetooth, and ZigBee.
AID: A Prototype for Agricultural Intrusion Detection Using Wireless Sensor Network	Sanku Kumar Roy, Arijit Roy	IEEE	2015 IEEE International Conference on Communications (ICC)	Micro-controller ATMEGA324PA-PU , ZigBee (IEEE802.15.4) ,Liquid Crystal Display (LCD 16X2) ,Sensor

Chapter 4

4.1 Proposed system

What we are building?

A device which will be placed inside the agricultural field and sense the various parameters of the soil and environment and Farmers can monitor and control the field through the website by logging their credentials provided by the admin.

Features and application: -

We have made a device with NodeMcu with Esp8266 as a main controller it has various sensors module like Dht11, soil moisture sensors. This sensor will sense the real time data and will send the data using wifi module to the server. we can access this data for our website and we can display it on the website. User will be given unique credentials through which they can log in can its will display the total number of device connected to that particular user, then user can individually monitor and control the one particular device and can monitor its parameter.

Final demo: -

we have created a device name (device 1) we have placed the device in the dry soil and monitored the moisture content and humidity and after that we have added some water to the field and observed the change in the water content of the soil and we have also controlled the motor pump through our website.

Flow chart: -

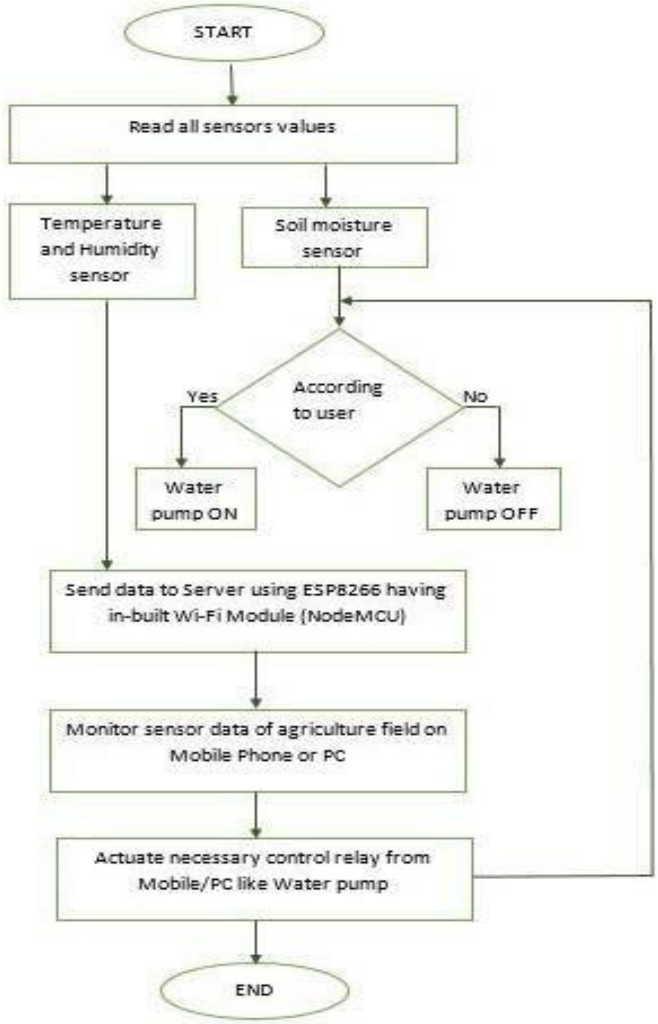


Figure 4.1.1 flow chart

- First all the sensors value is collected and gathered.
- Then the sensors value is send to the server and through our website we can monitor and control these data.
- If user thinks he wants to increase the moisture level of field he can do so by turning ON the pump from the website.
- We can also monitor the humidity and temperature of the surrounding and can do the necessary changes.

4.2 Components list

1. NodeMCU with ESP 8266

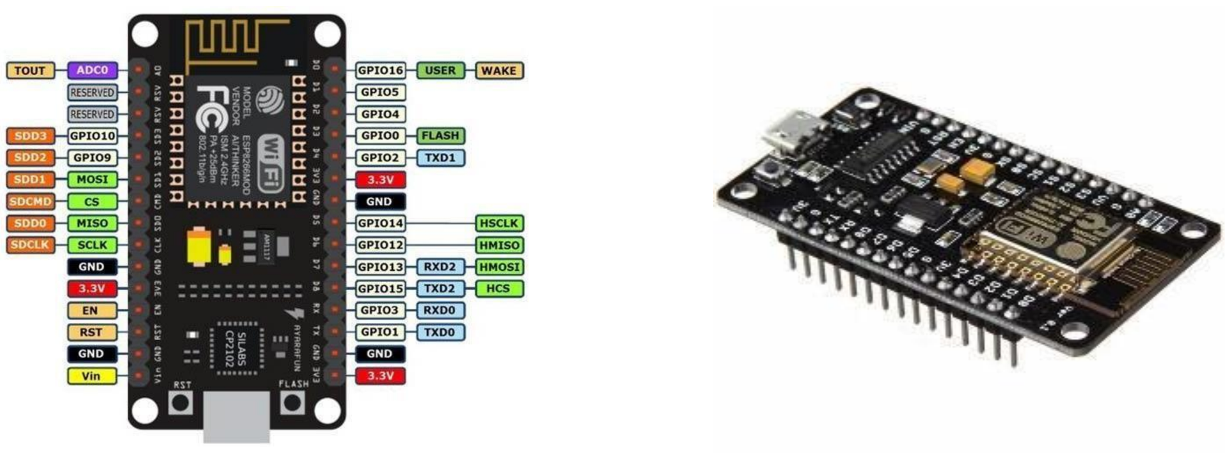


Figure 4.2.1 NodeMCU ESP8266

The NodeMCU (*N*ode *M*icro*C*ontroller *U*nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds. However, as a chip, the ESP8266 is also hard to access and use.. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects. NodeMCU measures 49mm x 26mm with a standard pin space of 0.1″ between pins and 0.9″ between rows.

NodeMCU ESP8266 Specifications & Features

- Operating Voltage: 3.3V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz

2. DHT 11 Module

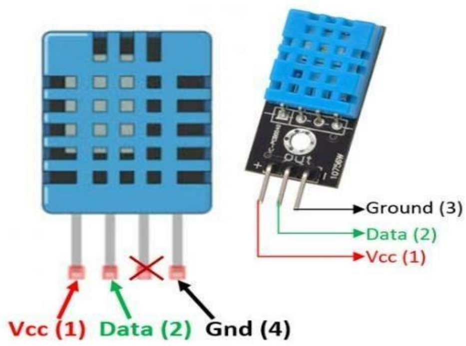


Figure 4.2.2 DHT11 Sensor

The DHT11 is a commonly used Temperature and humidity sensor that comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

DHT11 Specifications

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (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. Soil moisture Sensor

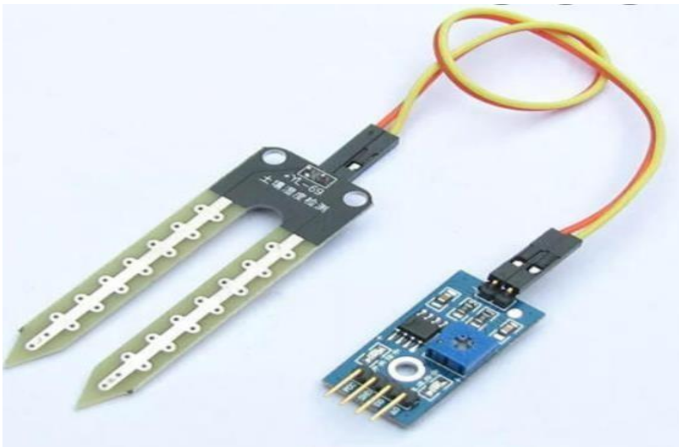


Figure 4.2.3 Soil Moisture Sensor

This resistance is inversely proportional to the soil moisture:

- The more water in the soil means better conductivity and will result in a lower resistance.
- The less water in the soil means poor conductivity and will result in a higher resistance.

The sensor produces an output voltage according to the resistance, which by measuring we can determine the moisture level.

Soil Moisture Sensor Module Features & Specifications

- Operating Voltage: 3.3V to 5V DC
- Operating Current: 15mA
- Output Digital - 0V to 5V, Adjustable trigger level from preset
- Output Analog - 0V to 5V based on infrared radiation from fire flame falling on the sensor
- LEDs indicating output and power
- PCB Size: 3.2cm x 1.4cm

4. DC Water pump

Figure 4.2.4 DC Water Pump

A pump is a device that moves fluids or sometimes slurries, by mechanical action, typically converted from electrical energy into hydraulic energy. DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways.

Operating voltage -6V

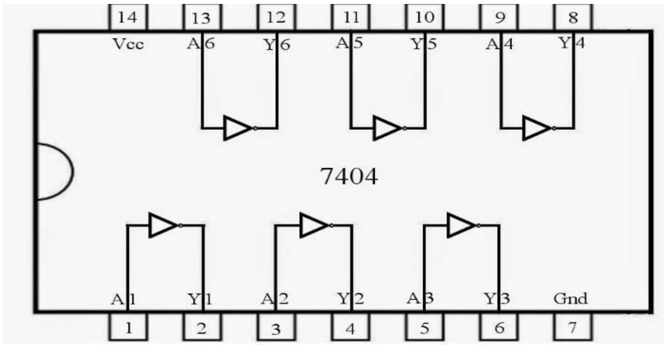
Current required 30-50 mA

5. Powe Supply (cell)

Figure 4.2.5 Pencil Cells

It is also known as a pencil cell or dry cell. It converts chemical energy into electrical energy. A dry cell is a primary cell that is non-rechargeable and thus cannot be reused. These cells are used in a number of household gadgets like a radio, a transistor, a tape-recorder, a calculator, etc.

6. IC 7404 inverter



INPUT	OUTPUT
HIGH	LOW
LOW	HIGH

Figure 4.2.6 IC 7404 Inverter

NOT gate is commonly used to INVERT a logical HIGH to logical LOW or logical LOW to logical HIGH. Each NOT gate has one input and one output. Commonly used NOT gate IC is 7404. Pinout diagram of 7404 is given below. Each 7404 has 6 NOT gates arranged as shown in the following figure. 14th pin is the Vcc and 7th pin is the Ground. Supply voltage should be less than 5.25V and greater than 4.75V. A voltage greater than 2V will be considered as HIGH level and voltage less than 0.8V will be considered as LOW level.

7. Relay module

Figure 4.2.7 Relay Module

A 5v relay is an automatic switch that is commonly used in an automatic control circuit and to control a high-current using a low-current signal. The input voltage of the relay signal ranges from 0 to 5V. It is frequently used in an automatic control circuit. To put it simply, it is an automatic switch to control a high-current circuit with a low-current signal. 5V relay signal input voltage range, 0-5V. VCC power to the system.

CHAPTER 5

5.1 Block Diagram

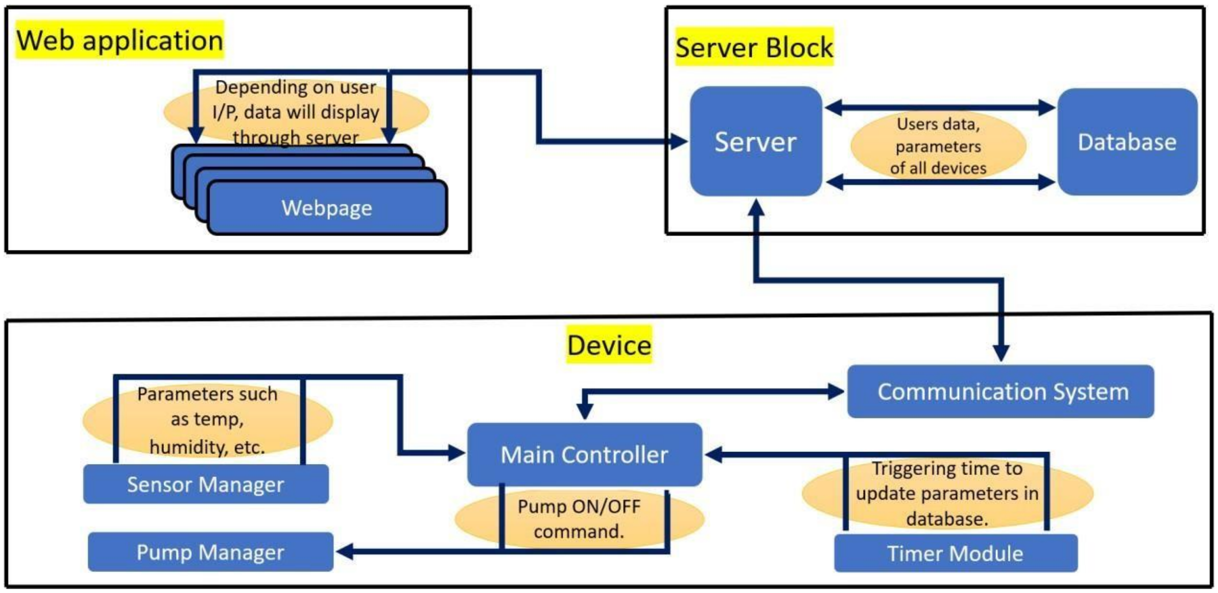


Figure 5.1.1 Block Diagram

Block diagram is basically divided into 3 parts-

- Device
- Server block
- Web Application

<u>Device: -</u>

In Device part main blocks are the sensor manager which is responsible for taking the sensor data from dht11 and soil moisture sensor and sends it to the controller. Here controller used is a NodeMCU 8266 which does the controlling action the data. The timer module automate the real time data every 3 seconds.The communication manager sends the sensor data from the controller to the Server part through the Wifi.

<u>Server Block: -</u>

We have created a server in which we have created the database to store the real time data from the sensor. The database stores the data properly in a systematic manner and run the server.

<u>Web Application: -</u>

We have created the website where the user will be logging through their credentials provided by the admin. The website is connected through the IP address of the server and get the data from the server and shows it on the website and update the data. we can also control the pump from the website.

5.2 Circuit Diagram

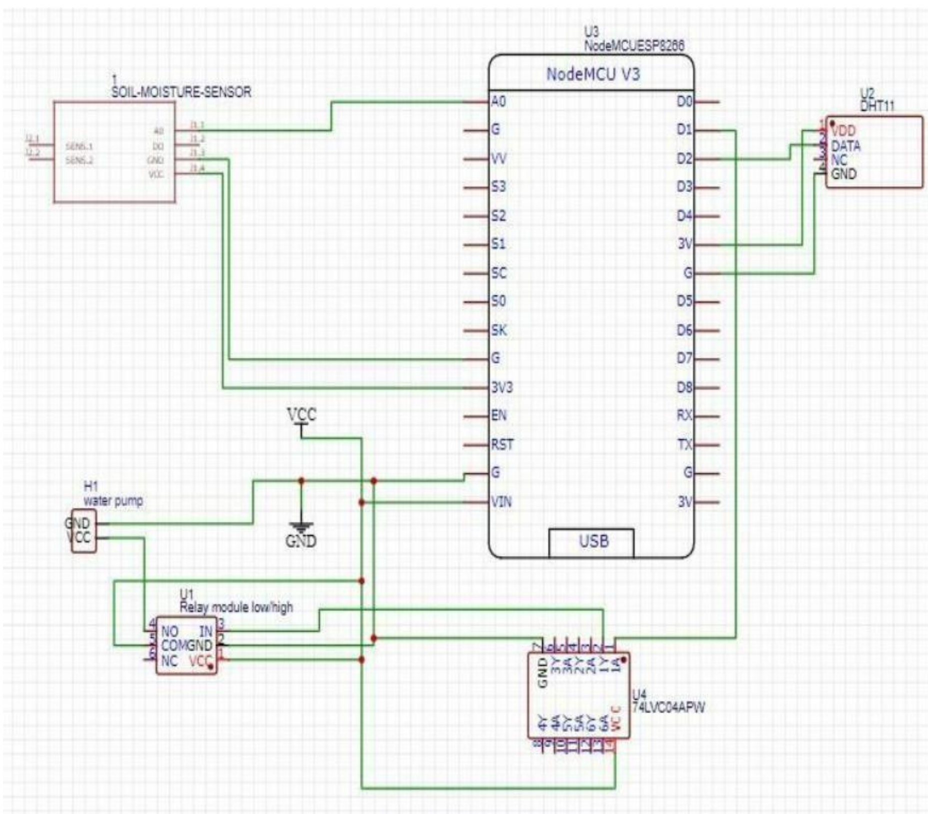


Figure 5.2.1 Circuit Diagram

5.3 Testing and Troubleshooting

- Initially we have tested the interfacing of the soil moisture sensor and DHT 11 sensor reading and obtained their output in the serial monitor of the ide.
- After that we have created a free server and created the database in it to store the sensor data and we have interfaced the sensor and the server and we have observed the reading in our database.
- Then we have created a website for our device we have used html, css, bootstrap, java script for the frontend part and used the php for the backend part and we also interface the website with the server and observed the data in the website. In the website part we have created the two login part; one for the admin and one for the user part.
- As we have tested our component ion breadboard it was looking a bit complex and congested, we have mounted the components in the zero PCB and done their wiring.
- Finally, we have tested our system on the real soil conditions. the sensor sensed the data and we could monitor the sensor data from the website we have also controlled the operation of PUMP from the website and it was successfully operated.

CHAPTER 6

6.1 Software Specification

- We have used **Arduino IDE** to program the NodeMCUESP8266.

- The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as **Windows, Mac OS X, and Linux**. It supports the programming languages C and C++. Here, IDE stands for **Integrated Development Environment**.

- The software has hundreds of integrated libraries. These libraries were made and openly shared by the Arduino community. Users can take advantage of this for their own projects without involving third-party installations.

- Arduino IDE allows users to share their sketches to other programmers. Each sketch comes with their own online link for users to share with their colleagues or friends. This feature is only available in the cloud version.

6.2 Program

```
#include <DHT.h>
#include <ESP8266WiFi.h>
#include <ArduinoJson.h>

#define DHTPIN D2                                  // define pin for collecting data
#define DHTTYPE DHT11

const char* ssid     = "Write your SSID";
const char* password = "Write your Password";
const char* host = "monitorfarm.000webhostapp.com";        // host name of the
                                                              website
const int sensor_pin = A0;
String url;

DHT dht(DHTPIN, DHTTYPE);

void setup() {
  Serial.begin(115200);
  delay(100);
  dht.begin();
  pinMode(D1, OUTPUT);                             // defined d1 pin as output pin
  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);

  WiFi.begin(ssid, password);                      // WiFi.begin is the function
  while (WiFi.status() != WL_CONNECTED) {            connect with the network
  delay(500);                                      and WiFi.status is to check
    Serial.print(".");                               weather connected to
  }                                                  network or not

  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
  Serial.print("Netmask: ");
```

```
  Serial.println(WiFi.subnetMask());
  Serial.print("Gateway: ");
  Serial.println(WiFi.gatewayIP());
}

void loop() {
  float h = dht.readHumidity();                     // h will store the value of humidity
                                                    // Read temperature as Celsius (the default)
  float t = dht.readTemperature();                  // t will store the value of temperature
                                                    // m will store the value of soil moisture

  float m = ( 100.00 - ( (analogRead(sensor_pin)/1023.00) * 100.00 ) );

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read data from sensor!");      // to check weather
    return;                                                     the data is read from
  }                                                             the sensor.

  Serial.print("connecting to ");
  Serial.println(host);

                                                    // to update parameters
  WiFiClient client;
  const int httpPort = 80;
  if (!client.connect(host, httpPort)) {            // connecting to our website
    Serial.println("connection failed");
    return;
  }

  String url = "/project/partials/insert.php?device_no=1&temp=" + String(t) +
"&hum="+ String(h) + "&moisture=" + String(m);

                                                    // storing the url in the variable url.

  Serial.print("Requesting URL: ");
  Serial.println(url);

  client.print(String("GET ") + url + " HTTP/1.1\r\n" +
               "Host: " + host + "\r\n" +
               "Connection: close\r\n\r\n");
```

```
delay(500);
                                        // passing all the parameters stored in the
                                           variables to the database.

while(client.available()){
  String line = client.readStringUntil('\r');
  Serial.print(line);
}

                                                  // to control water pump
if (!client.connect(host,  httpPort))  {
  Serial.println("connection failed");            // connecting to our website
  return;
}

  url = "/project/partials/readled.php?device_no=1";
  Serial.println("Here1");

Serial.print("Requesting URL: ");
Serial.println(url);

client.print(String("GET ") + url + " HTTP/1.1\r\n" +
          "Host: " + host + "\r\n" +
          "Connection: close\r\n\r\n");
delay(500);
                                           // we are fetching the status of water pump
                                              form the database.

String section="header";
while(client.available()){
  String line = client.readStringUntil('\r');

                                              // we'll parse the HTML body here
  if (section=="header")  {                   // headers..
    if (line=="\n") {                         // skips the empty space at the beginning
      section="json";
    }
  }
  else if (section=="json") {                 // print the good stuff
    section="ignore";
```

```
    String result = line.substring(1);

                                                      // Parse JSON
    int size = result.length() + 1;
    char json[size];
    result.toCharArray(json, size);
    StaticJsonDocument<200>  doc;
    DeserializationError error = deserializeJson(doc, json);

    if (error) {
      Serial.println("deserializeJson() failed");
      Serial.println(error.c_str());
      return;
    }
    String led = doc["led"][0]["pump"];

    if(led == "on"){
        digitalWrite(D1, 1);                        // making water pump on if the
        delay(500);                                    the status at the database ON
        Serial.println("D1 is On..!");
      }
      else if(led == "off"){
        digitalWrite(D1, 0);                        // making water pump off if the
        delay(500);                                    the status at the database OFF
        Serial.println("D1 is Off..!");
      }
    }
 }
  Serial.println();
  Serial.println("closing connection");             // closing the connection
  delay(3000);                                      // delay of 3 seconds.
}
```

CHAPTER 7

7.1 Website design

Software: - We have used Visual Studio Code for making our website. With support for hundreds of languages, VS Code helps you be instantly productive with syntax highlighting, bracket-matching, auto-indentation, box-selection, snippets, and more. Intuitive keyboard shortcuts, easy customization and community-contributed keyboard shortcut mappings let you navigate your code with ease. The features that Visual Studio Code includes out-of-the-box are just the start. VS Code extensions let you add languages, debuggers, and tools to your installation to support your development workflow. VS Code's rich extensibility model lets extension authors plug directly into the VS Code UI and contribute functionality through the same APIs used by VS Code.

Languages used to design Website: -

1) HTML (**H**yper**T**ext **M**arkup **L**anguage): -

HTML is a *markup language* that defines the structure of your content. HTML consists of a series of elements, which you use to enclose, or wrap, different parts of the content to make it appear a certain way, or act a certain way. The enclosing tags can make a word or image hyperlink to somewhere else, can italicize words, can make the font bigger or smaller, and so on.

2) CSS (**C**ascading **S**tyle **S**heets): -

Cascading Style Sheets (**CSS**) is a stylesheet language used to describe the presentation of a document written in HTML or XML. CSS describes how elements should be rendered on screen, on paper, in speech, or on other media.

3) JS (**J**ava **S**cript): -

JavaScript is a scripting or programming language that allows you to implement complex features on web pages every time a web page does more than just sit there and display static information for you to look at displaying timely content updates, interactive maps, animated 2D/3D graphics, scrolling video jukeboxes, etc.

4) PHP (Hypertext Preprocessor): -

PHP (recursive acronym for PHP: Hypertext Preprocessor) is a widely-used open source general-purpose scripting language that is especially suited for web development and can be embedded into HTML. PHP is mainly focused on server-side scripting, so you can do anything any other CGI program can do, such as collect form data, generate dynamic page content, or send and receive cookies.

5) MySQL: -

MySQL is a relational database management system (RDBMS) based on the SQL (Structured Query Language) queries. It is one of the most popular languages for accessing and managing the records in the table. MySQL is open-source and free software under the GNU license. Oracle Company supports it.

Website link: - https://monitorfarm.000webhostapp.com

- This index page of the website.

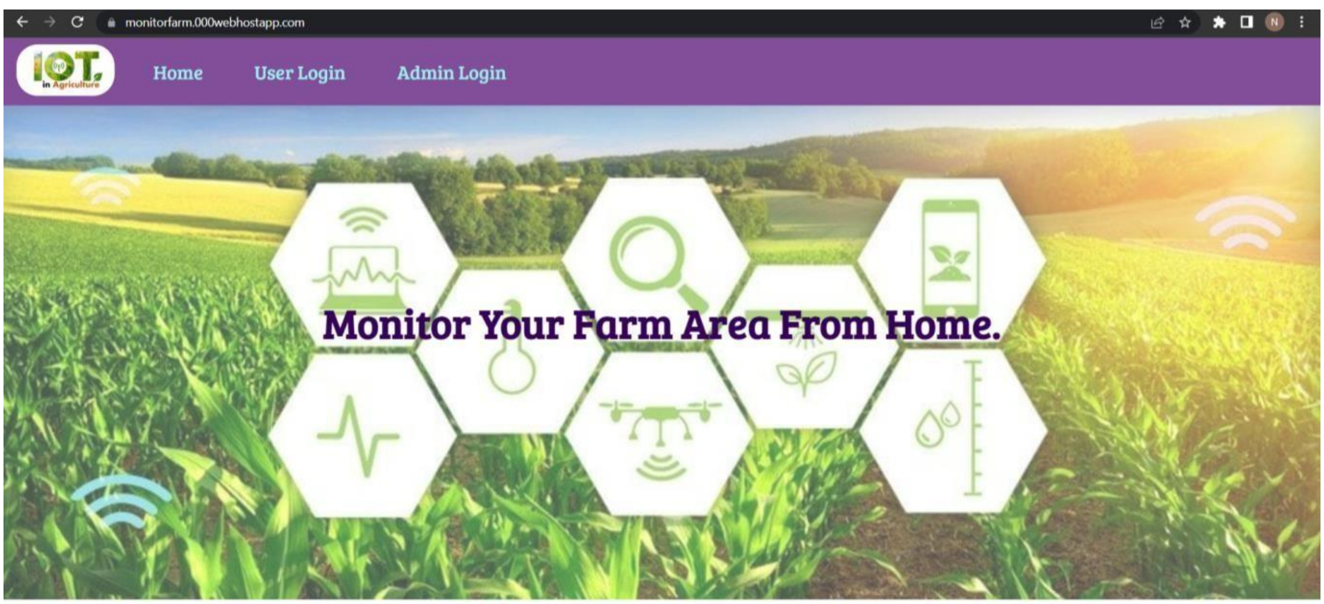
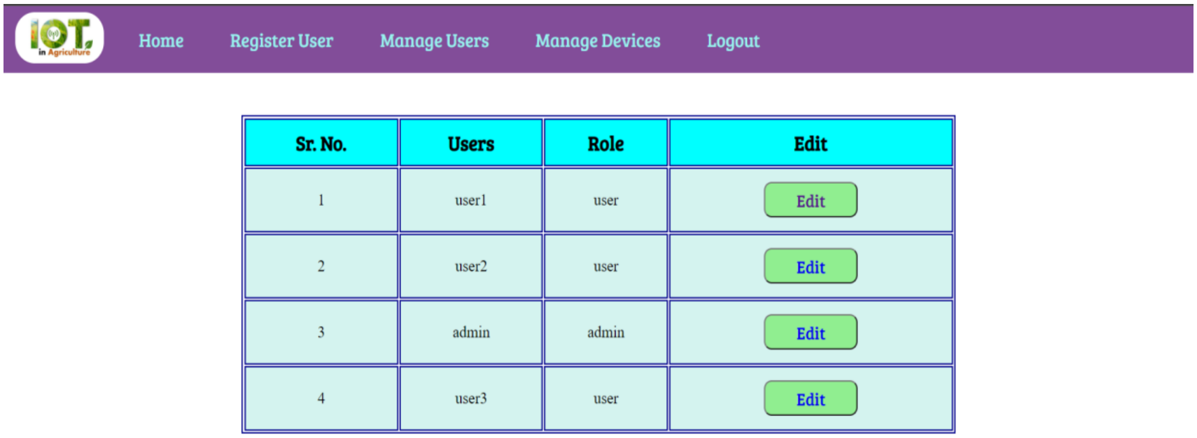


Figure 7.1.1 Index Page

➢ After login as the Admin, Admin will the list of users.



Sr. No.	Users	Role	Edit
1	user1	user	Edit
2	user2	user	Edit
3	admin	admin	Edit
4	user3	user	Edit

Figure 7.1.2 Manage Users Page

➢ As now Admin can see the options in the navigation bar such as Register User, Manage Users, Manages Devices, etc.

➢ Admin can Register New User by putting the following details.

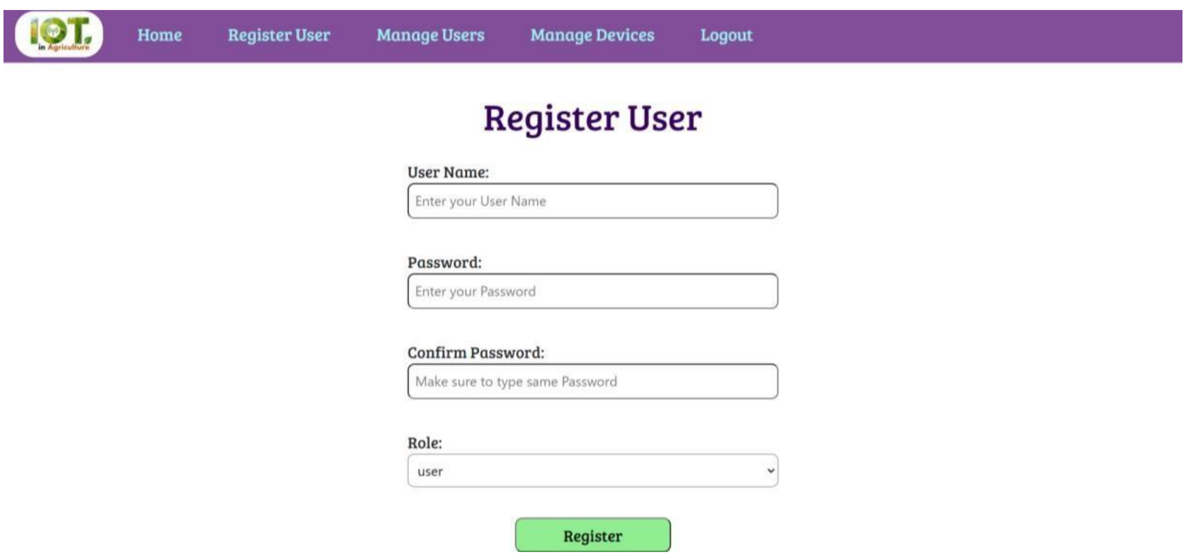


Figure 7.1.3 Register New User Page

- Only the condition is that username should not be repeated and password and confirm password should be same, if username repeated and both passwords do not match then it will throw the Error.

Figure 7.1.4 Error Messages

- Admin can add new device to any existing user by clicking the Manage Devices.

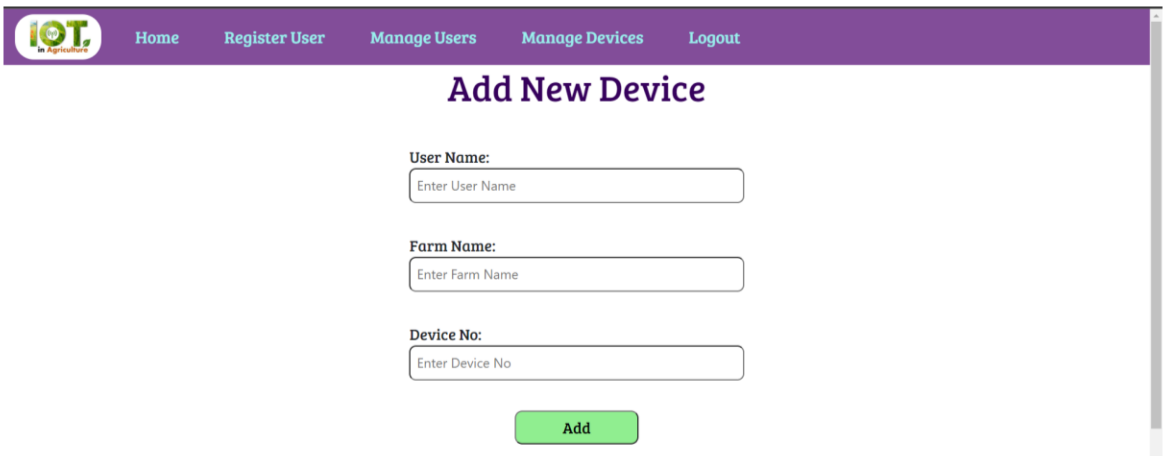


Figure 7.1.5 Manage Devices Page

- While adding new device user must have already registered and device no should be unique, without satisfying this conditions admin cannot add new device.

- By scrolling down this webpage Admin can see list of all the devices which are linked to the user

Farm Name	Device No	User
Farm 1	1	user1
Farm 1	2	user1
Farm 1	3	user2
Farm 1	4	user3

Figure 7.1.6 List of Devices in Manage Devices Page

How can users can use this system and device?

Step 1: Admin will provide the login credentials to the user.

Step 2: After successfully login user will redirected to the following web page.

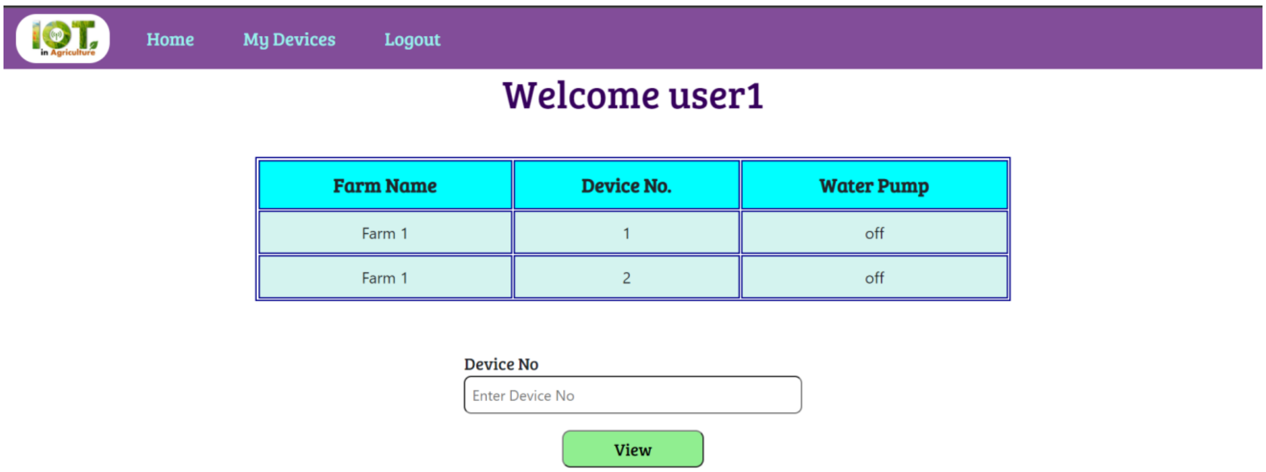


Figure 7.1.7 My Devices Page

In this webpage user will be able to all the device which are linked to his/her account. And also, the status of the water pump of respective device.

Step 3: Now, by entering the device no shown in the above list, user will be redirected to following webpage. User has to entre device no from the list only else user will be redirected to the same showing the following error.

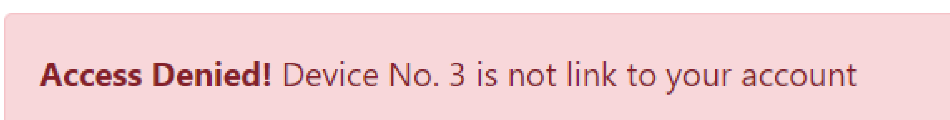


Figure 7.1.8 Access Denied Message

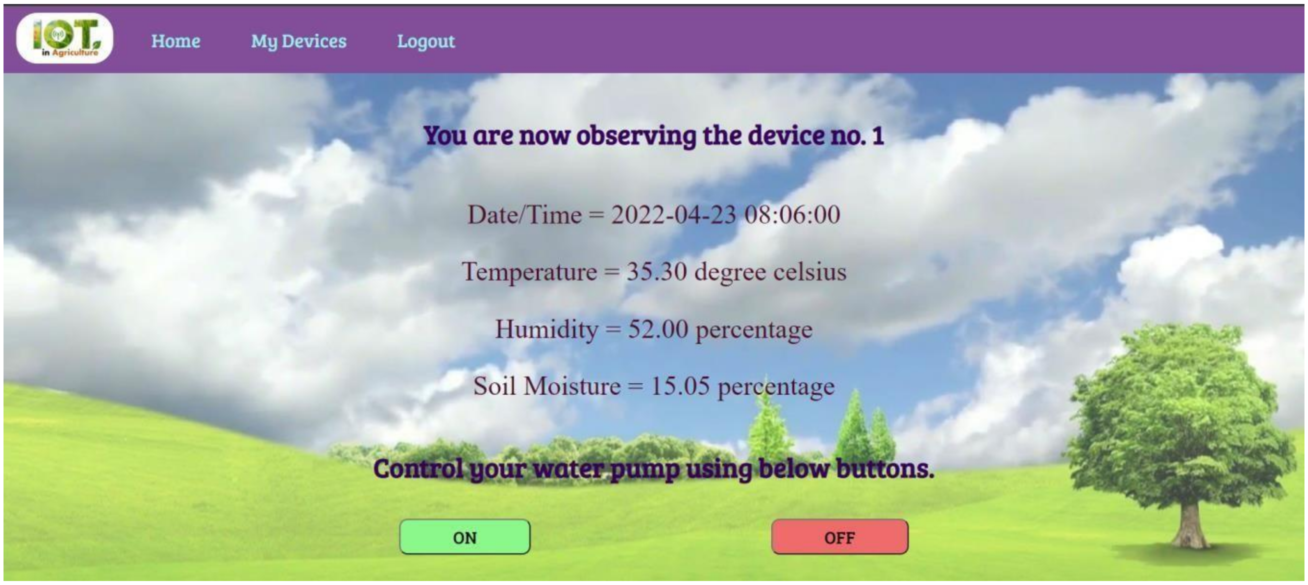


Figure 7.1.9 Parameters Page

Step 4: Now, user can ON the water pump and OFF the water pump using the buttons shown in the above webpage. After that simply user has to logout.

CHAPTER 8

8.1 Advantages

- It consumes less Power.
- Main advantage of our project is that is maximizes the yield of the crop and the quality of the crop is also good.
- It is cost effective method.
- Dryness, humidity and temperature of the field can be monitored easily from the website.
- It saves water.
- The device is small in size and doesn’t require much space for the installation.

8.2 Disadvantages

- The smart agriculture needs availability of internet continuously.
- The smart farming based equipment's require farmers to understand and learn the use of technology.
- Despite of being automatic it needs to be maintained at regular interval.

8.3 Applications

- These devices can be deployed in home gardens, where we can control and monitor the soil, humidity and temperature of the field and can increase the health of the crop without much human interference.

Figure 8.3.1 Application 1

- We can use these devices in the farm area where there is water shortage as the wastage of water is reduced by this system.
- We can also use this system in Precision Farming where inputs are utilized in precise amounts to get increased average yields, compared to traditional cultivation techniques.

Figure 8.3.2 Application 2

CHAPTER 9

9.1 Result

The below image is of the device which we have place in the farm.

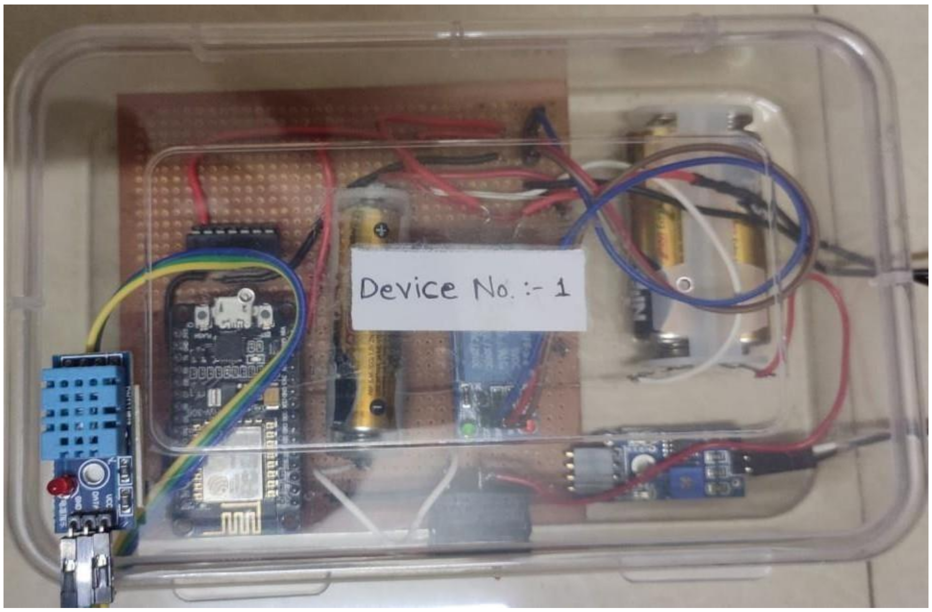


Figure 9.1.1 Device

Now place the device as shown in figure 9.1.2 and power on the device. You can see that the relay as well as the water pump is in the OFF condition.

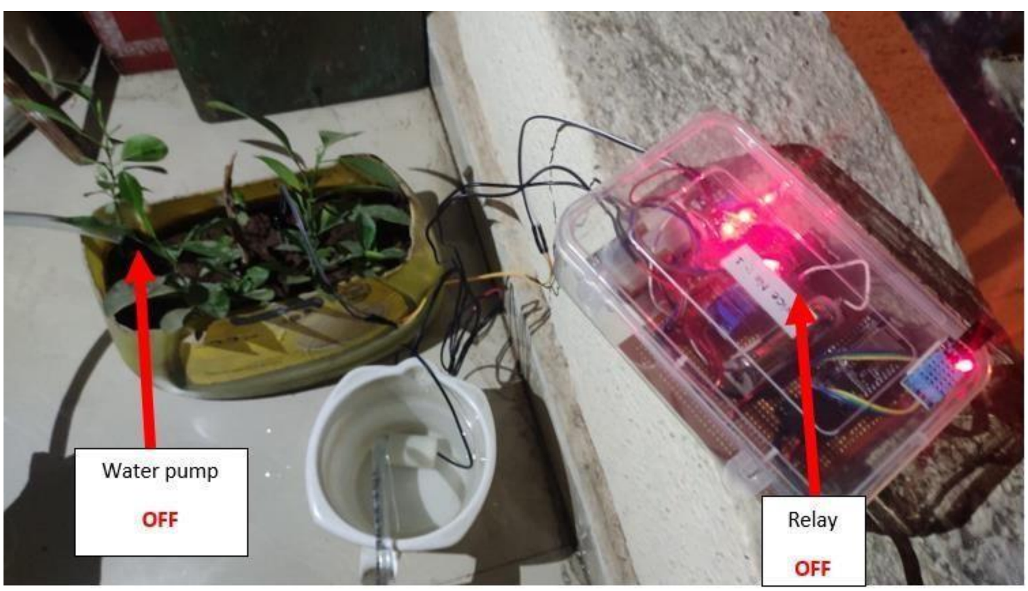


Figure 9.1.2 Image with water pump OFF condition

After all the arrangements done as shown in figure 9.1.2, User has to login using the credentials and go to the webpage as shown in the figure 9.1.3. You observer the readings in the figure 9.1.3; where the soil moisture of the soil is 45.16 %.

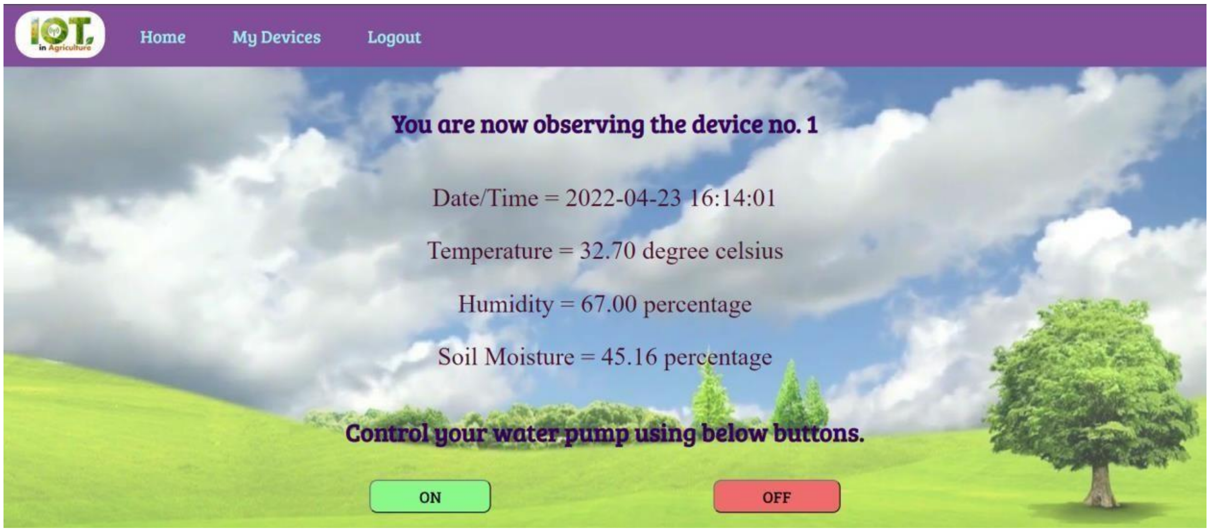


Figure 9.1.3 Before Watering the Plant

So, after pressing the ON button, we can see in the below figure relay as well as the water pump has been turned ON.

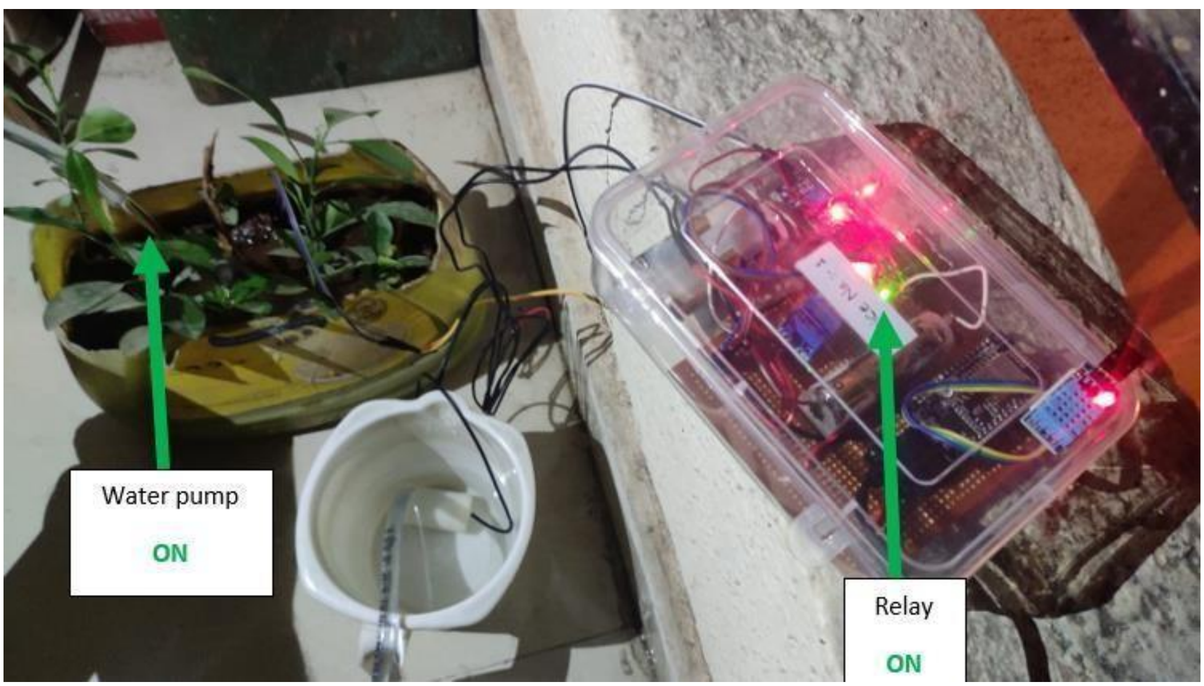


Figure 9.1.4 Image with water pump ON condition

We can also see change in the value of the soil moisture on the website as it is now 66.67% while before watering the plant it was 45.16%. After sufficient water provided to the plant turning OFF the water pump using the OFF button.

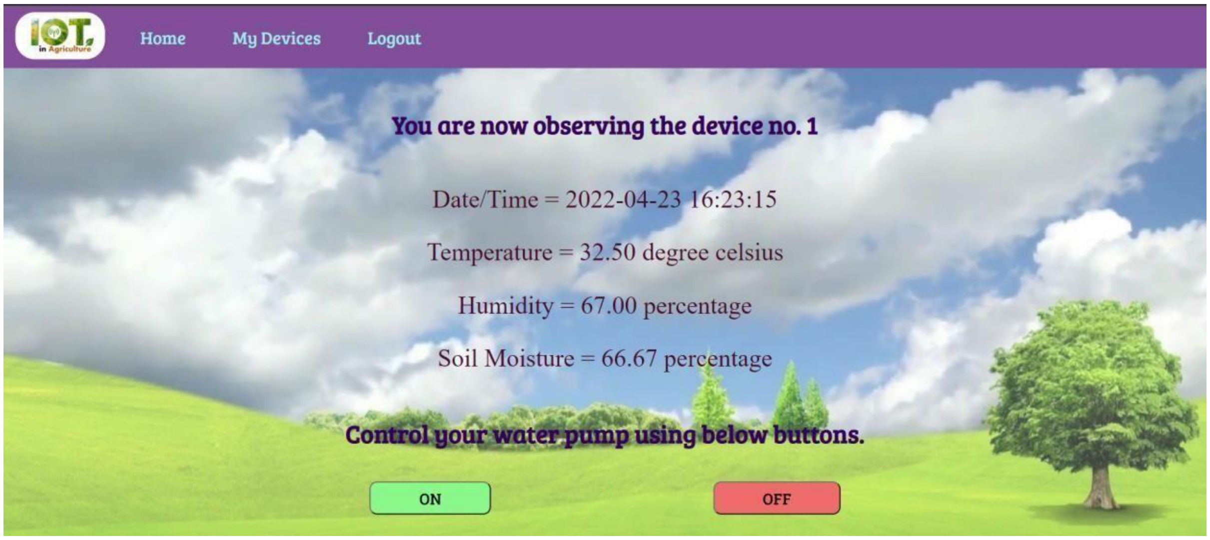


Figure 9.1.5 After Watering the Plant

9.2 Conclusion

Automated irrigation in agriculture land proposed a novel system for efficient irrigation using wireless sensor networks. The proposed system efficiently can monitor the parameters of the soil like Temperature, humidity and water content of the soil and can send the real time data from the sensor to the website and user can easily monitor their field from the website and controls the pump operation. The proposed system has many advantages and the human's interference in less and quality of the crop produced is also good. It is cheaper in cost and consumes less power, The developed system is more efficient and beneficial for the farmers. In future this system can be improved by adding several modern techniques like Machine learning, solar power source usage, GSM Module.

9.3 Future Scope

- We can use a float switch in a tank, so that system automatically shuts the pump down, once the reservoir is full.

- Use it in conjunction with a solar panel, so that the entire system is eco-friendly

Summary

This project describes an automated agricultural monitoring system using IoT. This system will sense all the mentioned parameters and send the data to the user. The user will take controlling action according to it. This asset allows the farmer to enhance the cultivation in a way the plant need. It leads to higher crop yields and better-quality crops.

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INTERNET OF THINGS (IOT) ENABLED AGRICULTURE SYSTEM: A STUDY

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ABSTRACT

This study is a review of designing an Internet of Things (IoT) enabled platform for monitoring and controlling agriculture parameters through web-based applications for precision agriculture. Moreover, this study will develop a low-cost, high-performance, and flexible distributed monitoring system not incorporating expensive components such as high-end personal computers. Also, it offers full control of the system, not by constant manual attention from the operator but to a large extent by wireless sensors. Thus the review describes several designs of a smart monitoring system using intelligent techniques (wireless sensors). There are three principal components in this study, which are an electronic device, software development, and system prototype internet protocol layer. The purpose is to combine all three components to make a web application. Furthermore, the adoption of intelligent techniques in monitoring systems could enhance the concept of the usefulness of monitoring and controlling processes.

Keywords: Internet Of Things, Wireless Sensor Networks (WSN), Microcontroller.

I. INTRODUCTION

In recent years, to improve crop production and quality of agricultural operations and to reduce labor's cost a concept "precision agriculture" that is remotely observing, measuring the environmental condition of the farm from anywhere, anytime by IoT has been attracting a lot of attention.

The IoT is a network of physical objects to exchange data with other devices and systems over the internet. By means of low-cost computing, the cloud, WSN, and mobile technologies, physical things can share and collect data with minimal human intervention. Wireless Sensor Network (WSN) technology is an essential component of IoT as it has great potential for monitoring different agriculture parameters with better accuracy. In a WSN-based system, the environmental information (e.g., temperature, humidity) is collected from a large number of sensor nodes installed in the farm this information is transferred to the sink node using low-power wireless communications (e.g. ZigBee). ZigBee has emerged as the most promising standard owing to its low power consumption and simple networking configuration. Wireless-based smart sensors networks can combine sensing, computation, and communication into a single, small device that reduces the cost of construction, maintenance, size, and weight of the whole system.

In this study, Arduino and NodeMCU were used. The Arduino is an open-source electronics platform used to build electronics projects. It consists of a physical programmable circuit board that can be connected using a USB cable (i.e. a microcontroller) and an IDE (Integrated Development Environment) software that has text editor, debugger and complier all in one. Arduino IDE uses a simplified version of C++, which makes it easy for a programmer to learn and understand. Additionally, Ethernet Shield is used for providing IP services on Arduino and PC to be able to connect to the internet. Similar to Arduino, NodeMCU is also an open-source software and hardware development environment based on ESP8266. IT contains the pivotal elements of a computer: CPU, RAM, and networking (Wi-Fi). That makes it a good choice for Internet of Things (IoT) projects of various kinds.

The system design consists of three layers: perception layer, network layer, and application layer, which provides users with various kinds of functions. The function of the perception layer is to provide all kinds of sensing data needed by the platform. With these data, users will have a better understanding of the state of their lands. The network layer is the link between the perception layer and the application layer. It implements the function that sends the sensing data generated by the perception layer to the database server located in the cloud. These data will be stored in the database server later. Lastly, the application layer, contains an

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application server, a database server, and various kinds of clients. The core function is processing the data stored in the database server located in the cloud, so as to realize remote monitoring. In addition, the platform will automatically determine the current state of land and inform users of the results in real-time. The primary aim of this study is to design a monitoring system using a wireless sensor network with the help of the internet where the presence of the farmers in the field is not compulsory.

Objective

The aim of this study is to understand the design and development of an automated and remotely controlled agriculture system using a wireless sensor network with the help of the internet where the presence of the farmers in the field is not compulsory. Specifically, these are the goals set for this study:

(a) To design and develop a microcontroller-based wireless sensor network using various environmental sensors;

(b) To analyse and monitor the moisture content of the soil alongside temperature and humidity via a customized server.

II. LITERATURE REVIEW

In recent years, the development of environmental monitoring systems has been implemented in many applications in order to improve crop production, support people in their work, and reduce cost and time. These monitoring systems can be used for, such as industrial, home, office, agriculture, and weather and forest monitoring. The following table shows the differences. All the previous projects are user-friendly as the system is literally used to monitor a particular region. It is a reliable system as it causes no precarious harm to the environment.

Paper No.	Components used	Method	Cost	Power	Advantage	Disadvantage
1	-	Based on the RBF network, the paper uses the Levenberg-Marquardt (LM) algorithm	-	-	This model predict the temperature and humidity of a greenhouse based on improved LM-RBF. As LM algorithm along with RBF neural network deals with over-parameterization problems, redundant parameters and costs less.	This type of model has a complex structure with many parameters, and many parameters are difficult to determine and can only be obtained through experience.
2	IoT nodes based on Arduino, Raspberry Pi, and PC.		high	high		
3	The system is based on a wireless sensor network which	Aeroponics: It is an Air-water plant growing	high	-	Aeroponics is a new way of cultivation technique, where the plant is cultivated in air	A failure to accurately control and monitor the parameters could significantly affect the growth of the

	comprises a data server, a wireless convergence node, a plurality of wireless routers, and a plurality of wireless sensor nodes. Temperature Sensor, pH sensor, EC sensor, Light intensity sensor, Humidity sensor, CO2 sensor, Water level sensor, Timer sensor.	technique where lower portions such as the roots of the plant are hung inside the growth chamber under complete darkness in controlled conditions.			surroundings, without any soil. In the system, the plant is grown for around a year by artificially adapting to the surrounding environmental conditions. It offers full control of the system, by wireless sensors.	plant and cause financial loss. Main drawback is the amount of attention required of the farmer with a high level of expertise and judgment.
4	Includes sensor units, Zigbee transceiver, an MCU, an SoC platform, and Web Server.		low	-	monitoring system with wireless sensor network (WSN) which integrates a System on a Chip (SoC) platform to reduce the cost and physical size of the system and Zigbee wireless network technologies because of its low power consumption and simple networking configuration.	ZigBee-based wireless monitoring and control system in one greenhouse is composed of a coordinator and several end devices including sensor nodes and actuator modules organized as a star network.
5	The proposed system uses 3D Robotics's 3DR SoLo as a UAV, which is capable of stable flight based on GPS coordinate and can be		low	low	This system uses UAV i.e. a wireless power transfer technology and Bluetooth Low Energy (BLE) to collect the environmental information related to crop	While landing a UAV, if it is not able to detect the sensor node correctly, the UAV rises its altitude and tries to detect it again until then the wireless power transfer

	controlled by Receiving the commands from the embedded system through the wireless. In addition, the embedded system on the UAV is based on a Raspberry Pi 4 Model B, which is a single-board computer supporting Wi-Fi and Bluetooth.				growth from sensor nodes installed at multiple locations of a large farm. In addition, by using technology sensor nodes can run without a battery, which eliminates the cost of periodic battery replacement.	cannot be started. This is repeated until the UAV detects the sensor node correctly it might require a few trials.
6	The sensor consists of a soil pH and humidity sensor. RF 433 MHz is used as a module sending data from the sensor to the microcontroller.		high	low	The monitoring system is able to display pH and soil moisture values in real-time with an average error value of the soil pH sensor which is equal to 1.66% and the YL69 sensor error average is 1% compared to a commercial soil analyzer.	-
7	three sensor nodes, central node, DHT22 humidity and temperature sensors, Wi-Fi router, Water flow sensor, and solenoid valve and server. The wireless sensor nodes		low	low	An advantage of this system is that a field sensing system does not take extensive time and costs to install and maintain. The system is planned to be implemented using distributed wireless sensor networks using soil moisture,	-

	are composed of: WEMOS D1 Mini, which is the main controller of the system; WEMOS D1 Mini Battery Shield, which is the power supply of the device; and the soil moisture sensor module. Also, the DHT22 shield, which is connected to the central node, measures the reading for the temperature and humidity of the air.				temperature, and humidity sensor real-time sensing to control and store the monitored data.	
8	The perception layer consists of a large number of ZigBee SNs. ZigBee is a low-rate, low-power, low-cost wireless network technology for automation and wireless control.		low	low	As using WSN on large scale is costly and difficult to construct. This system uses a mobile sink (MS) along with a UAV to collect data from sensor nodes (SNs) of large farms and thereby save energy and cost.	For this system it can be concluded that it works normally, the only thing that users need to do is follow the system's countermeasures.
10	It includes NodeMCU, Arduino Nano, sensors like soil moisture and		low	low	The main feature of this methodology is its cheap cost for installation and multiple	The smart agriculture needs availability of internet continuously.

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	Dht11, Ssolenoid valves, relays.				advantages. Here one can access it as well as control the agriculture system on a laptop, cell phone, or computer.	
11	The system consists of three main modules: the micro Web server, the hardware interface module, and the software Package (Smart phone app).		low		The system does not need a server PC and offers a new communication protocol to monitor and control the home environment with added switching functionality.	The system is only used to control devices and appliances remotely by using an android smartphone.
12	Made of three components: a soil moisture sensor, a sensing node that is responsible for scheduling and reporting soil moisture readings, and a controller node responsible for controlling and scheduling irrigation events.		low	low	The system could monitor the environmental information the outdoors remotely, and by supporting the decision-making of crop producers through analysis of the collected information.	The system required a CCTV to monitor a real-time video and a GSM module to transfer information and high technologies are needed.

Designing and applying IoT, in the areas of accuracy farming and ecological monitoring can be demanding, thus an orderly approach is required. The main need in these projects was to concentrate on the use of open-source software. Also to develop a low-cost, high-performance, and flexible distributed monitoring system with increased functionality. By comparing the project [1] and [2] with The IoT-Based Monitoring Systems for Humidity and Soil Acidity Using Wireless Communication the system design is divided into 3 parts, namely sensors, controllers, and web servers. Firstly several IoT sensor nodes were installed throughout the field to

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collect, process, and convert signals of field parameters into digital data. Secondly, the IoT nodes were wirelessly communicating to the servers to transmit digital data to the microcontroller also display it on the webserver. Then, a system was created in which field signal values were displayed on a Web page which was accessed by a personal computer (PC) and smartphone.

Other than that, in [3] and [5] the project explained about UAV, in this type of system the typical Internet of things (IoT) architecture was adopted. The system was divided into perception layer, network layer, and application layer. In the perception layer, a large number of sensor nodes are installed within the large farm for collecting the sensor data.

In the network layer, a mobile sink (MS) that consists of a gateway carried by an unmanned aerial vehicle (UAV) is used to gather data from the perception layer and transfer it to the application layer. On the other hand, UAVs can fly stably for a long time and has a large charging capacity.

After acquiring sensor data from all sensor nodes, UAV returns to the start point of the flight and sends the collected sensor data to the server via HTTP communication. The server manages and analyses the data received from the UAV, and provides the visualized data to the browser of the smartphone, tablet, and PC browsers.

III. DISCUSSION

By comparing all methods mentioned above there are various techniques that can be used to monitor a piece of land whether inside or outside fields such as WSN, UAV, and many more with the help of IoT these systems can also be employed at the home, office, public, farming, etc. As the proposed system is user-friendly, reliable, flexible, easier to install and maintain it can be used without any worries. Unlike previous studies systems using WSN via IoT can lessen human labor in many fields. Besides that an electronic board with all control functions built in it makes the system execute well. To boot, connecting board to IoT may be able to develop a feedback system that sends current status from sensors connected to the board to the application which makes the system more reliable.

IV. CONCLUSION

Based on the study, the conclusions drawn are the following: (1) the design and development of a microcontroller-based wireless sensor network using various environmental sensors improves the way of agricultural system with effective functionality of every components in the system. (2) The system is accurate in terms of its sensing capabilities and provides high accuracy for every setup made. (3) The objectives are obtained and achieved during the experiments with certain valuable data and interpretation.

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