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BACHELOR OF SCIENCE IN ELECTRONICS AND TELECOMMUNICATION ENGINEERING

IoT Based Agriculture Monitoring Framework for Sustainable Rice Production

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I hereby declare that this dissertation entitled "**IOT Based Agriculture Monitoring Framework for Sustainable Rice Production"** has been prepared by us at International Islamic University Chittagong, under the guidance of **Engr. Md.Jiabul Hoque,** Lecturer, Dept. of CCE, in partial fulfillment of the regulations of International Islamic University, for the award of any degree. This dissertation has not been submitted in part or full of any other university or toward any other degree before this below-mentioned date.

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First and foremost, a heartfelt thank you to Allah Ta'ala for creating the universe. Then, to his renowned Prophet, we impose his most cherished benediction (SAAS). Finally, we offer that modest effort to my reader with great honor, in the hope that Allah Almighty would assist him profit from it and put him and us among those who know the reality as well as among those who are guided.

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ABSTRACT

In the Internet of Things (IoT), devices are linked to the internet through a wireless network, allowing them to collect and transmit data without the need for a human operator. Agriculture relies heavily on wireless sensors, which are a vital component of the Internet of Things (IoT). This kind of wireless sensor network monitors physical or environmental variables like temperatures, sound, vibration, pressure, or motion without relying on a central location or sink and collaboratively passes its data across the network to be analyzed. As the primary source of plant nutrients, the soil is critical to the agricultural industry's continued growth. We're excited about the prospect of developing an Internet of Things (IoT) solution. To arrange the network, the sink node collects groundwater levels and sends them to the Gateway, which centralizes the data and forwards it to the sensor nodes. The sink node gathers soil moisture data, transmits the mean to the Gateways, and then forwards it to the website for dissemination. The web server is in charge of storing and presenting the moisture in the soil data to the web application's users. Soil characteristics may be collected using a networked method that we developed to improve rice production. Paddy land is running out as the population of our nation grows. The success of this project will be dependent on the appropriate use of the existing land base.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Devices are linked together through the internet as part of the internet of things (IoT). The Internet of Things (IoT) is a technology that enables objects to communicate and exchange data. The Internet of Things (IoT) describes online gadgets that can exchange data over the internet. Despite its maturity, the Internet of Things remains a hot topic in the IT industry. The phrase "Internet of Things" has gained a lot of traction in the past decade because it protects the idea of a universal architecture of networked physical items, allowing everywhere, anytime connection for everything and not just for everyone. There are many uses for the Internet of Things.

Agriculture is vital to a country's economic development. ICT application, focusing on wireless networks and overcoming different obstacles, especially in poor nations, shows growing productivity. There has been a lot of discussion about the creation of a precision agricultural IoT infrastructure. High-rise building construction has resulted in the loss of agricultural land. Despite the fact that rice production is decreasing, it must rise to meet the country's growing population needs. Only by increasing the quantity of crops grown on current land will this be possible. Using IoT and data-driven decisions from wireless sensors, a farmer may improve his profits and make better use of his property. To feed the vast population of our nation, a farmer must manage spoilage due to inadequate or excessive fertilizer usage, harvest failure risk, and operating expenses. Moisture content, humidity, and pH will all be studied in relation to rice production as a consequence of this research.

1.2 Background and Motivation

The "Iot" originated as a work of art in 2009, and it continues to be so today. As a result of the Internet of Things (IoT), our world is changing. As a result, it has a positive impact on our quality of life and the health of society as a whole. By 2020, it's expected that there will be 50 billion gadgets in use globally. When everything is linked to the internet and networks, the market value will be $14 trillion. There is a growing trend known as the Internet of Things (IoT) wherein the social and financial aspects are intertwined in unprecedented ways. The internet and strong data search abilities are being used to connect these items and change ways we perform, live, and have fun. Everything about this is destined to change for the better. By 2025, sales of IoT devices are expected to be worth $100 billion, with overall sales approaching $11 trillion, according to some estimates. Even as late as 2013, there were many different types of Internet-of-things systems that used various types of technology, along with wired Internet networks and wireless communications as well as microelectromechanical systems and combined ones. Automation system, wireless networks, GPS, various operating systems, and many other conventional areas of automation help the Internet of Things resources that can be switched in and out for remote are known as the Internet of Things (IoT) (IoT). Cell phones, building maintenance, and airplane engines are all included.

In addition to medical devices like a heart rate monitor, the Internet of Things includes farm animals that can send and receive data via the network. The environmental and agricultural departments benefit from their assistance, as well. The goal of this research is to learn about farmer views on improving paddy rice qualities and switching to a new production technique for paddy rice. Farmers' ambition to maintain paddy rice production drives their efforts to improve the quality of their paddy rice and embrace new production methods. In contrast to sustainability, continuity has no growing character of any well-being measure. A lack of enthusiasm for the farming environment that causes farmers to stop producing paddy rice. The reasons people have for wanting to keep making paddy rice have shifted throughout time and between locations. In contrast to the older farmers who have depended on pleasure to produce rice as Japan's main meal, the current generation of farmers believes that paddy rice cultivation is still a dependable source of revenue since it reduces production costs Agriculturalists in Bangladesh's northern metropolis of Dhaka are concerned about their own well-being and the well-being of future generations. Whereas people in other parts of the country are more interested in maintaining ties between generations and within their own communities. Most farmers' management methods revolve on generating enough income for their operations while also reducing labor costs. Different approaches are used depending on the circumstances around the farms.

1.2 Objectives

We want to build and construct a wireless sensor module that gathers information about the soil. We utilized a variety of sensors to collect data on the soil's various properties. They collect data and transmit it to a web page. A particular IP address may readily access the data that has been submitted to the website. As a result, farmers may take the appropriate actions to improve rice output on their field based on the server data.

1.3 Chapter Outline

I. Chapter one contains an introduction to this project and information about the project's motivation, background, and objectives.

II. Chapter two includes a survey of literature as well as a brief overview of earlier work.

III. Chapter three explored methods, including block diagrams, circuit diagrams, and other components.

IV. The fourth chapter depicts the project's hardware implementation.

V. Chapter five discusses the project's end and future work.

CHAPTER 2

LITERATURE REVIEW

2.1 Paper Review

In this section, other researchers' works related to this project, "IOT based soil attributes monitoring framework for sustainable Rice production," will be reviewed, which is essential to ensure the success of this project.

2.2 Research paper on "e-PADI: An IoT-based paddy productivity monitoring and advisory system."

This article proposes a monitoring and advising system for paddy productivity based on the Internet of Things (IoT). Dash7 Wireless Network Protocol was used in the development of the system by the team. A database system will store all the collected data, making it accessible to users on tablets, smartphones, and PCs. A microprocessor, the ATmega328p, controls the wireless network payload and reads data from the sensor nodes on Dash7's main board. There are three key components to this system: sensor nodes, a gateway, and a user app. The goal of this study is to increase rice productivity for landowners by continuously monitoring environmental variables related to paddy production. Using arduino ide and sensor network on an IoT platform, the prototypes functioned well.

2.3 Research paper on "IOT based Smart Agriculture Monitoring and Irrigation System."

This article proposes an Internet of Things (IoT)-based smart irrigation and monitoring system for agriculture. The proposed system's main features include real-time temperature, humidity, tree and water monitoring. The internet may be used to transmit data from a Wi-Fi module to a server. Peer-to-peer and multipoint networks may be created by making each module a sensing node. Here Using a Wi-Fi connection device, the sensor network installed in each component will keep the cloud's parameter readings up to date indefinitely. There will be logging and reporting in the server room for any modifications to a data that may set off the alert. The data and caution notifications may be accessed by the relevant authorities or communities. ThingSpeak's cloud-based server stores the data, which can be analyzed in the field. The findings revealed that they are extending the technology to manage agricultural monitoring in areas where people cannot provide security. They're setting up a system inside the ground to keep tabs on costly crops and all of the weather's variables.

2.4 Research paper on "IOT based Automated Smart Farming System for Paddy Cultivation."

This article proposes an Internet of Things (IoT)-based Paddy Cultivation Smart Farming System. The sensors used to measure the water levels, wet, temperature, and humidity of the field were all used in the system. An LCD monitor will display the gathered data. The relay module for controlling the water pump will be switched on or off depending on the values of the parameters collected. When the field needs water, the engine will turn on automatically. If the region does not need water, the pump will be turned off. Consequently, they were able to demonstrate the enormous success of their endeavors. Smart paddy farming automates the on/off of the pump with the help of several sensors.

2.5 Research paper on "Agriculture monitoring and prediction using Internet of Things (IoT)."

It is suggested in this article to use the Internet of Things to monitor and forecast agricultural outcomes. Sensors including moisture in the soil, air pressure and rain detection were utilized for this model's many functions. It also had humidity sensors. Automatic collection and computation will be done on the cloud using the data gathered. Intelligent agriculture include crop management, data collection, and analysis, all of which may be automated. According to this article, IoT may be utilized for a number of different things, including humidity monitoring, temperature and water supply to field, as well as monitoring climatic conditions. The results section revealed that an IoT-enabled agricultural system allowed them to get up-to-date scientific solutions. Reliability, productivity, and quantity gaps have been bridged as a result of this article.

2.6 Research paper on "Smart Farming – IoT in Agriculture."

Smart farming based on the Internet of Things is suggested in this article. An IoT sensor-based paradigm is proposed, which collects data and transmits it via a Wi-Fi network to a server, where its server may then act on that data. A variety of Internet of Things (IoT) sensors are included into the model, including those for air temp, soils pH, soil moisture, and water volume. To understand more about cutting-edge agricultural technology, the researchers also looked at traditional agriculture techniques now being utilized by farmers and the difficulties they confront in this article.

2.7 Research paper on "Crop Selection and IoT Based Monitoring System for Precision Agriculture."

This article proposes precision agricultural crop choices and monitoring systems based on the Internet of Things. Sensors were utilized in their research to measure temperature, humidity, pressure, and other factors such as air quality and moisture content in the soil. Three things go into making a crop model: crop selection, a crop monitoring and controlling system, and the maturity of the crop. By using a Web app, users will be able to make more accurate decisions based on the facts they see. Their findings show that the suggested work is critical in helping users make informed choices based on data that may be seen in a Web app. A graph is used to analyze and show most of the data that has been collected by the different sensors. Farmers may determine whether to irrigate crops if the moisture in the soil percentage is low based on the data.

2.8 Research paper on "Smart Agro: IOT Based Rice Plant Health Monitoring System."

This paper proposes a brand-new approach to agriculture. Using this system, the elements of the design will be monitored, and the agricultural equipment will be controlled. This energy infrastructure is composed of different sensor such like soil moisture, humidity, and soil wetness. We now have a water pumping system that is fully automated. This technology now includes GPS for obtaining precise position data as well as unique device identification numbers. The parameters are checked via the usage of a mobile application. This is a low-cost alternative that doesn't need the presence of any employees. The suggested architecture is able to collect data and keeping it on a webserver.

2.9 Research paper on "IoT Based Soil Testing Instrument For Agriculture Purpose."

This article proposes an internet-of-things-based soil testing device for agricultural use. As a result of this project, an IoT-based ecosystem with a network system for soil surveillance in agricultural areas has been created. The sensor network will use sensors such as moisture in the soil sensors, humidity sensors, temperature sensors, and NPK sensors to collect actual information on soil fertility rate using thing speak technologies for Applications and to recommend farmers on crop production and fertilization. As a consequence, they came to the conclusion that the metrics used to assess system performance are accurate and reliable.

2.10 Research paper on "An IoT Based System for Remote Monitoring of Soil Characteristics."

In this paper IoT Based System for remote monitoring and soil characteristics is proposed. The suggested system aims to gather soil samples and remotely monitor its pH, temperature, and humidity using cellphones in real-time. The device's brain is a microcontroller. It's in charge of the device's sensing and communication blocks, as well as reading soil factors, including pH, moisture, and temperature. It also transmits data from the sensors to a smartphone through Bluetooth. The prototype was put to the test in garden pots and agricultural areas, yielding positive results.

2.11 Research paper on "Remote Sensing and Controlling of Greenhouse Agriculture Parameters based on IoT."

Researchers in this article suggest using the Internet of Things (IoT) to perform remotely sensed and control of greenhouse agricultural parameters The paper discussed a wireless sensor and actuator system used in greenhouse agriculture. In order to control CO2, soil moisture, warmth, and light, greenhouse windows/doors must be adjusted quarterly throughout the year according to crop needs. Producing more with the same inputs while remaining committed to organic practices is the aim. Researchers analyze greenhouse variables including CO2, soil moisture, temperature, and light for bell pepper plants using a graphical representation built on empirical data from the IoT kit. The comparison shows that the proposed work is effective.

2.12. Research paper on "IoT Based Smart Agriculture System."

This article proposes an Internet of Things (IoT)-based intelligent agricultural system. The article's goal is to make new technologies like the Internet of Things (IoT) and precision farming possible via automation. Improving the production of effective crops requires the capacity to monitor environmental factors. According to this article, the goal is to create a system that uses sensors to keep tabs on crop-destroying animals in agricultural areas while also sending alerts to the peasant's smartphone through Wi-Fi/3G/4G in the case of a mismatch between what is being monitored and what is being reported. Data inspections and irrigation scheduling may be set through an android app thanks to the system's duplex communication connection, which uses a cellular Internet interface. As a consequence, a farmer may use this gadget to determine whether or not he needs irrigation. However, internet connectivity is a must-have. Instead of using a mobile app, extend the system to provide recommendations to the farmer through SMS if you have a GSM module problem.

2.13. Research paper on "Simulation of Internet of Things Water Management for Efficient Rice Irrigation in Rwanda."

This article explores how the Internet of Things may be used to improve the resilience of agricultural systems in the face of increasingly complicated water usage demands. Adapting prior research to the Rwandan setting for grain (Oryza sativa) cultivation with irrigation is the primary goal of this study. When the advanced functions and communications are working properly, the system will automatically offer irrigation management based on seasonal and regular irrigational requirements thanks to the system's cheap cost. We utilized historical Meteo Rwanda rainfall and evaporation data from March 2017 to January 2019 for four seasons to assess the efficacy of the proposed decision modeling method.

CHAPTER 3

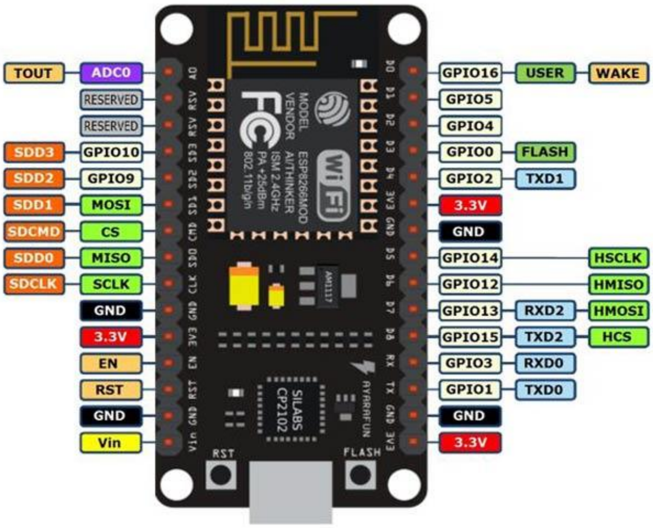
PROJECT COMPONENTS

3.1 Hardware components of this project

1. NodeMCU ESP-8266 (WIFI module)
2. Arduino UNO
3. Soil moisture sensor
4. DHT11 temperature and humidity sensor
5. pH sensor (pH-4502c)
6. Rain sensor (YL83)
7. Power source
8. LDR
9. Gas sensor
10. Ultrasonic sensor
11. Connecting wires

3.1.1 Node MCU ESP-8266 (WIFI module)

With the NodeMCU ESP8266 development board, you may use the ESP-12E module, which incorporates the ESP8266 chip and is supported by a Tensilica Xtensa 32-bit LX106 RISC CPU. This microprocessor is RTOS-compatible and can run at a clock frequency ranging from 80MHz to 160MHz according to user preference. NodeMCU has 128 KB of RAM and 4MB of Flash memory for storing data and applications. IoT projects benefit from its high computing power, as well as its integrated Wi-Fi/Bluetooth and Deep Sleep Operating features. NodeMCU is a microcontroller and development board based on open-source Lua that's tailored for Internet of Things (IoT) uses. Firmware for the ESP8266 Wi-Fi SoC from Espressif Systems is included, as is hardware for the ESP-12 module from the same company.



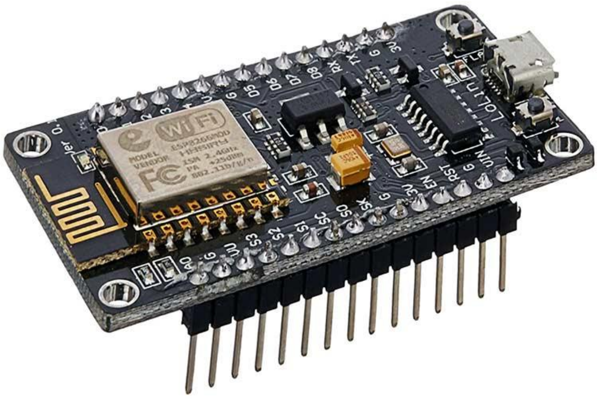


Figure 3.1: NodeMCU ESP8266 and Pinout

NodeMCU ESP8266 Specifications & Features

I. .Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
II. Operating Voltage: 3.3V
III. Input Voltage: 7-12V
IV. Digital I/O Pins (DIO): 16
V. Analog Input Pins (ADC): 1
VI. UARTs: 1
VII. SPIs: 1
VIII. I2Cs: 1
IX. Flash Memory: 4 MB
X. SRAM: 64 KB
XI. Clock Speed: 80 MHz
XII. USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
XIII. PCB Antenna
XIV. Small Sized module to fit smartly inside your IoT projects

Applications

I. Prototyping of IoT devices
II. Low power battery operated applications
III. Network projects
IV. Projects requiring multiple I/O interfaces with Wi-Fi and Bluetooth functionalities

3.1.2 Arduino UNO

The Arduino Uno is a microcontroller board that is based on the 8-bit ATmega328P microcontroller. It includes other components to support the microcontroller, such as a crystal oscillator, serial communication, a voltage regulator, and so on, in addition to the ATmega328P. The Arduino Uno has 14 digital I/O pins (six of which can be used as PWM outputs), six analog I/O pins, a USB connection, a power barrel jack, an ICSP header, and a reset button.

Figure 3.2: Arduino UNO

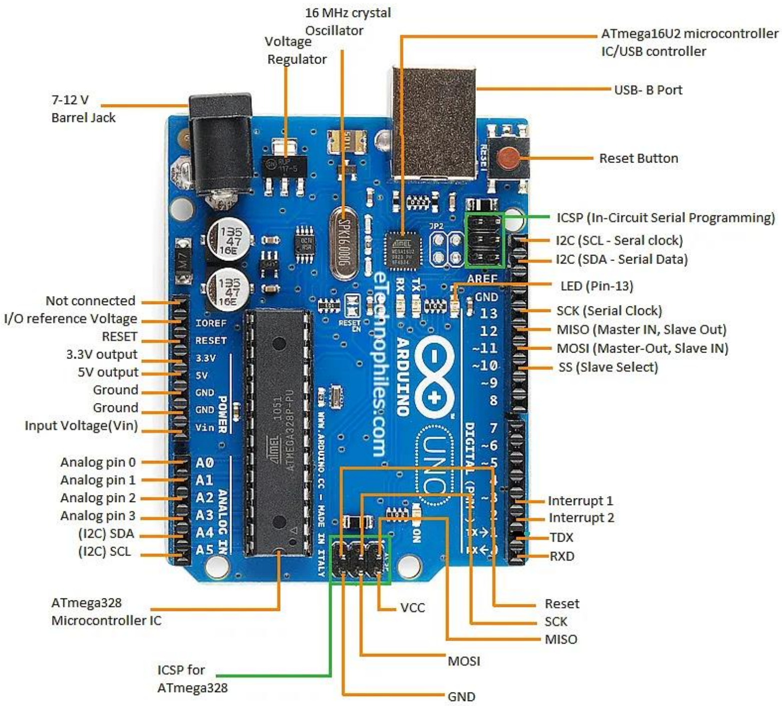


Figure 3.3: Arduino UNO pinout

Specifications and features of Arduino UNO:

- **I.** Microcontroller: ATmega328p
- **II.** Operating Voltage: 5V
- **III.** Input Voltage (recommended): 7-12V
- **IV.** Input Voltage (limits): 6-20V
- **V.** Digital I/O Pins: 14 pins (of which 6 are PWM output pins)
- **VI.** Analog Input Pins: 6
- **VII.** DC Current per I/O Pin: 40 mA
- **VIII.** DC Current for 3.3V Pin: 50 mA
- **IX.** Flash Memory: 32 KB (of which 0.5 KB is taken by bootloader)
- **X.** SRAM: 2 KB (ATmega328)
- **XI.** EEPROM: 1 KB (ATmega328)
- **XII.** Clock Speed: 16 MHz
- **XIII.** Length:6 mm
- **XIV.** Width:4 mm
- **XV.** Weight: 25 g

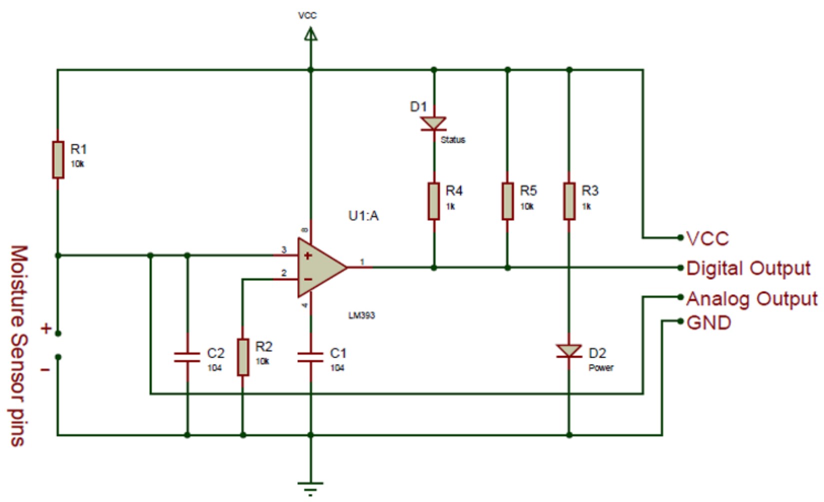
Applications

- **I.** Prototyping of Electronics Products and Systems
- **II.** Multiple DIY Projects
- **III.** Easy to use for beginner-level DIYers and makers.Projects requiring Multiple I/O interfaces and communications.

3.1.3 Soil Moisture Sensor

In order to keep track of soil moisture, a moisture sensor module like this one is needed. It measures the soil's water volumetric content and returns a moisture level as an output. A potentiometer controls the threshold level of the module's digital and analog outputs. In this integrated circuit, there is a moisture sensor, along with other components such as resistors, capacitors, a potentiometer, an LM393 comparator, and a power and status LED. The voltage comparator in this moisture sensing element is an LM393 Comparator IC. The Preset (10K Pot) is attached to LM393 Pin 2, while the moisture sensor is connected to LM393 Pin 3. Pin 2 is used by the comparator IC for comparing the threshold voltages (pin3). Two probes make up the moisture sensor, which measures soil moisture. Moisture sensor probes have an immersion gold coating to keep the nickel from oxidizing. To determine soil moisture levels, these two probes transmit current into the ground. The sensor then measures the resistance.

Figure 3.4 Soil Moisture sensor



There are four pins on the moisture sensor module: VCC, GND, DO, and AO. When using an LM393 comparator IC, the digital output is connected to the external pin, while the analog output is linked to the moisture sensor. The internal circuit diagram for the Moisture Sensing Element is depicted in the figure below. Moisture sensor modules and microcontrollers go hand in hand very well. Before you do anything else, connect the Analog/Digital Output pins of your module and microcontroller together. Then connect the VCC and GND pins to the microcontroller's 5V and GND pins. To use the probe, make a small hole in the ground and insert it. Water conducts electricity better when there is more of it in the ground. This means low resistance and an absorption capacity.

Soil Moisture Sensor Module Features & Specifications

I. Operating Voltage: 3.3V to 5V DC

II. Operating Current: 15mA

III. Output Digital - 0V to 5V, Adjustable trigger level from preset

IV. Output Analog - 0V to 5V based on infrared radiation from fire flame falling on the sensor

V. LEDs indicating output and power

VI. PCB Size: 3.2cm x 1.4cm

VII. LM393 based design

VIII. Easy to use with Microcontrollers or even with standard Digital/Analog IC

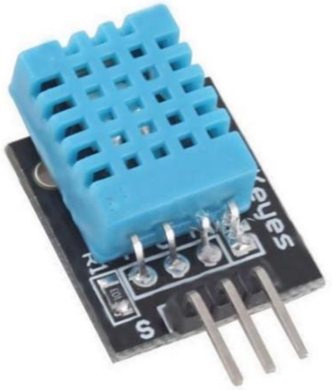
IX. Small, cheap, and readily available

Applications of Soil Moisture Sensor

- Gardening
- Irrigation Systems
- Used in Controlled Environments

3.1.4 DHT11 Temperature and Humidity sensor

An 8-bit microcontroller and a specialized NTC for temperature sensing make up the DHT11, a widely used temperature and humidity sensor. The serial data from the sensor is sent to a computer. It's common to find a DHT11 temperature and relative humidity sensor in electronic equipment. Temperature and humidity measurements are output as serial data from the sensor through an 8-bit CPU, which has a specialized NTC for temperature detection. A factory-calibrated sensor makes interfacing with other microcontrollers a breeze. The sensor has a temperature range of 0°C to 50°C and a humidity range of 20% to 90%, all with a precision of 1°C. Consequently, if you're looking for a sensor that can monitor in this region, this one may be a suitable option.



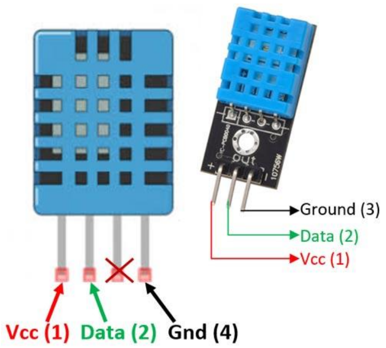
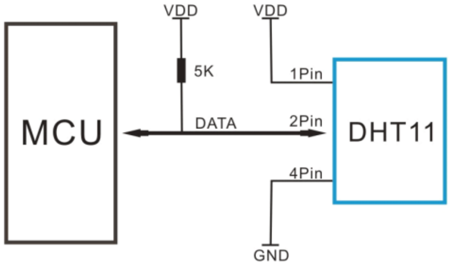


Figure 3.5: DHT11–Temperature and Humidity Sensor and pinout



With its factory calibration and serial data output, the DHT11 sensor is ready to use right out of the box. This sensor's wiring is shown in the figure below. As you can see, a 5K pull-up resistor connects the data pin to an MCU I/O pin. The temperature and relative humidity are sent in serial on this data pin. There are ready-made libraries available for connecting a DHT11 to an Arduino. The data pin is connected to an MCU I/O pin using a 5K pull-up resistor, as shown. This data pin transmits serial temperature and humidity measurements. If you want to attach a DHT11 to an Arduino, you may use pre-made libraries to get up and running fast.

DHT11 Specifications and Features:

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

Applications:

I. Check the humidity and the temperature.
II. A local weather station
III. Temperature regulation by use of an automatic system
IV. Monitoring of the natural environment

3.1.5 Raindrop module Sensor (FC37)

The Raindrop Sensor is a device that detects raindrops. One module detects rain, while the other compares and digitalizes the analog reading to arrive at a final result. When it rains, raindrop sensors can sense it and operate the wipers on your car's windshield. They can also be utilized in agriculture and in-home automation systems.

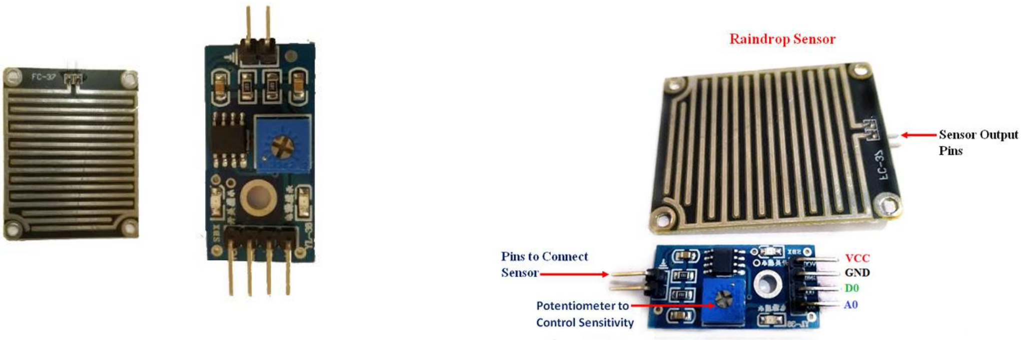


Figure 3.6: Raindrop module

Microcontrollers like the 8051, Arduino, or PIC are simple to connect to the raindrop sensor. The drop of water sensor control module is connected to the mainboard module as shown in the following diagram. There are four outputs on the raindrop sensor controller module. Connecting a 5V power source to the VCC completes the circuit. The GND pin of the module is connected to ground. Using the D0 pin with the microcontroller's digital pin or the analog pin allows digital output. To use the microcontroller's analog output, connect the A0 pin to the ADC pin on the microcontroller. Because Arduino has six ADC pins, we can use any one of them directly without using an ADC converter.

An LN393 comparator and LEDs are utilized in the sensor system along with a resistor and a potentiometer. The components of the control module are shown in the image above. The variable resistor in the module is made up of copper paths. It has a wide range of moisture resistance on the motherboard. An example of a mainboard module may be seen in the picture below. There are four outputs on the raindrop sensor controller module. The VCC is wired with a 5V power supply. The GND pin of the module is connected to ground. The D0 pin may either be connected to the microcontroller's digital pin for digital output or to the analog pin for analog input.. To use the microcontroller's analog output, connect the A0 pin to the ADC pin on the microcontroller. Because Arduino has six ADC pins, we can utilize any one of them without a converter. An LN393 comparator and LEDs are utilized in the sensor system along with a resistor and a potentiometer. The components of the control module are shown in the image above. The variable resistor in the module is made up of copper paths. It has a wide range of moisture resistance on the motherboard. Pictured above is a rainboard module in action.

Features of the Raindrop Sensor:

I. 5V work voltage
II. Output Format: Digital output switching (0 and 1), analog output voltage AO
III. The sensitivity adjustment potential
IV. It uses a large voltage comparator LM393
V. The clean waveform output comparator is excellent, driving skills above 15mA
VI. Long-term anti-oxidation, anti-conductivity
VII. With bolt holes to be easily installed
VIII. PCB board small size: 3.2cm x 1.4cm

Applications of Rain sensor:

I. Automatic windshield wipers
II. Smart Agriculture
III. Home-Automation

3.1.6 pH sensor (4502c)

When connected to an analog pin, the sensor on this board may produce voltage, which indicates a PH value as any other sensor connected to an analog pin. It seems that the PH=0 0V output and the PH=14 5V output should be displayed, however there is no PH=7 Neutral set to 0V. As a result, the voltage drops whenever reading acidic pH readings, making it impossible to use the Arduino analog interface. In order for PH = 7 to read the expected 2.5V to the Arduino analog pin, the offset pot is needed. PH = 7 is in the middle of the PH range, between PH 0 and 14. The analog pin can read voltages from 0V to 5V, thus the range is 2.5V to 5V. Offset must be adjusted by cranking the offset potentiometer, which is located on the BNC connector in the offset jar (the blue jar nearest to it). The offset may be easily adjusted..

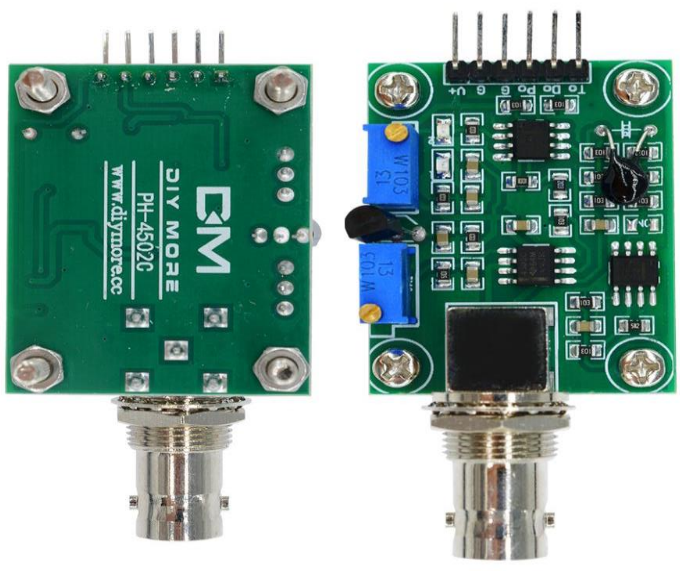
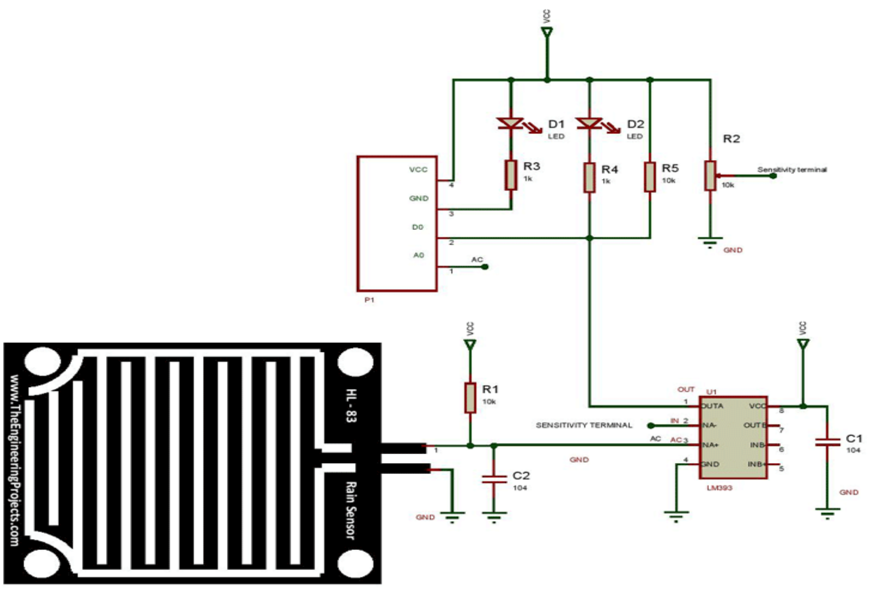


Figure 3.7 pH Sensor (4502c)



pH 4502c features and specifications

I. Voltage heating: 5±0.2V (AC -•DC)

II. Current work: 5-10mA

The detection range is PH0-14

III. Temperature sensing range: 0-60 centigrade

IV. The answer time: 5S

V. Stability time: 60S Stability time

VI. Consumption of power: 0.5W.

VII. Working temperature: -10~50 cm (the nominal temperature 20 centigrade)

VIII. Working moisture: 95% RH (nominal humidity 65 percent RH)

IX. Life of service: 3 years

X. Dimensions: 42mm x 32mm x 20mm High: 25g

XI. Output: analog signal voltage output

3.1.7 5V DC power supply

Most electrical gadgets include a circuit for converting AC power to DC (DC). Direct current (DC) power supplies convert alternating current (AC) to direct current (DC). When using a direct - current source, a power transformer is usually found near the inlet. The DC is then transformed to alternating current using a bridge rectifier (a diode circuit). In order to remove any residual noise or ripples, it runs the signal through a smoothing filter and then a voltage regulator circuit using capacitors. We will utilize an LM7805 voltage regulator integrated circuit to construct a basic DC 5V power supply circuit in this project. Many of the 5V power supply circuits currently on the market use the LM7805 voltage regulator integrated circuit. The IC has a voltage output of 5V and is a three-terminal positive voltage regulator. In addition to the safe operating area prevention and thermal shutdown, this IC also has internal current limiting and contributes to the IC's overall excellent dependability. The IC's output current capacity is up to 1A with the proper heat sink.

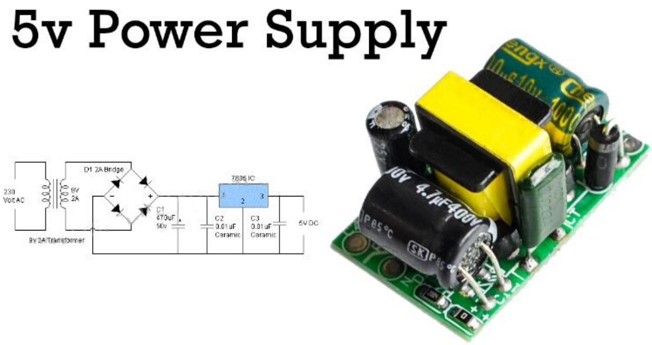


Figure 3.8: 5V power supply

Applications

Power supplies with a direct current output are extensively used in low voltage applications such as battery charging, automobile applications, aviation applications, and others with low voltage and low current.

3.1.8 Light Dependent Resistor (LDR)

The Light Dependent Resistor (LDR) is another kind of resistor that is distinct in that it has no polarity, allowing it to be connected in any way. The LDR is also referred to as a Photoresistor in certain circles. They are simple to use on a perf board and are nice to the touch on a breadboard as well. Despite the fact that the LDR symbol looks like a resistor, it includes the inner arrows seen in the LDR wiring schematic above. The signals are shown by the arrows.

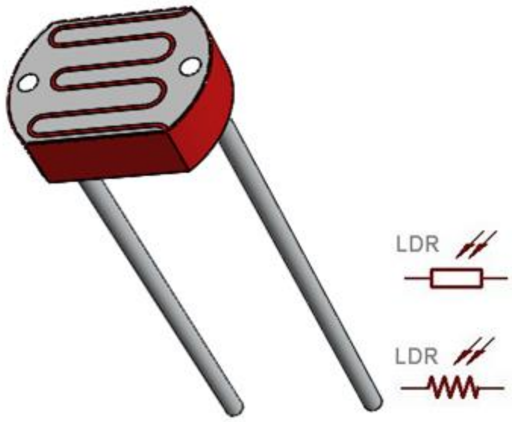


Figure 3.9: LDR light dependent resistor

LDR Features

I. It can be used to sense light
II. Easy to use on Breadboard or Perf Board
III. Easy to use with Microcontrollers or even with standard Digital/Analog IC
IV. Small, cheap, and readily available
V. Available in PG5, PG5-MP, PG12, PG12-MP, PG20, and PG20-MP series

Applications

I. Automatic Street Light
II. Detect Day or Night
III. Automatic Head Light Dimmer
IV. Position sensor
V. Used along with LED as obstacle detector
VI. Automatic bedroom Lights
VII. Automatic Rearview mirror

3.1.9 Gas Sensor

The sensors are used in air quality control systems and are capable of detecting and measuring NH3, NOx, alcohol, benzene, smoke, and CO2 in addition to other pollutants. The MQ-135 sensor module includes a digital pin that allows it to function without the need of a microcontroller, which is particularly helpful when just one gas is being detected. If the concentration of gases in parts per million (PPM) is to be monitored, the analog pin must be used. The TTL pin runs at 5V and may therefore be utilized with the majority of microcontrollers on the market. This sensor is an excellent choice if you are looking for a sensor that can detect or monitor a wide range of typical air quality gases, such as CO2, smoke, NH3, NOx, alcohol, benzene, and other contaminants.

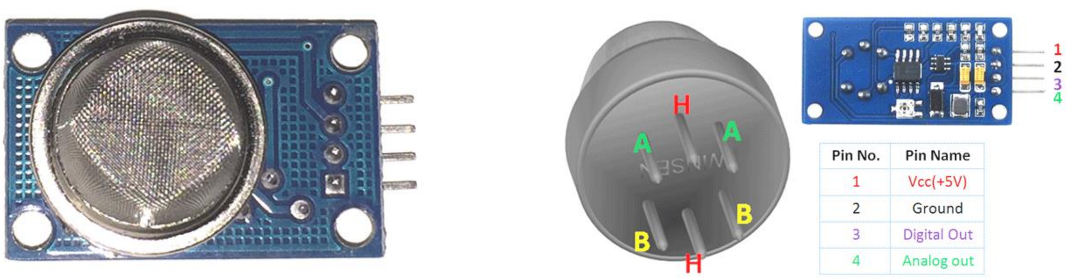


Figure 3.10: Gas Sensor

MQ-135 Sensor Features

I. Wide detecting scope
II. Fast response and High sensitivity
III. Stable and long life
IV. The operating voltage is +5V
V. Detect/Measure NH3, NOx, alcohol, Benzene, smoke, CO2, etc.
VI. Analog output voltage: 0V to 5V
VII. Digital output voltage: 0V or 5V (TTL Logic)
VIII. Preheat duration 20 seconds
IX. It can be used as a digital or analog sensor
X. The sensitivity of the Digital pin can be varied using the potentiometer

Applications:

I. They are used to detect leakage/excess of gases like Ammonia, nitrogen oxide, alcohols, aromatic compounds, sulfide, and smoke.
II. Air quality monitors.

3.1.10 Ultrasonic Sensor (HC-SR04)

The HC-SR04 distance sensor is extensively used with a variety of platforms, including Arduino, ARM, PIC, Raspberry Pie, and microprocessors. It is important to note that the mandatory is universal in that it should be followed irrespective of the type of computer equipment being used. The Vcc and Ground pins on the sensor are used to provide the sensors with a regulated +5V. Because the sensor consumes less than 15mA of power, the 5V pins on the circuit may be usually powered from the sensor (if available). It is possible to connect the Triggers and Echo pins together with other I/O pins since they are both I/O pins on the microcontroller. The trigger pin must be lifted for 10uS in order to start the measurements and then turned off to complete the process. This operation causes an ultrasonic wave with a frequency of 40Hz to be sent from the transmitters, and the receivers wait for the wave to arrive. As soon as the lock is recovered from any item, the Echo pin goes high for a length of time equal to the amount of time it takes the wave to rebound to the sensor, and then it goes low. The period during which the Echo pin stays high is monitored by the MCU/MPU in order to calculate how long it would take for the waves to travel to the sensors to be detected. The distance between the two points is computed using the information provided in the previous paragraph.

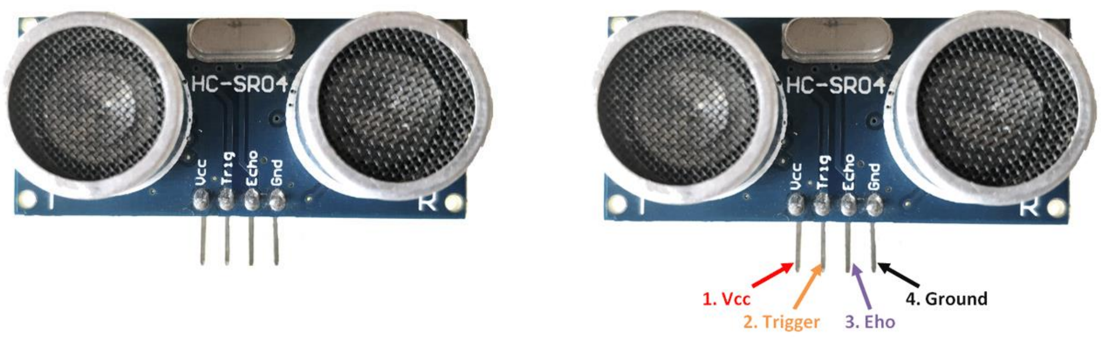


Figure 3.11: Ultrasonic Sensor (HC-SR04

HC-SR04 Sensor Features

I. Operating voltage: +5V
II. Theoretical Measuring Distance: 2cm to 450cm
III. Practical Measuring Distance: 2cm to 80cm
IV. Accuracy: 3mm
V. Measuring angle covered: <15°
VI. Operating Current: <15mA
VII. Operating Frequency: 40Hz

Applications

I. Used to avoid and detect obstacles with robots like a biped, obstacle avoider, pathfinding, etc.
II. Used to measure the distance within a wide range of 2cm to 400cm
III. It can be used to map the objects surrounding the sensor by rotating it
IV. Depth of certain places like wells, pits, etc. can be measured since the waves can penetrate through the water

3.2 Software requirements of this project

3.2.1 EasyEDA Software

A web-based electronic design automation (EDA) tool suite, EasyEDA enables hardware engineers to design and simulate circuits and printed circuit boards, as well as share and debate these designs in an open and private environment. Among the other features are the creation of a bill of materials, the generation of Gerber and pick - and - place files, and the generation of documentation outputs in the PDF, PNG, and SVG file formats.

3.2.2 Arduino IDE

This cross-platform application, built in C and C++ functions, is known as the Arduino Integrated Development Environment (IDE). Arduino compatible boards, as well as other entrepreneurship development boards that contain third-party cores, may be programmed and uploaded using this tool.

3.2.3 Fritzing Software

Designers who really are prepared to advance from conducting experiments with a project to constructing a more permanent circuit can benefit from Fritzing, an open-source project aimed at developing amateur or hobby-level CAD software for designing electrical hardware to assist them.

CHAPTER 4

PROJECT DESIGN

4.1 Arduino and NodeMCU Serial Data Interface

This project concerns serial communication between Arduino and ESP8266-12(NODE-MCU). As we know, ESP-12 has one analog pin where we can attach our analog sensor; however, if we require more than one analog pin and want to transmit data to a server, such as adafruit.io or your server. Furthermore, serial communication is needed when we transfer sensor data from one device to another device. In this project, we use serial communication to send various sensor data of Arduino Uno such as Moisture Sensor, Gas Sensor, Rain Sensor to the NodeMCU.

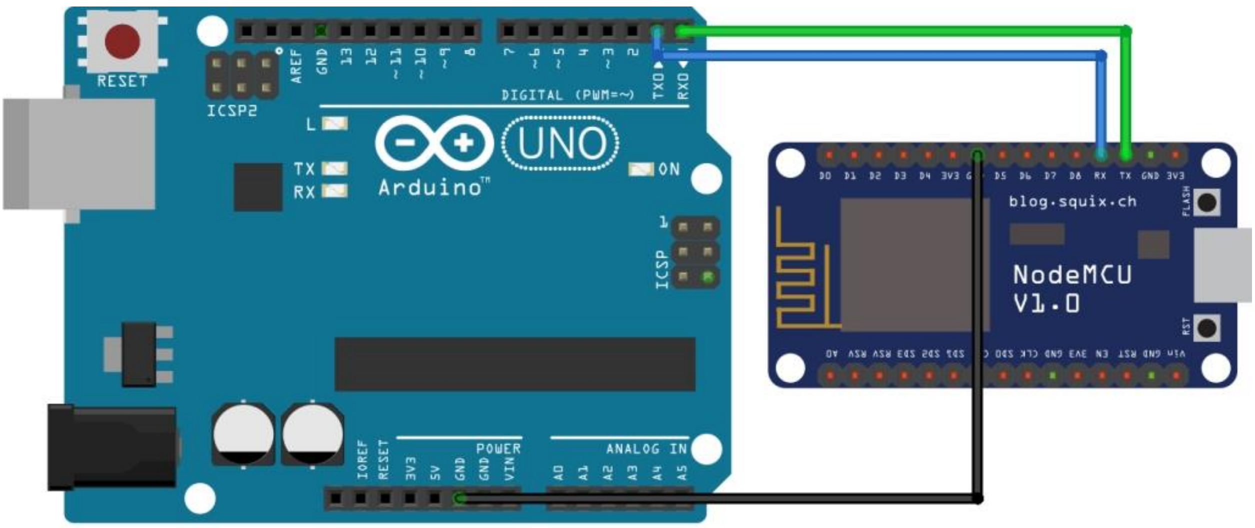


Figure 4.1: Serial communication between Arduino Uno and NodeMCU.

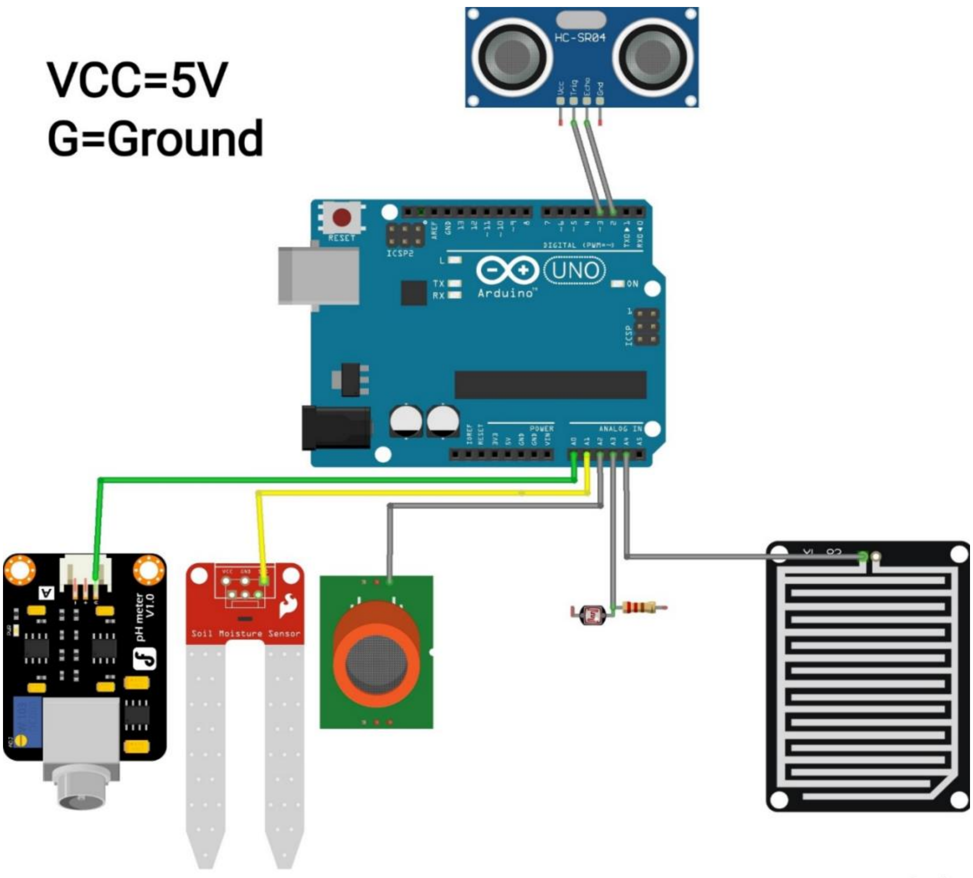
I. TX (Port of Arduino) set with RX (Port of NodeMCU)

II. RX (Port of Arduino) set with TX (Port of NodeMCU)

4.2 Sensors and Arduino Interface

Sensors are extensively utilized in virtually every area, and they are becoming more sophisticated. Sensors provide a new dimension to your project and may be used in a wide range of applications to enhance its functionality. As a result, I decided to create this lesson to assist people who are new to sensors. I hope this has helped you to comprehend better what I'm trying to say. Let's get this party started! For starters, there are many distinct types of sensors that can capture various kinds of data. Light sensors, ultrasonic sensors, gas sensors, humidity sensors, and other types of sensors all operate distinctly. Although each sensor has its own set of characteristics, the procedure is very similar when connecting them to a microcontroller (in this instance, an Arduino Uno).

Sensors capture biological data by altering the voltage at its output pin in response to changes in physical conditions, which are recorded as data. First, let's look at an example to grasp further what I mean. Next, consider the use of a light sensor (LDR). The output voltage is low in a dark environment, but the output voltage rises dramatically when the device is placed in a brighter setting. Now, the microcontroller is alerted to the change in voltage and may be programmed to react appropriately. In this line, we will demonstrate how to interface an LDR with an Arduino Uno.



Figures 4.2: Sensor Interfacing with Arduino.

I. We have connected PH- Sensor with analog pin A0 of Arduino, VCC with 5V and, Ground with Ground

II. We have connected Soil Moisture Sensor with analog pin A1 of Arduino, VCC with 5V and, Ground with Ground

III. We have connected GAS Sensor with analog pin A2 of Arduino, VCC with 5V and, Ground with Ground

IV. We have connected LDR one port with 5V, another port set with 10K Ohm resistance and A3 pin of Arduino, Set resistance last port with ground

V. We have connected Rain Sensor with analog pin A4

VI. We have connected the Echo pin of Ultrasonic Sensor with the digital pin of Arduino and Set Trig pin of a sensor with digital pin 3 of Arduino.

VII. We have developed and updated the code for Arduino.

4.3 DHT11 interfacing with NodeMCU

The DHT11 detect vapour by measuring the resistance between two electrodes, which is done by passing an electrical current between two electrodes. It comprises of a moisture-holding substrate with electrodes put on the surface of the substrate to detect moisture, and a humidity sensing component. It has been shown that when an organic substrate absorbs water vapor, the discharge of ions by the organic substrate enhances the conductance between the electrodes. Changes in relative humidity between the two electrodes cause resistance between them to vary in response to changes in relative humidity. Antagonism and resistance between electrodes are decreased when the relative humidity of the environment is high, while the resistance between electrodes increases when the relative humidity of the environment is low.

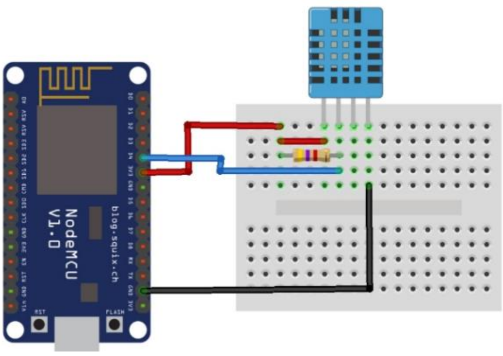


Figure 4.3 DHT11 interfacing with NodeMCU

I. We have Connected VCC with 3V and Ground with Ground of Arduino.
II. We have connected the digital pin of DHT11 with the D4 of Arduino.
III. We have developed and updated the code for NodeMCU.
IV. We interface with Arduino Uno and NodeMCU

4.4 Block Diagram

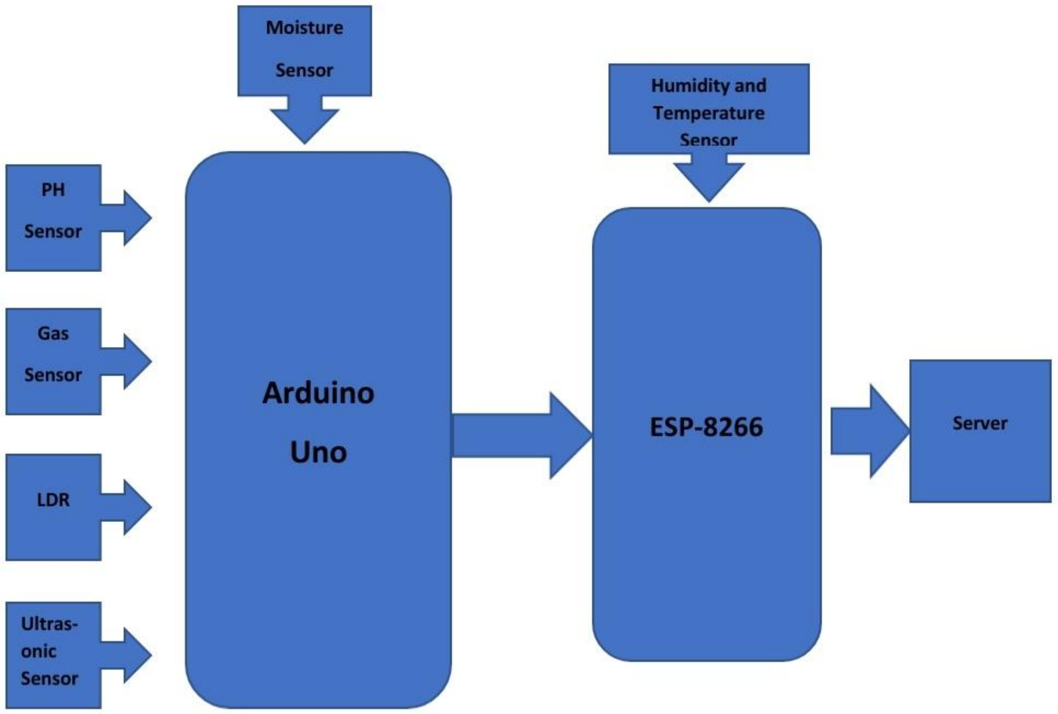


Figure 4.4: Block diagram of soil moisture attributes for rice production

4.5 Circuit Diagram

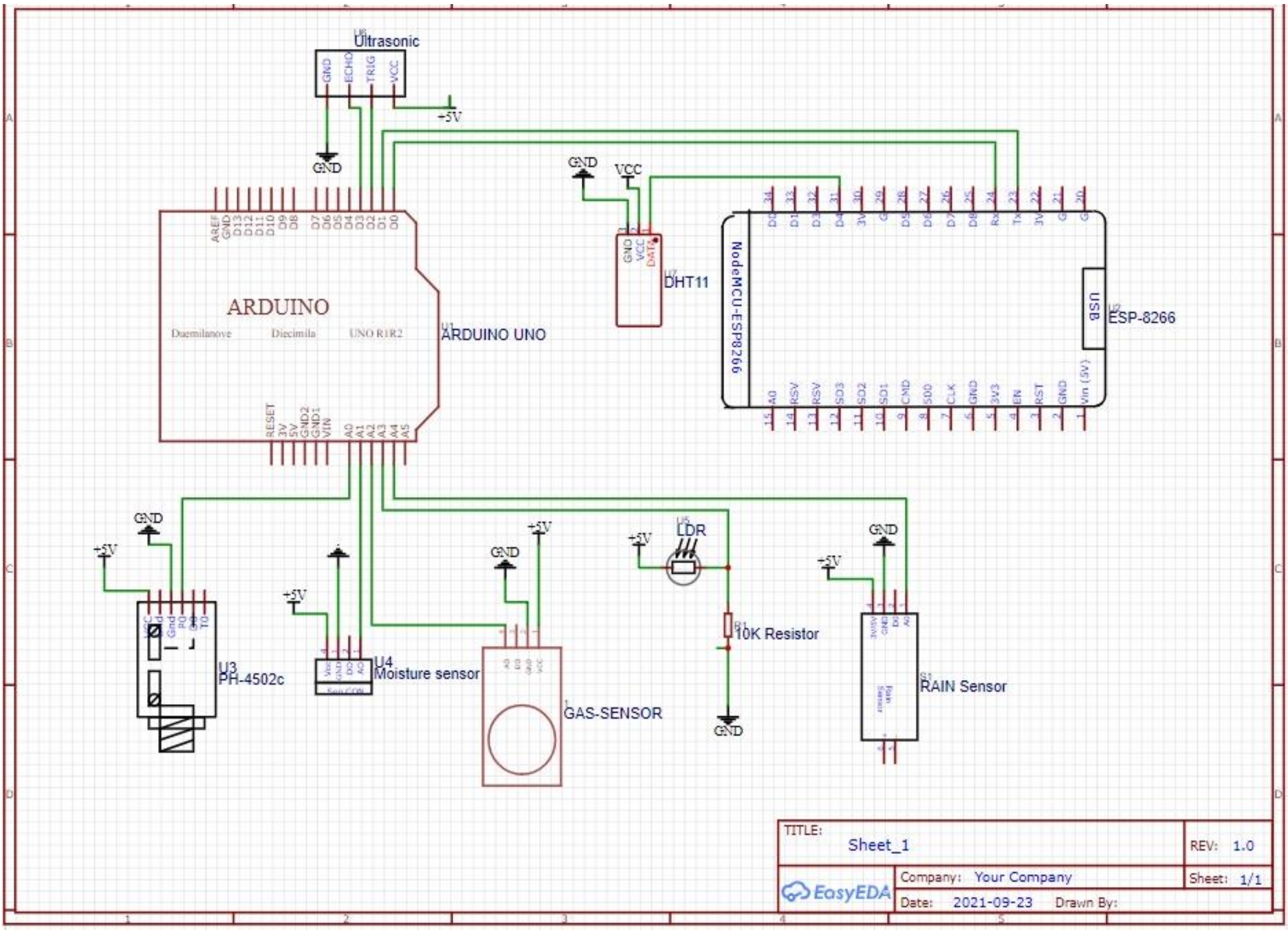


Figure 4.5: Circuit Diagram of the system

4.6 Flowchart

The flowchart of the system is given below :

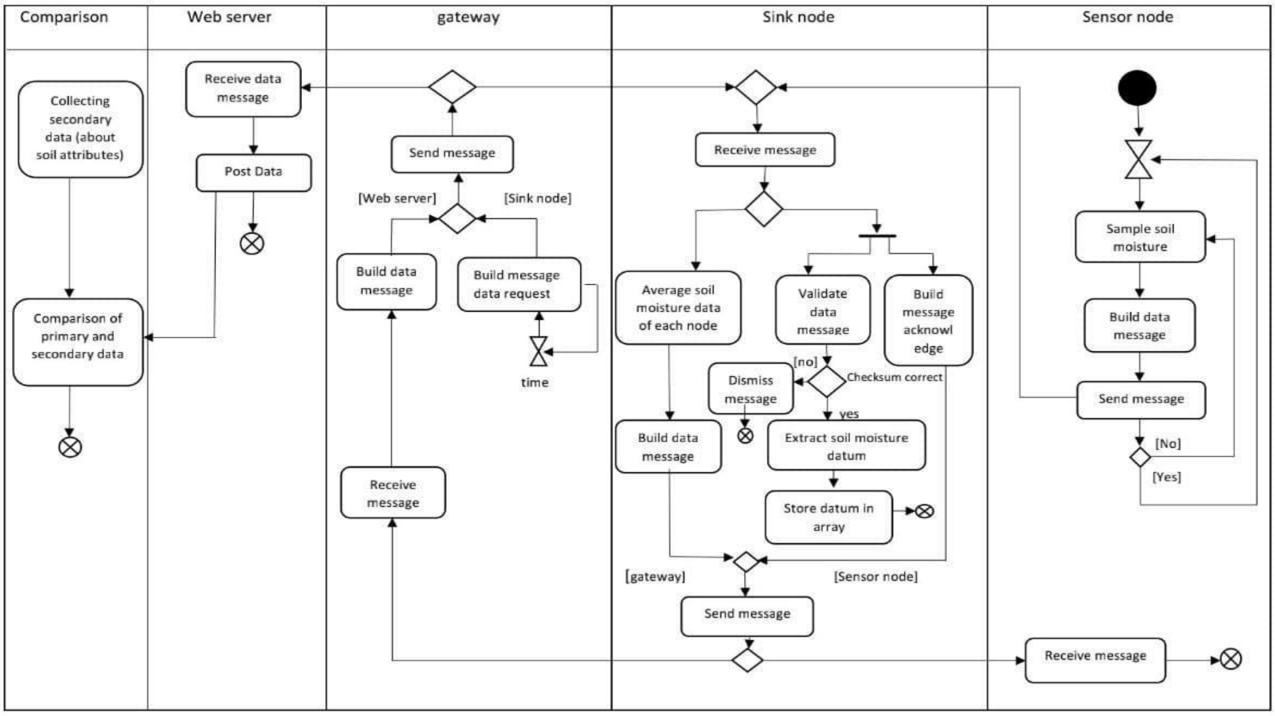


Figure 4.6: Flowchart of the system

4.7 PROTOTYPE OF THIS PROJECT

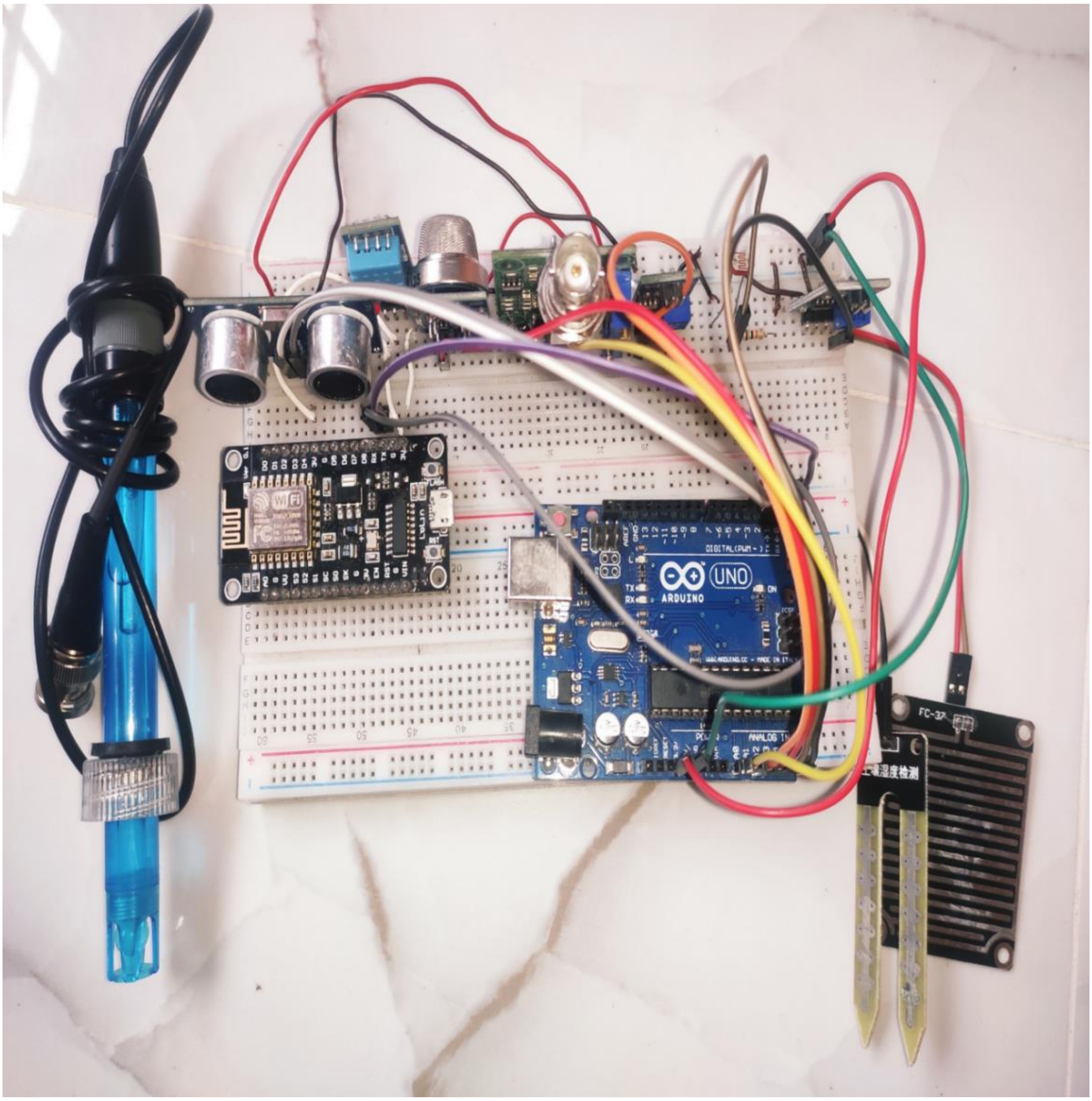


Figure 4.7: Prototype of this project

4.8 Results:

Data Table: Sample A

Particulars	**Value of Sample A (Location: Pahartoli)**	**Value of Sample B (Location: Noapara)**	**Value of Sample C (Location : IIUC)**	**Ideal Value/ Note**
PH Meter	7	6	9.1	5-8
Temperature (Degree C)	27	26	27	25-35
Gas Sensor	53	53	53	Near 0 : Fresh Air Near 100: polluted Gas
Humidity (%)	77	77	72	60-85
Moisture(%)	20	56	30	50-100

Data Table: Sample 2

Particulars	Day 1	Day 5	Day 10	Day 15	Day 20	Day 25	Day 30	Ideal Value / Note
PH	6	6	6	6	6	6	6	5-8
Temperature (°c)	32	32	30	30	31	29	28	25-35
Gas Sensor	53	53	53	53	53	53	53	Near 0: Fresh air Near 100: Polluted Ait
Humidity %	77	84	93	93	81	81	77	60-85
Moisture %	56	54	40	33	54	55	54	50-100
Value of Ultrasonic sensor (cm)	20	20	19	18	18	18	18	When it decreases, water level increases
Value of LDR	40	55	77	75	77	76	71	Near 0 no light Near 100 lot of light
Rain Possibility %	8	10	0	1	1	8	9	Rain possibility

Figure4.1: Result of the system

4.9 Working Principles of the Project

In this project, an Arduino Uno is linked to a NodeMCU via a serial monitor. Adriano will collect data from various sensors (such as a moisture sensor, a pH sensor, a rain sensor, an LDR, a gas sensor, and an ultrasonic sensor) and send it to the Node MCU. We're working on HTML code to display the results based on the IP address. Node MCU will gather data from the Arduino and DHT11 sensors and send it to a web server (specified IP address). After connecting the Arduino and NodeMCU to a power source, the NodeMCU sends real-time data to the Serial Monitor. Serial Monitor provides an IP address. So we can see the outcome at the same time.

CHAPTER 5

CONCLUSION & FUTURE WORKS

5.1 Conclusion

Crop management equipment, such as soil monitors, is used in the internet of things for agriculture. These devices are commonly used to collect data on crop cultivation and are generally positioned across fields. These sensors are sensed by temperature, moisture, insect presence, and other factors and transmitted to the farmer for analysis.

Rice is the staple meal of our country's people. However, as a result of unchecked population expansion, agricultural land is rapidly diminishing. Paddy farming is dwindling as a result of the failure to receive the projected crop. Hopefully, our initiative can expand paddy farming and fulfill people's needs. Hopefully, our industry can expand paddy farming and satisfy people's needs. It concludes that the current project's work has been a tremendous success. It will give a primary means to preserve real-time soil characteristics and aid farmers, industry, ordinary people, and others whose daily lives are connected to rice production. It may be utilized to obtain the information required for each specific location over many years. If we speak about agriculture, and the farmer can modify the state of the environment most suited for emergence growth, it will significantly influence agriculture.

5.2 Future Work

Though there are many features in this project, there are some limitations. We will try to reduce this limitation in the future.

We will do more research on paddy land. Then, I will create a framework on what land and what type of paddy will be produced.

We will do this project through was, and then try to do it with Artificial Intelligence. We intend to pursue a master's degree in this field in the future.

5.3 Cost Analysis

SL No:	Particulars	Unit Cost (BDT)	Total Cost (BDT)
1	Bread Board	90	180
2	Arduino Uno	500	500
3	NodeMCU	400	400
4	Moisture Sensor	150	150
5	DHT11	120	120
6	Ultrasonic Sensor	85	85
7	Gas Sensor	150	150
8	LDR	20	20
9	10K Ohm Resistance	5	5
10	Rain Sensor	90	90
11	PH Sensor	2400	2400
12	Connecting Wires	100	100
Total			4200

Figure 5.1: Total Cost analysis

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Appendix

Appendix A: Code for Arduino UNO

```
#include <ArduinoJson.h> //include arduinojson header file

float calibration_value = 21.34;

int phval = 0; // declatre the variable

unsigned long int revival;

int buffer_arr[10], temp;

int gas=0;

int light=0;

int rain;

#define echo pin 2 // define digital pin two or echo pin of ultrasonic sensor

#define trigpin 3 define digital pin three por origin of ultrasonic sensor

int duration, distance;

void setup()
{

  pinMode(trigpin, OUTPUT);

  pinMode(echopin, INPUT);
```

```
  Serial.begin(9600); // select bourd rate 9600

}

StaticJsonBuffer<1000> jsonBuffer;

JsonObject& root = jsonBuffer.createObject();

void loop() {

  for (int i = 0; i < 10; i++)

  {

    buffer_arr[i] = analogRead(A0);

    delay(30);
  }

  avgval = 0;

  for (int i = 2; i < 8; i++)

    avgval += buffer_arr[i];

  float volt = (float)avgval * 5.0 / 1024 / 6;

  float ph_act = -5.70 * volt + calibration_value;  //temp_sensor.requestTemperatures();

  int moisture_analog=analogRead(A1);

  int moist_act=map(moisture_analog,0,1023,100,0);

  gas=analogRead(A2);
```

```
light=analogRead(A3);

rain=analogRead(A4);

rain=map(rain,0,1023,100,0);

digitalWrite(trigpin, LOW);

delayMicroseconds(2);

digitalWrite(trigpin, HIGH);

delayMicroseconds(10);

digitalWrite(trigpin, LOW);

duration=pulseIn(echopin, HIGH);

distance=(duration*0.0343)/2;

root["a1"] = ph_act; // value of ph sensor

root["a2"] = moist_act; // value of moiture sensor

root["a3"] = gas; // value of gas sensor

root["a4"] = light; // value of ldr

root["a5"] = rain; // value of rain sensor

root["a6"] = distance;  // value of ultrasonic sensor

root.printTo(Serial);
```

```
  Serial.println("");

}
```

Appendix B: Code for Node MCU

```
#include<ESP8266WiFi.h> // including esp8266Wifi header file

#include<WiFiClient.h> // used for a client can connect to a specified IP address

#include<ESP8266WebServer.h> // including header file for support client to handle

#include <ArduinoJson.h> //include arduinojson header file

#include "DHT.h" // including library for dht11 tempreture and humidity sensor

#define DHTTYPE DHT11      // DHT 11 define

#define dht_dpin D4

DHT dht(dht_dpin, DHTTYPE);

const char* ssid = "Redmi"; //Replace with your network SSID

const char* password = "baizid1234"; //Replace with your network password

ESP8266WebServer server(80);

String page = "";

int data1, data2, data3, h, t, data4, data5, data6, data7, data8;
```

```
void setup()
{

  Serial.begin(9600); // buad rate 9600 bits per second

  WiFi.begin(ssid, password);

while (WiFi.status() != WL_CONNECTED)

  {

  delay(2000); // delay 2 second

  Serial.print(".");

  }

  Serial.println(WiFi.localIP());

  server.on("/", []()

  {

    page = "<html><head><title>IoT Design</title></head><style type=\"text/css\">";

    page += "table{border-collapse: collapse;}th {background-color:  blue ;color: 
white;}table,td {border: 4px solid   black;font-size: x-large;";

    page += "text-align:center;border-style: groove;border-color: 
rgb(255,0,0);}</style><body><center>";

    page += "<h1>Iot based agriculture monitoring </h1><br><br><table style=\"width: 
1200px;height: 450px;\"><tr>";
```

```
page += "<th>Parameters</th><th>Value</th><th>Units</th></tr><tr> <td>PH Value</td><td>"+String(data1)+"</td><td>N/A</td></tr>";

page += "<tr> <td>Moisture </td><td>"+String(data2)+"</td><td>%</td></tr>";

page += "<tr> <td>Gas</td><td>"+String(data3)+"</td><td>N/A</td></tr>";

page += "<tr> <td>Sun Light Condition </td><td>"+String(data4)+"</td><td>%</td></tr>";

page += "<tr> <td> Rain chances </td><td>"+String(data5)+"</td><td>%</td></tr>";

page += "<tr> <td>Distance water from sensor</td><td>"+String(data6)+"</td><td>cm</td></tr>";

page += "<tr><td>Humidity </td><td>"+String(data7)+"</td><td>%</td></tr><tr><td>Temperature </td><td>"+String(data8)+"</td><td>Centrigate</td> ";

page += "<meta http-equiv=\"refresh\" content=\"3\">";

server.send(200, "text/html", page);

});

server.begin();

}

void loop()

{
```

```
StaticJsonBuffer<1000> jsonBuffer;

JsonObject& root = jsonBuffer.parseObject(Serial);

if (root == JsonObject::invalid())

{

  return;

  Serial.println("invalid");

}

int t = dht.readTemperature();

int h = dht.readHumidity();

data1 = root["a1"]; // ph value

data2 = root["a2"] // mosture value

data3 = root["a3"]; //Gas

data4 = root["a4"]; // light

data5 = root["a5"]; // rain condition

data6 = root["a6"]; // distance from sensor

data7 = t; //  value of temperature Sensor

data8 = h; //  value of humidity  of dht11 sensor
```

```
  Serial.println(data1);  // show result in serial monitor
  Serial.println(data2);

  Serial.println(data3);

  Serial.println(data4);

  Serial.println(data5);

  Serial.println(data6);

  Serial.println(data7);

  Serial.println(data8);

  server.handleClient();

}
```