IoT Based Weather Monitoring System

A PROJECT REPORT

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in partial fulfillment for the award of the degree of

Bachelor of Engineering

IN

Computer Science and Engineering(DevOps)

Chandigarh University

February-May 2024

BONAFIDE CERTIFICATE

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Submitted for the project viva voce examination held on 30/04/2024.

INTERNAL EXAMINER

EXTERNAL EXAMINER

: Table of Contents:

• List of Acronyms

1) IoT – Internet of Things
2) DHT- Digital Humidity and Temperature
3) LCD – Liquid Crystal Display
4) BMP – Barometric Pressure
5) LED – Light Emitting Diode
6) SDA – Serial Data
7) SCL – Serial Clock
8) A.I – Analog Input
9) D.I – Digital Input
10) GND – Ground
11) TX – Transmitting Pin
12) RX – Receiving Pin
13) VCC – Common Collector Voltage

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Abstract

The method described in this paper provides a sophisticated way to keep track of local weather conditions and make the data accessible from anywhere in the globe. The Internet of Things (IoT), a cutting-edge and effective method for linking objects to the internet and linking everything in the world in a network, is the technology underlying this. Things like electronic devices, sensors, and vehicle electronics could be found here. Sensors are used by the system to monitor and adjust environmental parameters like temperature, relative humidity, and CO level. The information is sent to a web page, where the sensor data is plotted as graphical statistics. Anywhere in the world can access the updated data from the established system over the internet.

Chapter -1

Introduction

Introduction

Here, we provide an intelligent online weather reporting system. We have implemented a system that enables online reporting of weather parameters. Without the assistance of a weather forecasting organization, it enables anyone to monitor the weather conditions immediately online. The system tracks temperature, humidity, and precipitation along with a humidity sensor to offer real-time weather statistics reporting. Using temperature and humidity sensors, the system continuously checks for rain and temperature. The task of a weather monitoring system is to identify and collect a variety of meteorological parameters at multiple sites so that they can be analyzed or utilized for weather forecasting. Cloud and Internet of Things (IOT) technologies help this system achieve its goal. Connecting a device to the internet and other necessary connected devices is the concept behind the internet of things. Information from the Internet of Things (IOT) device can be effortlessly moved to the cloud and subsequently from the cloud to the end user. An key practical application of the Internet of Things idea is weather monitoring, which entails sensing and collecting numerous weather data and using them for long-term analysis, alarms, and notification sending. It also requires altering appliances accordingly. Furthermore, we will attempt to use graphical representation to find and show trends in the parameters. The tools employed for this function gather, arrange, and present data. With the help of sensors and devices that can record, process, and send meteorological data, the internet of things is predicted to change society by monitoring and managing environmental phenomena. The cloud refers to the availability of computational power and data storage on a computer system without the need for direct, user-managed administration. The collected data is sent to the cloud in order to enable additional data display. The Arduino UNO board, a microcontroller board with 14 digital pins, a USB connection, and everything needed to support a microcontroller, is one of the other components of the system. The DHT11 temperature and humidity sensor is used to detect the aforementioned parameters, and the WIFI module converts the data gathered from the sensors before sending it to the web server. Thus, from any remote position in the world, it is possible to monitor the meteorological conditions of any location. The micro controller receives this data from the system continuously, processes it, and then sends it again via a wifi connection to the online web server. The internet server system allows users to view this real-time updated data. Additionally, the system lets the user create alerts for certain cases. Many pollution monitoring systems in use today are created using various environmental factors. The current system model is an Internet of Things (IoT)-based weather monitoring and reporting system that allows you to gather, handle, examine, and display your measured data on a web server. The end device, router, gateway node, and management monitoring center make up the wireless sensor network management model. Data from wireless sensor networks must be collected by the end device and sent to the parent.

next, either directly or via a router, data are transmitted from the parent node to the gateway node. The gateway node receives data from the wireless sensor network, analyzes it, packages it into Ethernet format, and then transmits it to the server. Any gadget that runs server software is more colloquial.

1.1. OVERVIEW: -

Assemble every system in accordance with the schematic. Utilizing the Arduino IDE, program the NodeMCU. Confirmation will appear on your screen after the NodeMCU—a programmable controller with an integrated wifi module—is programmed.
Three sensors are connected. 1) DHT11, 2) Rain Sensor to NodeMCU, and 3) BMP180. These three sensors allow us to gather the necessary meteorological data for observational purposes. The Internet is used to transmit this combined data so that anyone can view or read it from any location. Following hardware programming success, the NodeMCU is assigned a single IP address. We may access this IP address using any web browser, including Chrome, Firefox, Internet Explorer, and others. As a result, we are able to show the necessary real-time data that was collected by sensors in an elegant graphical user interface. We keep an eye on the following meteorological parameters: temperature, pressure, humidity, and rain. Since this server is publicly hosted, you can also use the Internet to verify whether data is accessible from anywhere. To make our weather monitoring system easily accessible, we created an Android application.

1.2. Literature Review

The author of this paper explains how the weather prediction system is increasingly becoming a significant difficulty in every weather extreme event that has a negative impact on both human lives and property. Therefore, improving weather prediction skills and strengthening resistance to the negative effects of weather report conditions depend heavily on the quality of meteorological data. The author explains that the lack of reliable weather observation has made it difficult for Uganda and many other developing nations to produce timely and accurate meteorological data. One reason for the high expense of creating automated weather scenarios is the limited availability of weather monitoring. The national meteorological services of the corresponding nations are eligible for the restricted funding. The author of this suggested system addresses the issues first, then implements the solutions. The author suggested a wireless sensor network-based automatic weather monitoring station. The author intends to create three iterations of AWS (Automated Weather Station) prototypes. Depending on the demand and generation, the author of this study assesses the first-generation AWS prototype in order to enhance the second generation. In order to have an Automatic Weather Station, the author suggests improving the non-functional requirements, such as power consumption, data accuracy, dependability, and data transfer. The suggested work, such developing nations like Uganda will be able to obtain the AWS in acceptable quantities, as the non-functional need collapsed with cost reduction in order to manufacture a strong and economical Automatic Weather Station (AWS). in order to enhance weather forecasting In [2], the author describes an Internet of Things-based weather monitoring system. In this study, sensors are used to get the ambient parameter. To scale multiple parameters like humidity, temperature, pressure, and rain value, the author employs an LDR sensor in addition to another sensor. The dew point value is also computed by the system using the temperature prototype. Any space, room, or location can have its value measured using the temperature sensor. The light intensity can be employed as the author describes with the aid of the LDR sensor. In this case, the author made advantage of an extra weather monitoring feature: an SMS warning system that activates when temperature, humidity, pressure, light intensity, and rain value reach predetermined thresholds. An email and tweet post alerting system is also included by the author. The author of this system makes use of many sensors and node MCU 8266. The author of this study [3] describes a low-cost OLED-based live weather monitoring system and shows the several domains where IoT innovation has resulted in novel things in the system. The writer expounded upon a novel and innovative framework. It gauges the current state of the weather in real time. Everyone can benefit greatly from weather monitoring, including farmers, businesses, regular workers, and students. Therefore, the author lessened the challenge for farmers and industry by creating a live weather monitoring system. The author of this work makes use of an OLED display to show the current weather and The author's suggested solution makes use of an Arduino-powered WeMos D1 board with an ESP8266-EX microcontroller to retrieve data from the cloud.

A wifi module called WeMos D1 is built on the ESP-8266EX microprocessor. Its flash memory is 4MB in size. It is among the best that uses the Arduino IDE and Node MCU for programming. The author of this paper measures the weather using just two devices: Wemos and OLED. Following the connection, the data will be stored on the cloud for data storage, and the weather data will be shown on the Thingspeak website. The OLED and cloud-speaker devices of the system show the data. The author wants to be able to access real-time weather data on an OLED display. The author of [4] suggested a system that tracks and forecasts weather conditions so that everyone can make plans for their daily lives. This exercise proved beneficial in every sector, including business and agriculture. The author employs the first two phases of the weather management system to accomplish tracking and forecasting weather information. In order to provide a weather reporting system in stations and buses in real-time, they combined data from the sensors, bus mobility, and deep learning technology. The friction model is used to forecast the weather. The study incorporates the strength of local information processing based on the sensing measurement from vehicles such as buses. Using temperature, humidity, and air pressure data from the test environment, the author describes how multilayer perception models, long-term memory, and weather sensing are trained in stage I. The training is used in Stage II to acquire the meteorological time series. The author compared the weather data that was really collected from the Environment Protection Administrator and the central Baeuro of the Taichung observation system that calculates the forecast of accuracy with the weather data that was predicted in order to determine whether or not the system was performing as intended. At last, the author discusses the suggested system has dependable results when tracking the weather. Additionally, using the training model, this model suggested a one-day weather forecast or prediction. Finally, the author shows how bus information management is used in this system to present a real-time weather monitoring and prediction system. The writer embodies four fundamental elements. 1. Management of information. 2. Interactive transportation hub 3. Predictive model for machine learning 4. A platform for weather information. Information is displayed in this using a dynamic chart. In this research work, the author [5] explains how to monitor the weather using IoT technology and implements an IoT-based weather monitoring system. and which offer information on factors that are influencing the climate. People can become aware of the changes in climate conditions with the assistance of this project. It provides an output that is both accurate and efficient, and the swarm method is employed to further improve accuracy. Thus, the author's goal in this project is to use IoT to create a weather monitoring system. This project is simple to implement because it makes use of both hardware and software. In the project, the author gathers climate data using a separate sensor and stores it in the cloud. The website www.thingspeak.com is frequently used for Internet of things projects for this storage. Additionally, it retrieves all of the meteorological data from the cloud storage area and uses an API key to transfer it to the Android mobile application. Rain sensors are devices that can identify drops of precipitation. When the plague appears, the voltage is calculated based on the raindrops that appear on the strips.

Chapter - 2

Theory

THEORY

2.1 IoT (Internet of Things)

The Internet of Things, or IoT, is a sophisticated automation and analytics system that uses big data, artificial intelligence, networking, sensing, and sensing technologies to supply entire systems for a good or service. When used in any system or industry, these systems enable increased performance, control, and transparency.
IoT systems' exceptional versatility and adaptability to any setting make them useful in a variety of industries. They use smart devices and strong enabling technologies to improve operations, automation, data collection, and much more.

2.1.1 IoT−Key Features

- Artificial intelligence, connection, sensors, active involvement, and the utilization of small devices are among the most crucial aspects of the Internet of Things. Below is a quick rundown of these characteristics.

• **AI** − IoT basically uses networks, artificial intelligence algorithms, and data collection to make almost anything "smart," improving all facets of life. This might be as easy as adding sensors to your cupboards and refrigerator to sense when milk and your favorite cereal are running low and to automatically place an order with your favorite grocery store.

• **Connectivity**: Thanks to new technologies that make networking possible, particularly Internet of Things networking, networks are no longer only dependent on large suppliers. Networks are still useful even at much lower and less expensive sizes. These tiny networks are formed by IoT between its system devices.

• **Sensors**: Without sensors, IoT becomes less unique. They serve as defining tools that turn the Internet of Things from a typical passive network of devices into an active system that can be integrated into the actual world.

• **Active Engagement**: Passive engagement accounts for a large portion of today's interactions with linked technologies. A new paradigm for active content, product, or service interaction is brought about by IoT.

• **Small Devices:** As expected, devices have gotten cheaper, smaller, and more powerful over time. IoT delivers its accuracy, scalability, and versatility by utilizing specially designed tiny devices.

2.1.1 IoT – Advantages

- IoT has benefits for every aspect of business and lifestyle. These are just a few of the benefits that the Internet of Things can provide.

• **Enhanced Customer interaction –** Blind spots and serious accuracy issues plague current analytics, and as mentioned, interaction is still passive. This is entirely transformed by IoT to generate richer and more fruitful audience engagement.

• **Technology Optimization**: The same data and technologies that enhance customer satisfaction also facilitate better device usage and contribute to more significant technological advancements. A world of vital functional and field data is made accessible by IoT.

• **Decreased Waste –** IoT highlights opportunities for improvement. While current analytics only offer surface-level understanding, IoT offers practical data that may be used to manage resources more skillfully.

- **Enhanced Data collecting:** The design of modern data collecting is passive and has certain limitations. IoT removes it from those areas and puts it precisely where people want to go to analyze their surroundings. It makes it possible to see things clearly..

2.1.1 IoT – Disadvantages

- IoT offers a substantial number of problems in addition to its amazing benefits. These are a few of its main problems.
• **Security:** The Internet of Things establishes a networked ecosystem of continuously connected gadgets. Despite all security precautions, the system provides limited control. Users are exposed to different types of attackers as a result.
• **Privacy** – Without the user's active involvement, the sophisticated nature of IoT gives significant personal data in incredibly detailed ways.

• **Complexity** – Because IoT systems employ numerous technologies and a wide range of new supporting technologies, some people find them difficult to design, implement, and maintain.

• **Flexibility**: The ease with which one IoT system can be integrated with another is a concern shared by many.

•**Compliance –** IoT needs to abide by rules, just like any other company technology. Many people view standard software compliance as a battle because of its complexity, which makes the issue of compliance appear extremely difficult.

2.1.4 IoT Software

- IoT software uses platforms, embedded systems, partner systems, and middleware to address its two main functionalities: networking and action. Within the IoT network, these individual and master apps are in charge of data gathering, device integration, real-time analytics, and application and process extension. They take advantage of the integration of vital business processes.

  (such as robots, scheduling, ordering systems, and more) in the completion of associated tasks.

Information Gathering

This software controls data aggregation, light data security, light data filtering, and sensing. It facilitates sensor connections with real-time machine-to-machine networks by use of specific protocols. After then, it gathers data from various devices and distributes it in line with the parameters. Additionally, it distributes data among devices in reverse.

• **Analytics in Real Time**

These programs transform data or input from different devices into workable actions or distinct patterns that can be examined by humans. To carry out automation-related duties or supply the data needed by industry, they evaluate information based on different settings and designs.

• Utilization and Extension of Process

By extending the functionality of current software and processes, these apps provide a more expansive and efficient system. For example, they incorporate specified devices to grant access to certain mobile devices or technical instruments. It facilitates increased output and more precise data gathering.

2.1.2. Internet of Things - Technology and Protocols

IoT mostly makes use of networking technology and standard protocols. Nonetheless, low-energy Bluetooth, low-energy wireless, low-energy radio protocols, LTE-A, WiFi-Direct, RFID, NFC, and low-energy wireless are the main IoT enabling technologies and protocols. In contrast to a typical uniform network of common systems, these technologies support the particular networking functionality required in an Internet of Things system.

• RFID and NFC

For identity and access tokens, connection bootstrapping, and payments, NFC (near-field communication) and RFID (radio-frequency identification) offer straightforward, energy-efficient, and adaptable solutions. RFID technology tracks and identifies tags attached to things using two-way radio transmitters and receivers.

NFC consists of communication protocols for electronic devices, typically a mobile deviceand a standard device.

- **Low-EnergyBluetooth**

This technique takes advantage of a standard that is natively supported by many systems to satisfy the low-power, long-use requirements of Internet of Things functions.

- **Low-Energy Wireless**

The IoT system's most power-hungry component is replaced by this technology. While sensors and other components may shut down for extended periods, wireless communication links need to be in the listening state. Low-energy wireless not only saves energy but also prolongs the device's lifespan by requiring less use.

• **Radio Communication Protocols**

Radio technologies such as Thread, Z-Wave, and ZigBee are used to build low-rate private area networks. Unlike many alternatives of a similar nature, these technologies enable excellent throughput at low power. Small local device networks now have more power without the usual expenses.

• LTE-A

LTE-A, also known as LTE Advanced, improves LTE technology significantly by boosting throughput, decreasing latency, and expanding coverage. It greatly increases the range of IoT, and its most important uses are in automobile, unmanned aerial vehicle, and related communication.

• Direct WiFi

With WiFi-Direct, an access point is not necessary. Peer-to-peer (P2P) connections are possible at WiFi-like speeds with less latency. WiFi-Direct does not reduce speed or throughput while getting rid of a component of a network that frequently slows it down.

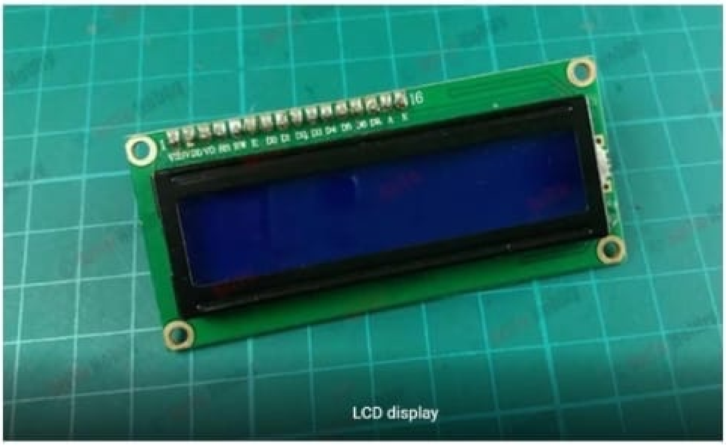
2.1.2. Internet of Things - Common Uses

Applications for IoT can be found across many sectors and industries. Its user base includes both major enterprises looking to streamline their operations and individuals looking to cut back on energy use in their homes. In many areas, it turns out to be not only helpful but almost indispensable as technology develops and we get closer to the sophisticated automation of the far future.

• Infrastructure, Industry, and Engineering

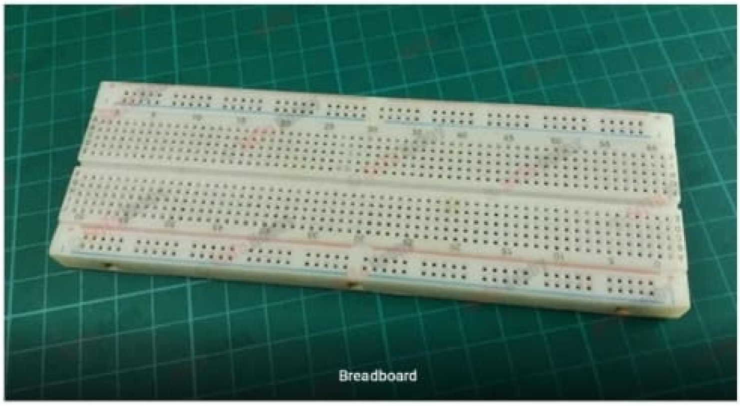
These sectors see improvements in manufacturing, marketing, service delivery, and safety thanks to IoT applications. IoT is a powerful tool for process monitoring, and genuine transparency makes improvement opportunities easier to see.

The deep level of control afforded by IoT allows rapid and more action on those opportunities, which include events like obvious customer needs, nonconforming product, malfunctions in equipment, problems in the distribution network, and more.



LCD display

I2C module



Breadboard

• Safety and Governance

When used in conjunction with IoT, government and safety can enhance economic management, municipal planning, defense, and law enforcement. The technology closes many of the existing gaps, fixes numerous issues, and broadens the scope of these initiatives. IoT, for instance, can give governments and city planners a greater understanding of the local economy and a clearer picture of the effects of their designs.

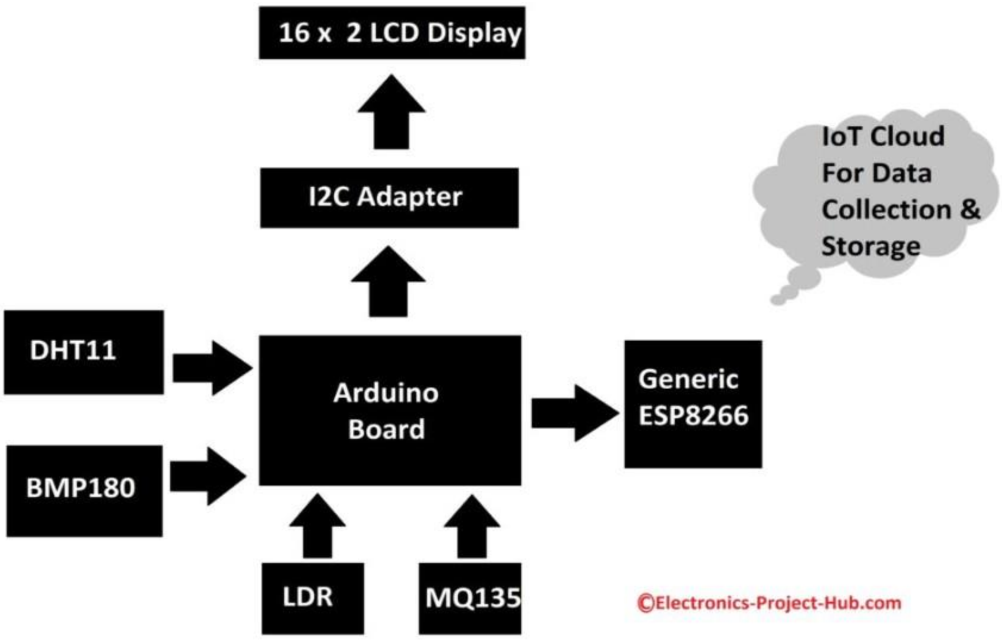
• Residence and Workplace

IoT offers a personalized experience in our daily lives, whether it be at home, at work, or at the companies we regularly do business with. This raises our level of contentment generally, boosts output, and advances our security and well-being. IoT, for instance, can assist us in personalizing our workspace to maximize our productivity.

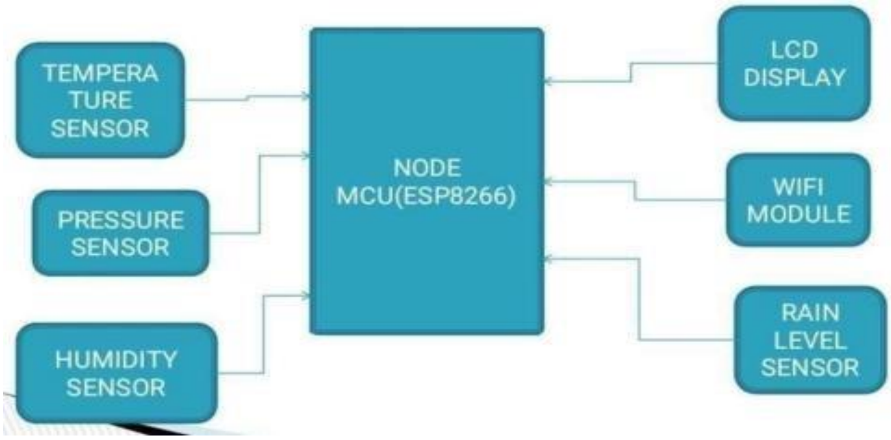
• **Medical and Health**

IoT is driving us closer to the medical future we envision, one that takes advantage of a highly connected network of advanced medical equipment. IoT can now significantly improve medical treatment, gadgets, research, and emergency care. The integration of these components lowers the usual overhead of medical research and administration while delivering greater accuracy, more attention to detail, quicker responses to events, and continuous improvement.

2.2. Block Diagram



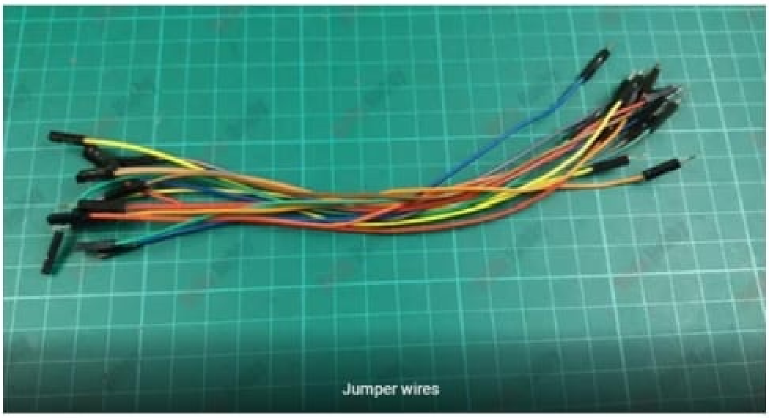
Block diagram with Arduino



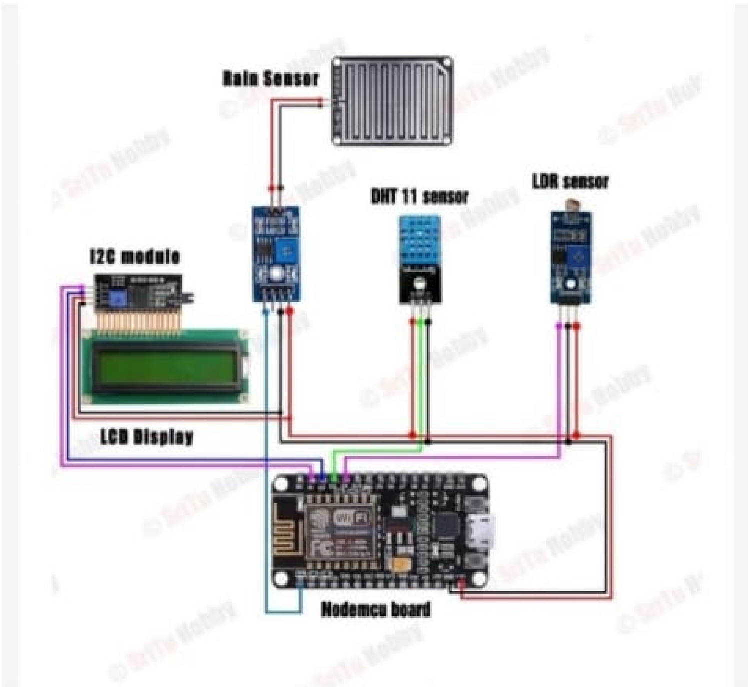
Block diagram of Node MCU

2.2. Advantages of Proposed System

- Decreased field damaging conditions
- Improved safety and security
- High-quality receiving data
- Less power consumption
- Accuracy is High
- Smart way to monitor Environment
- The low cost and efforts are less in this system


Jumper wires

3.2 Working


Rain Sensor
DHT 11 sensor
LDR sensor
I2C module
LCD Display
Nodemcu board

Chapter - 3

Proposed System and Hardware Architecture

3.1. Features of purposed system

Four weather parameters are measured by the Arduino Uno utilizing four sensors in the Internet of Things enabled weather monitoring system project. These sensors include light, rain level, temperature, and humidity sensors. Since the Arduino Uno includes an integrated analog to digital converter, these four sensors are immediately attached to the board. For weather monitoring and climate change, the weather monitoring system offers excellent accuracy and dependability. It charges the attached battery using a renewable energy source, such as a solar panel. It has access to real-time meteorological data and information via the internet. Over the general packet radio service (GPRS) network, this system can communicate. The end user requires little upkeep. It has the ability to store data and deliver it to consumers as needed.

3.2. Hardware Architecture in Purpose

The microcontroller (ESP8266) in the constructed system serves as the primary processing unit for the entire system, and it may be connected to all sensors and devices. The microcontroller can be used to control the sensors and retrieve data from them. It then does analysis on the sensor data and uploads it to the internet via a Wi-Fi module linked to the Blynk app. This allows us to analyze the following parameters: temperature, humidity, pressure, and precipitation.

3.3. Circuit Diagram

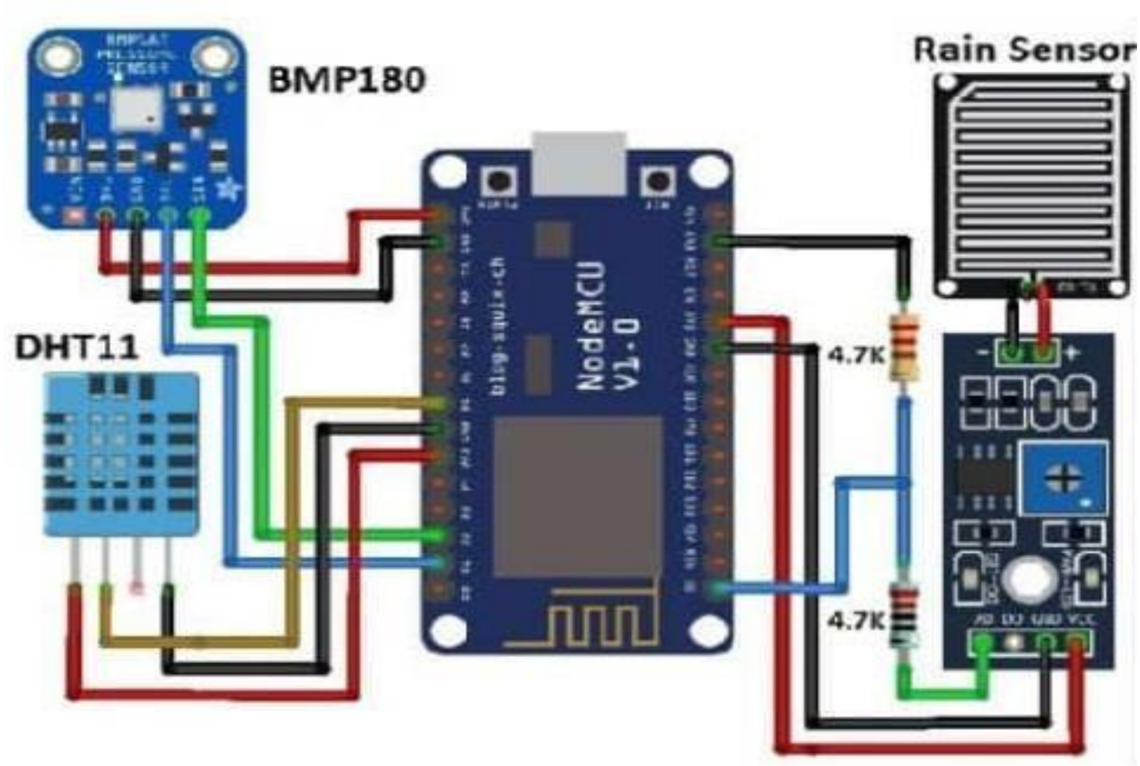


Fig – 1 Circuit diagram of NodeMCU

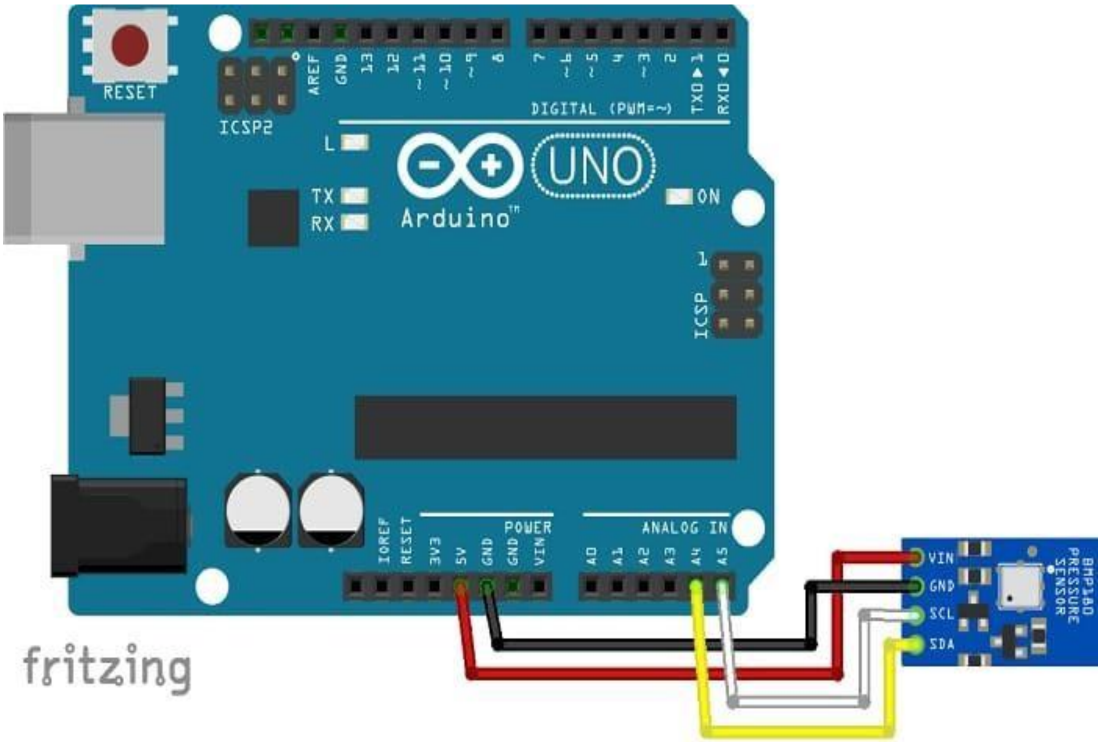


Fig – 2 Circuit diagram of BMP180 with Arduino

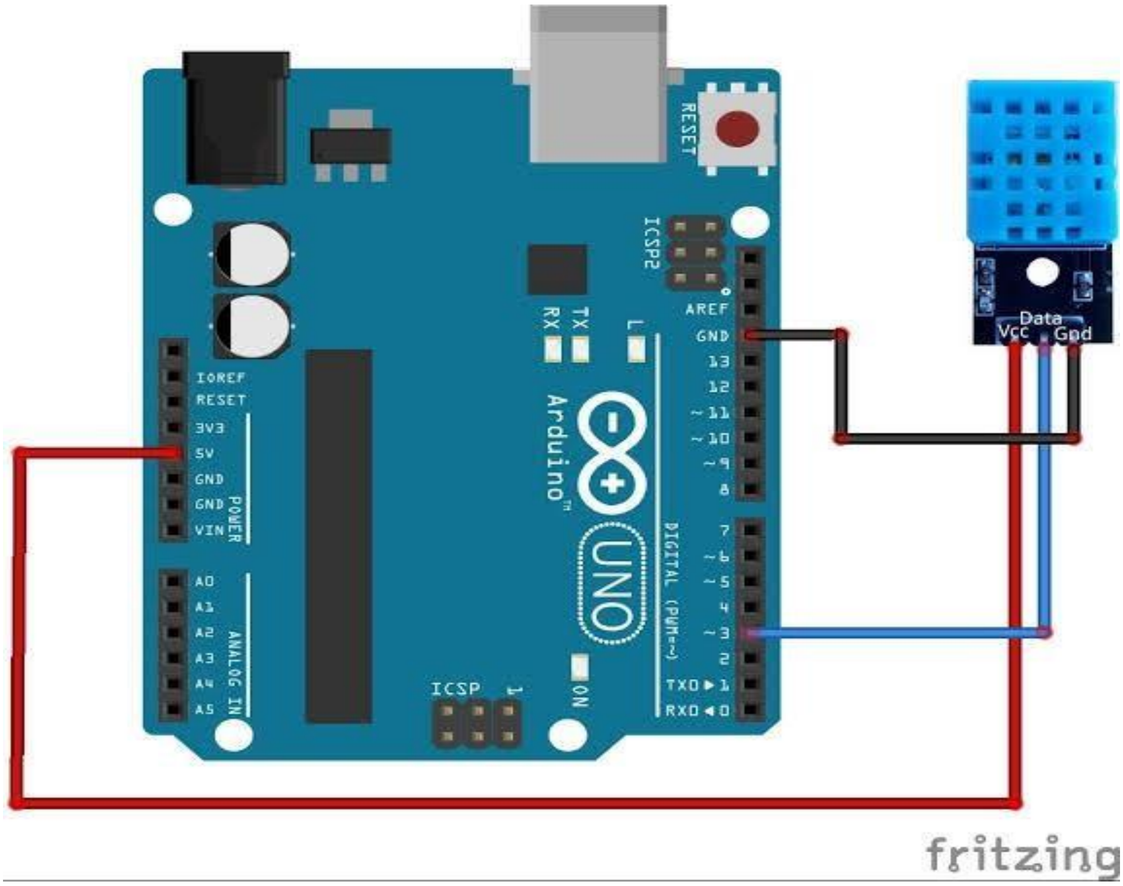


Fig – 3 Circuit diagram of DHT11 with Arduino


Blynk
New Project
My Apps
Community


Create New Project
Weather monitoring
NodeMCU
Wi-Fi
Create


Wether monitoring


Widget Box
+ Add
Value Display
Labeled Value
LED
Gauge
LCD
SuperChart
Terminal
Video Streaming
Level H

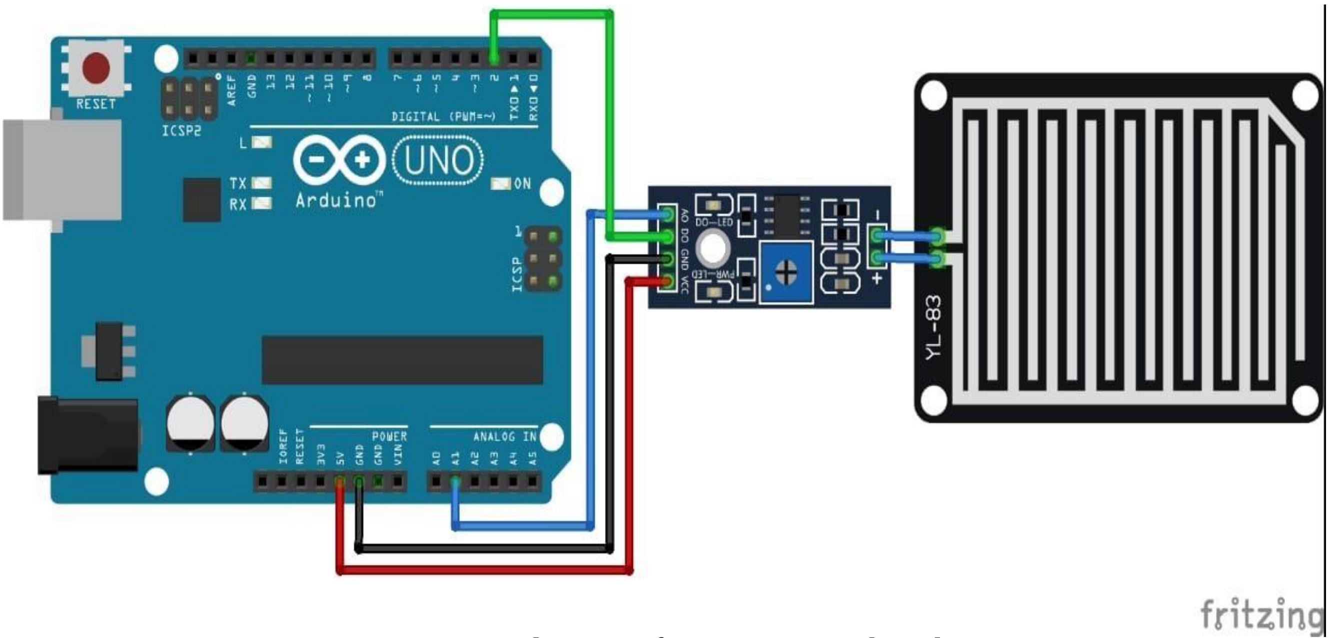


Fig – 4 Circuit diagram of Rain sensor with Arduino

3.5. List of required hardware components

Serial No.	Name of the components
1.	Arduino UNO
2.	ESP8266 WiFi Module
3.	DHT11
4.	BMP180
5.	Rain Sensor
6.	16*2 LCD Display
7.	Beard Board
8.	Jumper Wire
9.	Data Cable

3.6. Details of Hardware Component

3.6.1. Arduino Uno

The ATmega328P is the basis for the Arduino Uno microcontroller board (datasheet). It contains six analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), fourteen digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; all you need to do is power it with a battery or an AC-to-DC adapter or connect it to a computer via a USB cable to get going. Play around with your Uno without having to worry too much about

If something goes wrong, in the worst case you may start over by replacing the chip, which should only cost a few bucks. Since "uno" in Italian means "one," it was chosen to commemorate the release of software (IDE) for Arduino 1.0. The reference versions of Arduino, which have now progressed to newer releases, were the Uno board and version 1.0 of the Arduino Software (IDE). The Arduino index of boards contains a comprehensive list of all previous and current Arduino boards, as well as the Uno board, which is the first in a series of USB Arduino boards and the platform's reference model.

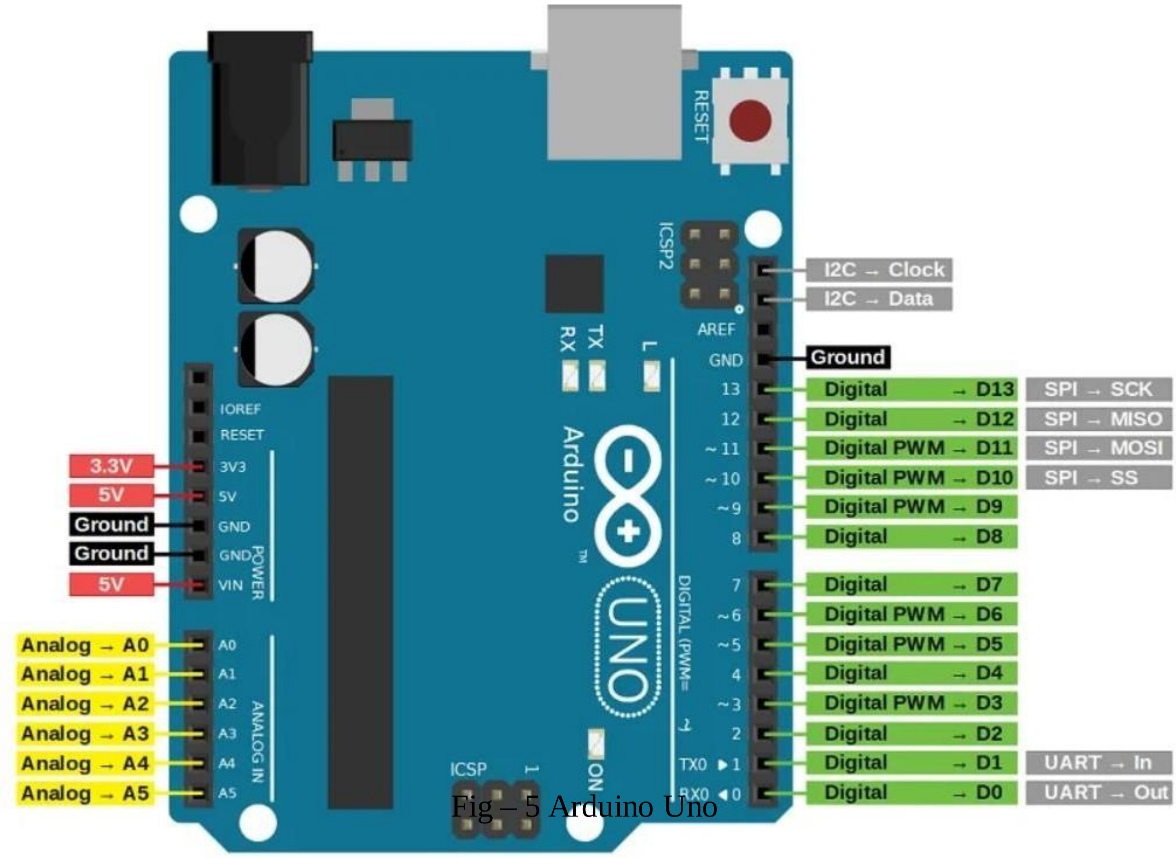


Fig – 5 Arduino Uno

- **Pin Configuration of Arduino UNO**
- **Vin -** The Arduino board's input voltage pin is utilized to supply input power from an external power source.
- **5V -** The Arduino board's pin serves as a regulated power supply voltage that supplies electricity to both the board and its internal components.
- **3.3V -** This pin on the board is used to supply 3.3V, which is produced by the board's voltage regulator.
- **GND -** The Arduino board is grounded using this pin on the board.
- **Reset -** The microcontroller can be reset using this pin on the PCB. It serves as a microcontroller reset.

- **Analog Pins -** The analog input range for pins A0 through A5 is 0 to 5 volts**.**
- **Digital Pins -** The Arduino board uses pins 0 through 13 as digital inputs and outputs.
- **Serial Pins** - Another name for these pins is a UART pin. It facilitates communication between the Arduino board and other gadgets or a computer. To send and receive data, respectively, the transmitter pin number 1 and receiver pin number 0 are utilized.
- **External Interrupt Pins -** Pins 2 and 3 of the Arduino board are used to generate the external interrupt, which is produced by this pin**.**
- **PWM Pins -** By altering the pulse's width, these pins on the board are utilized to transform a digital signal into an analog one. A PWM pin is utilized, and its numbers are 3,5, 6, 9, 10, and 11**.**

  SPI Pins - With the aid of the SPI library, this pin, known as the Serial Peripheral Interface pin, is used to sustain SPI communication.
- SPI pins include:

1) SS: Pin number 10 is used as a Slave Select
2) MOSI: Pin number 11 is used as a Master Out Slave In
3) MISO: Pin number 12 is used as a Master In Slave Out
4) SCK: Pin number 13 is used as a Serial Clock

• **LED Pin:** Digital pin-13 on the PCB powers an integrated LED. Only when the digital pin is high does the LED light up.

• **AREF Pin:** The Arduino board's analog reference pin is located here. It is employed to supply an external power source with a reference voltage.

3.6.1. ESP8266 – Wi-Fi Module

With its inbuilt TCP/IP protocol stack, the self-contained ESP8266 WiFi Module allows any microcontroller to connect to your WiFi network. Either an application can be hosted on the ESP8266, or it can delegate all Wi-Fi networking tasks to another application processor. Since each ESP8266 module has an AT command set firmware pre-programmed, all you have to do is connect it to your Arduino device to obtain roughly the same amount of WiFi functionality as a WiFi shield—and that's right out of the box! The ESP8266 module is a very affordable board with a sizable and continuously expanding community.

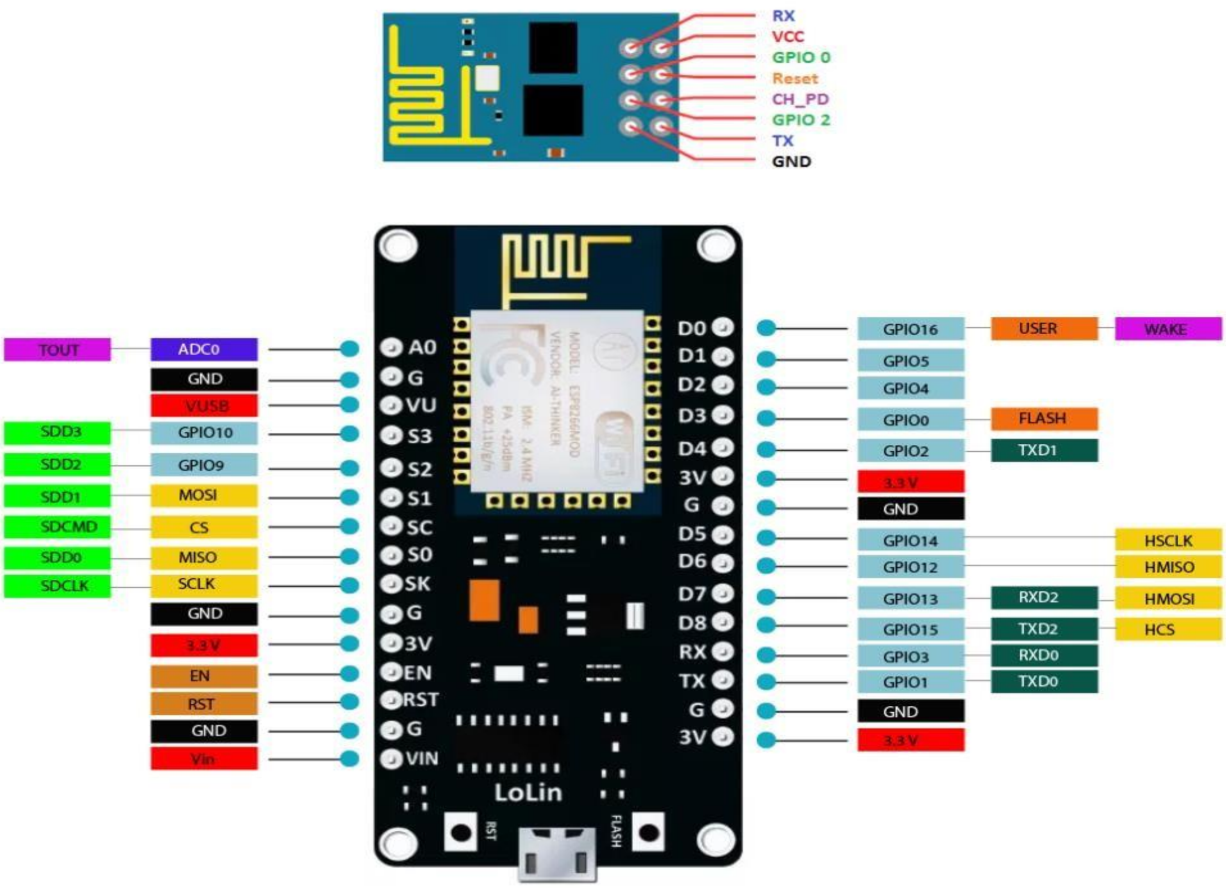


Fig – 6 ESP8266 WiFi Module

3.2.1. Pin Configuration

Pin Number	Pin Name	Alternate Name	Normally used for	Alternate purpose
1	**Ground**	-	Connected to the ground of the circuit	-
2	**TX**	GPIO – 1	Connected to Rx pin of programmer/uC to upload program	Can act as a General purpose Input/output pin when not used as TX
3	**GPIO-2**	-	General purpose Input/output pin	-
4	**CH_EN**	-	Chip Enable – Active high	-
5	**GPIO - 0**	Flash	General purpose Input/output pin	Takes module into serial programming when held low during start up
6	**Reset**	-	Resets the module	-
7	**RX**	GPIO - 3	General purpose Input/output pin	Can act as a General purpose Input/output pin when not used as RX
8	**Vcc**	-	Connect to +3.3V only	

4.2.2. Some features of ESP8266

- Low cost, compact and powerful Wi-Fi Module
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: 3.6V (max)
- I/O source current: 12mA (max)
- Built-in low power 32-bit MCU @ 80MHz
- 512kB Flash Memory
- Can be used as Station or Access Point or both combined0
- Supports Deep sleep (<10uA)
- Supports serial communication hence compatible with many development platform like Arduino
- Can be programmed using Arduino IDE or AT-commands or Lua Script

4.3. DHT11(Temperature & Humidity sensor)

A straightforward, incredibly affordable digital temperature and humidity sensor is the DHT-11. It measures the ambient air using a thermistor and a capacitive humidity sensor before emitting a digital signal on the data pin (analog input pins are not used).

needed).

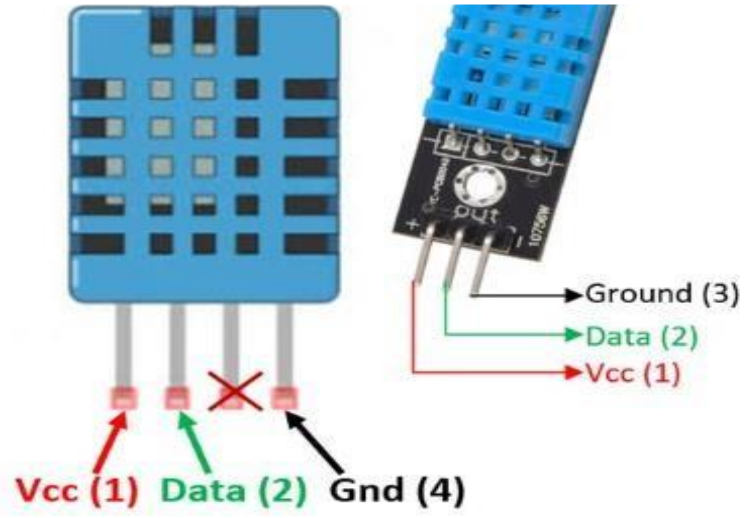


Fig – 7 DHT11(Temperature & Humidity Sensor)

3.3.1. Pin Configuration of DHT11

1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	NC	No Connection and hence not used
4	Ground	Connected to the ground of the circuit

3.3.1. 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%

3.4. BMP180 (Pressure Sensor)

One sensor in the BMP XXX series is the BMP180. All of them are made to measure atmospheric or barometric pressure. The BMP180 is a highly precise sensor intended for use in consumer products. All that is meant by barometric pressure is the weight of air applied to everything. Everywhere there is air, there is pressure because air has weight. The BMP180 sensor detects that pressure and outputs the data digitally. Additionally, since temperature has an impact on pressure, temperature-compensated pressure readings are required. The BM180 also contains a decent temperature sensor as a make-good measure..

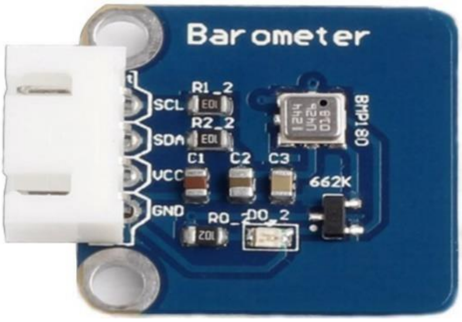


Fig – 8 BMP180

3.4.1. Pin Configuration

Pin Name	Description
VCC	Connected to +5V
GND	Connected to ground.
SDA	Serial Data pin (I2C interface)
SCL	Serial Clock pin (I2C interface)
3.3V	If +5V is not present. Can power module by connecting +3.3V to this pin.

3.4.2. Some features of BMP180 Module

- Can measure temperature and altitude.
- Pressure range: 300 to 1100hPa
- High relative accuracy of ±0.12hPa
- Can work on low voltages
- 3.4Mhz I2C interface
- Low power consumption (3uA)
- Pressure conversion time: 5msec
- Potable size

3.4.2. Specification of BMP180 Module

- Operating voltage of BMP180: 1.3V – 3.6V
- Input voltage of BMP180MODULE: 3.3V to 5.5V
- Peak current: 1000uA
- Consumes 0.1uA standby
- Maximum voltage at SDA , SCL : VCC + 0.3V
- Operating temperature: -40ºC to +80ºC

3.5. Rain Sensor

One type of switching device that is used to detect rainfall is a rain sensor. This sensor functions similarly to a switch, with the idea being that when it rains, the switch will generally be closed.

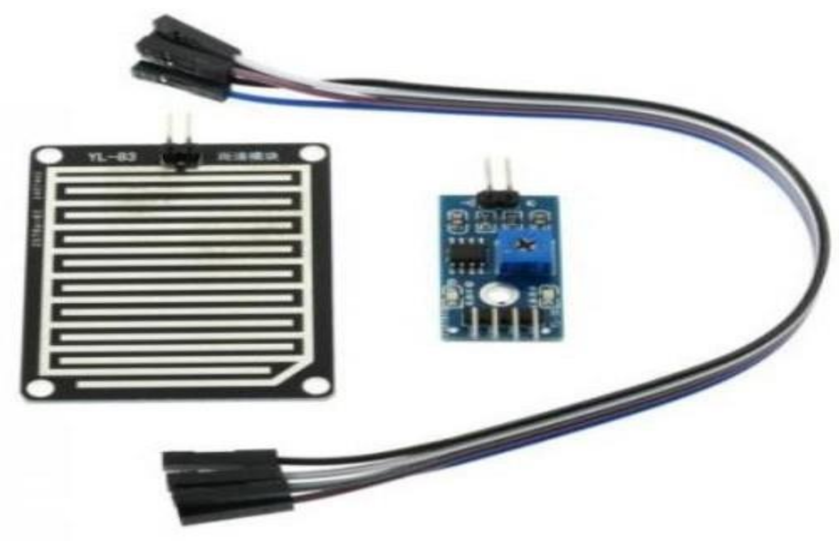


Fig – 9 Rain Sensor with Module

3.5.1. Rain Sensor Module

Below is a picture of the rain sensor board or module. This board functions primarily on the resistance principle and has lines coated with nickel. This sensor module provides a digital output when the moisture threshold is exceeded and allows for the measurement of moisture through analog output pins.

Because it comes with a PCB and an electrical module, this module is comparable to the LM393 IC. Here, raindrops are collected using a PCB. A parallel resistance path is created by rain on the board, which the operational amplifier uses to calculate.

Fig – 10 Rain Module

3.5.2. Pin Configuration

The pin configuration of this sensor is shown below. This sensor includes four pins which include the following.

- Pin1 (VCC): It is a 5V DC pin

- Pin2 (GND): it is a GND (ground) pin
- Pin3 (DO): It is a low/ high output pin
- Pin4 (AO): It is an analog output pin

3.5.2. Specification of Rain Sensor

- This sensor module uses good quality of double-sided material.
- Anti-conductivity & oxidation with long time use
- The area of this sensor includes 5cm x 4cm and can be built with a nickel plate on the side
- The sensitivity can be adjusted by a potentiometer
- The required voltage is 5V
- The size of the small PCB is 3.2cm x 1.4cm
- For easy installation, it uses bolt holes
- It uses an LM393 comparator with wide voltage
- The output of the comparator is a clean waveform and driving capacity is above 15mA.

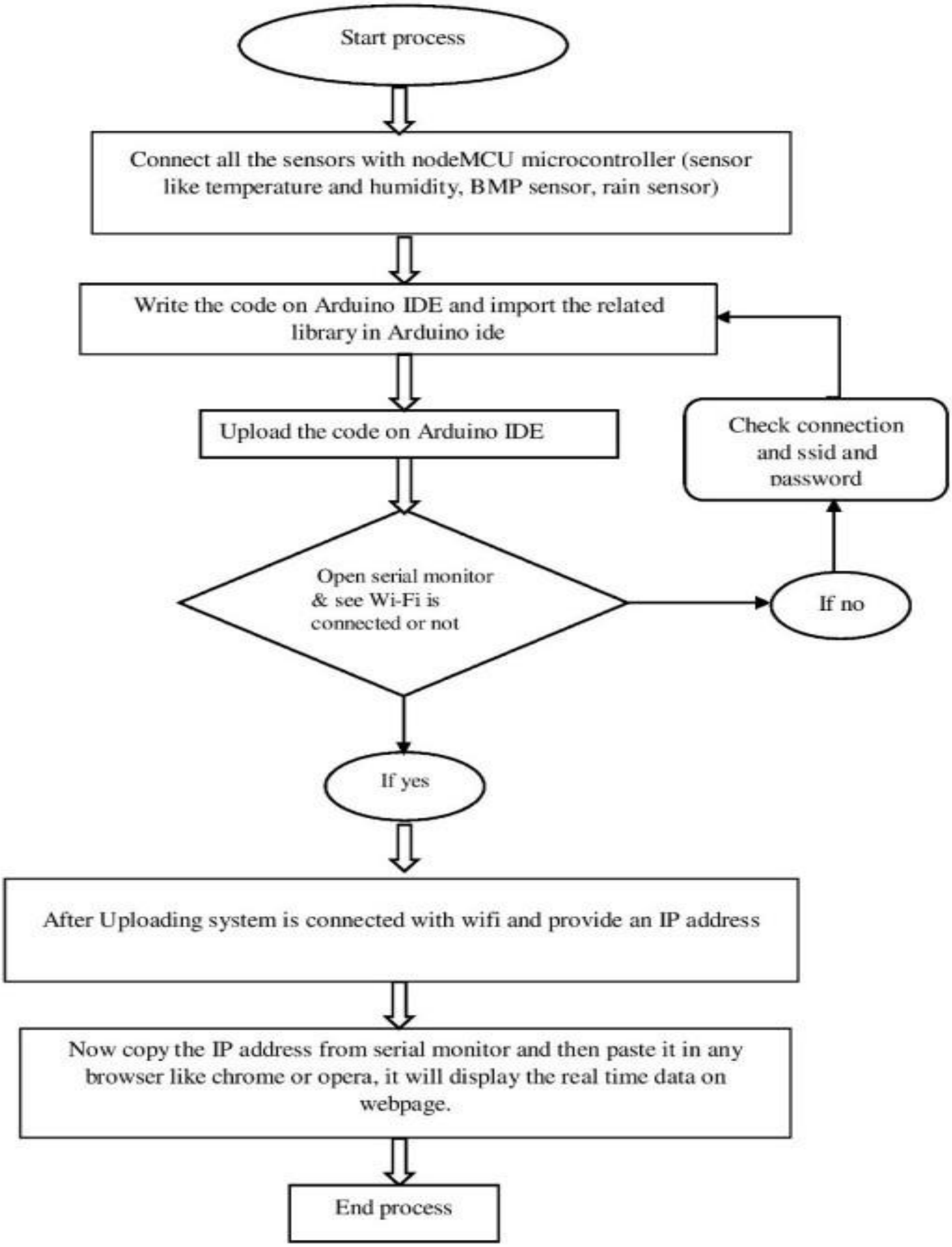
3.6. LCD Display

A liquid crystal display, or LCD for short, is essentially a display device made with liquid crystal technology. In order to show output data and messages in real-world electronics projects, we need a medium or device. Seven-segment displays are the most basic type of electronic display now in use, however they have drawbacks of their own. Liquid crystal displays are the next best alternative available; they are available in various size specifications. The most widely used LCD module available on the market is the 16x2 LCD module, which has the ability to show 32 ASCII characters in two lines. In order to facilitate effective communication between the human and machine realms, display units are crucial. They therefore play a crucial role in embedded systems. All display devices operate on the same fundamental idea, regardless of size. Working with basic displays like 16x1 and 16x2 units is important in addition to more advanced ones like graphic and 3D displays.

Fig – 11 16*2 LCD Display

Chapter - 4
Algorithm

4.1. Flow chart of the system



4.2. Source Code

4.2.1. DHT11 with Arduino

```
#include <SimpleDHT.h>
// for DHT11,
//      VCC: 5V or 3V
//      GND: GND
//      DATA: 3
int pinDHT11 = 3;
SimpleDHT11 dht11(pinDHT11);
void setup() {
   // start working...
  Serial.println("Temperature and Humidity Data");
  Serial.begin(9600);
}
void loop() {
  // read without samples.
  byte temperature = 0;
  byte humidity = 0;
  int err = SimpleDHTErrSuccess;
  if ((err = dht11.read(&temperature, &humidity, NULL)) != SimpleDHTErrSuccess) {
    Serial.print("Read DHT11 failed, err="); Serial.print(SimpleDHTErrCode(err));
    Serial.print(","); Serial.println(SimpleDHTErrDuration(err)); delay(1000);
    return;
  }
  Serial.print((int)temperature); Serial.print(" *C, ");
  Serial.print((int)humidity); Serial.println(" H");
    // DHT11 sampling rate is 1HZ.
  delay(1500);
 }
```

4.1.2. Rain Sensor With Arduino

```
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
}
```

```
// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
  int sensorValue = analogRead(A0);
  // print out the value you read:
  Serial.println(sensorValue);
  delay(1);        // delay in between reads for stability
}
```

4.1.3. BMP180 (Pressure)

```
#include <Wire.h>
#include <Adafruit_Sensor.h>
#include <Adafruit_BMP085_U.h>

/* This driver makes use of the Adafruit unified sensor library (Adafruit_Sensor), which offers several assistance functions as well as a standard 'type' for sensor data.

You must additionally download and add the Adafruit Sensor library to your libraries folder in order to utilize this driver.

In order to identify this specific sensor in any data logs or other records, you should also give it a unique ID when using the Adafruit Sensor API. Just enter the necessary value in the constructor below to assign a unique ID (in this case, 12345 is used by default).


   Connections
   ===========
   Connect SCL to analog 5
   Connect SDA to analog 4
   Connect VCC to 3.3V DC
   Connect GROUND to common ground

   History
   =======
```

```
  2013/JUN/17  - Updated altitude calculations (KTOWN)
  2013/FEB/13 - First version (KTOWN)
*/

Adafruit_BMP085_Unified bmp = Adafruit_BMP085_Unified(10085);

/**************************/
/*
    Displays some basic information on this sensor from the unified
    sensor API sensor_t type (see Adafruit_Sensor for more information)
*/
/**************************/
void displaySensorDetails(void)
{
  sensor_t sensor;
  bmp.getSensor(&sensor);
  Serial.println("------------------------------------");
  Serial.print  ("Sensor:       "); Serial.println(sensor.name);
  Serial.print ("Driver Ver: "); Serial.println(sensor.version);
  Serial.print  ("Unique ID:    "); Serial.println(sensor.sensor_id);
  Serial.print  ("Max Value:    "); Serial.print(sensor.max_value); Serial.println(" hPa");
  Serial.print  ("Min Value:    "); Serial.print(sensor.min_value); Serial.println(" hPa");
  Serial.print ("Resolution: "); Serial.print(sensor.resolution); Serial.println(" hPa");
  Serial.println("------------------------------------");
  Serial.println("");
  delay(250);
}

/**************************/
/*
    Arduino setup function (automatically called at startup)
*/
```

4.1.4. ESP8266 with Rain Sensor via Blynk

```
#include <SoftwareSerial.h>
```

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
char auth[] = "P4pODDBKIyHrzw2YJW5g6Bfc8-H1bWqa";
char ssid[] = "ASUS_X00TD";
char pass[] = "suvadip1998";

BlynkTimer timer;

void moisture() {
  int rainSensor = analogRead(A0);
 rainSensor = map(rainSensor, 0, 1023, 0, 350);
  Blynk.virtualWrite(V5, rainSensor);
  Serial.println(rainSensor);
}
void setup() {
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  timer.setInterval(350, moisture);

}
void loop()
{
  Blynk.run();
  timer.run();
```

4.1.5. ESP8266 with BMP180 via Blynk App

```
#include <Wire.h>
#include <Adafruit_BMP085.h>
#include <Blynk.h>
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

Adafruit_BMP085 bmp;
```

```
float temp, pressure, Altitude, Sealevel;

char auth[] = "8LU16RepIbHVm0gt7-9-XMz9l-rwXjsS";

char ssid[] = "Dlink";
char pass[] = "Pabitra1999";



void setup()
{

  Serial.begin(115200);
  WiFi.begin(ssid, pass);
  Serial.print("Connecting…. ");

  while(WiFi.status() != WL_CONNECTED)
  {
    delay(500);
    Serial.print("Waiting to connect WiFi\n");
  }
  Serial.print("WiFi is connected \n");
  Serial.print(WiFi.localIP());

  Blynk.begin(auth, ssid, pass);

  if (!bmp.begin())
  {
  Serial.println("Could not find a valid BMP085 sensor, check wiring!");
  while (1)
  {

  }
```

```
  }

}

void loop()
{
   Blynk.run();


   temp = bmp.readTemperature();
   pressure = bmp.readPressure();
   Sealevel = bmp.readSealevelPressure();
   Altitude = bmp.readAltitude();


   Blynk.virtualWrite(V6, temp);
   Blynk.virtualWrite(V7, pressure);
   Blynk.virtualWrite(V8, Sealevel);
   Blynk.virtualWrite(V9, Altitude);


   Serial.print("Temperature = ");
   Serial.print(bmp.readTemperature());
   Serial.println(" *C");

   Serial.print("Pressure = ");
   Serial.print(bmp.readPressure());
   Serial.println(" Pa");

   Serial.print("Altitude = ");
   Serial.print(bmp.readAltitude());
   Serial.println(" meters");

   Serial.print("Pressure at sealevel (calculated) = ");
```

```
    Serial.print(bmp.readSealevelPressure());
    Serial.println(" Pa");



    Serial.println();

}
```

5.1.6. ESP8266 with DHT11 via Blynk App

```
#define BLYNK_TEMPLATE_ID "TemplateID"
#define BLYNK_DEVICE_NAME "Temperature Alert"
#define BLYNK_AUTH_TOKEN "Auth Token"

#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>


#include <DHT.h>

char auth[] = BLYNK_AUTH_TOKEN;

char ssid[] = "WiFi Username";  // type your wifi name
char pass[] = "WiFi Password";  // type your wifi password

#define DHTPIN 2          // Mention the digital pin where you connected
#define DHTTYPE DHT11     // DHT 11
DHT dht(DHTPIN, DHTTYPE);
BlynkTimer timer;

void sendSensor(){
  float h = dht.readHumidity();
  float t = dht.readTemperature(); // or dht.readTemperature(true) for Fahrenheit
  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
```

```
    return;
  }

  Serial.println(t);
  Blynk.virtualWrite(V6, h);
  Blynk.virtualWrite(V5, t);
  Serial.print("Temperature : ");
  Serial.print(t);
    Serial.print("    Humidity : ");
    Serial.println(h);



  if(t > 30){
   // Blynk.email("shameer50@gmail.com", "Alert", "Temperature over 28C!");
    Blynk.logEvent("temp_alert","Temp above 30 degree");
  }
}

void setup(){
  Serial.begin(115200);
  Blynk.begin(auth, ssid, pass);
  dht.begin();
  timer.setInterval(2500L, sendSensor);
}

void loop(){
  Blynk.run();
  timer.run();
}
```

Chapter - 5
Implementation

5.1. Prototype mode of the system -

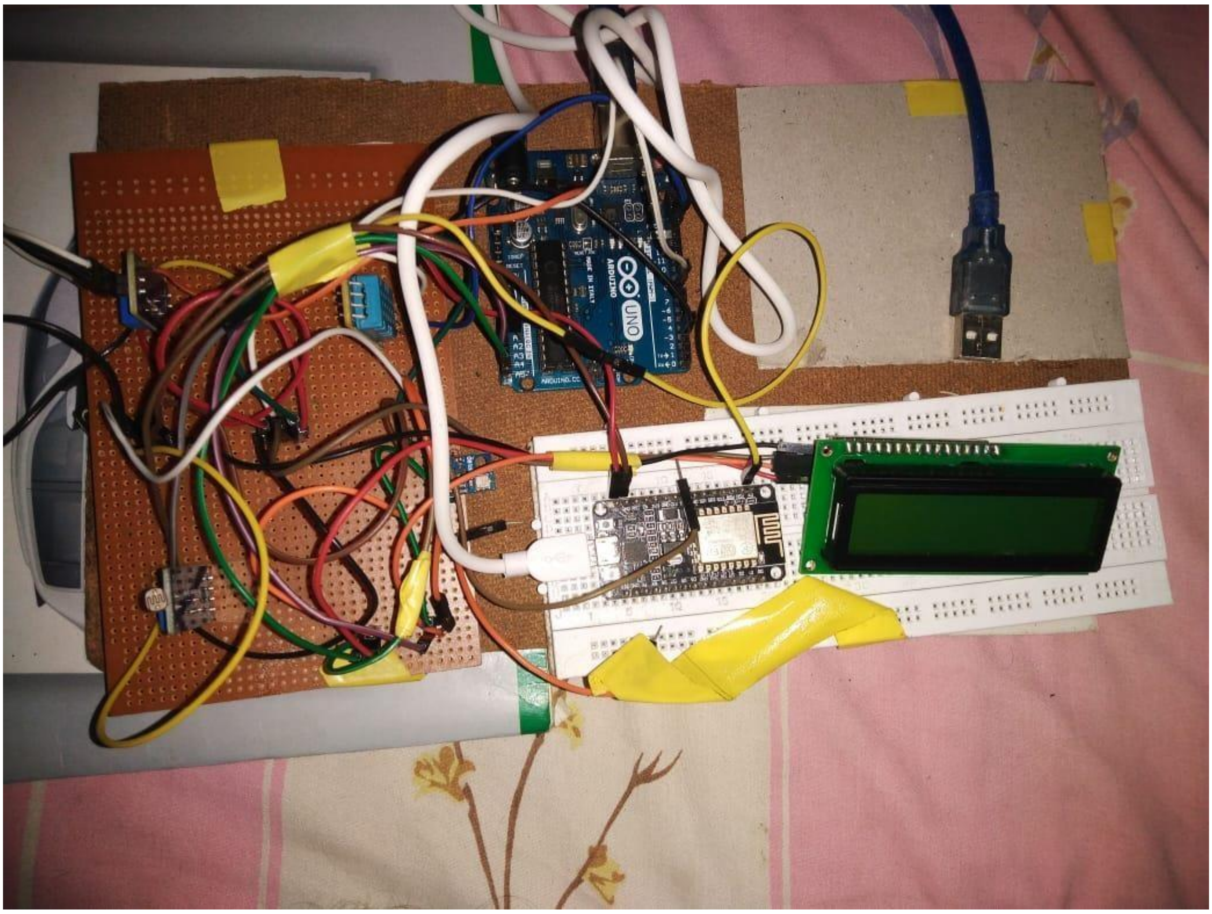


Fig – 12 Hardware Circuit

5.2. Implementaion of Hardware –

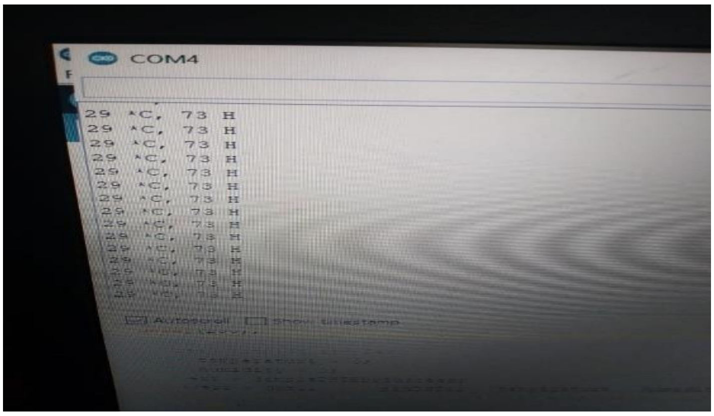
Simplicity of real-time weather monitoring from any location in the world. for long-term and short-term meteorological and environmental data storage in order to track changes in weather patterns and comprehend the impact of human-caused climate change on local weather.The setup for tracking local atmospheric variables and microclimates for weather forecasting and prediction can be easily deployed.

To improve agricultural productivity, farmers need to know the temperature, relative humidity, soil moisture, amount of rain, etc. The following kinds of sensors are used to collect this data:sensor of temperature.Sensor for humidity and hygrometer.sensor for soil moisture.rain sensor, etc. An aircraft pilot must be aware of factors such as visibility, atmospheric pressure, precipitation, wind direction, and speed. before to departure, and they employ the subsequent sensors: A barometric sensor measures the pressure in the atmosphere.
Antenna: a device used to measure wind speed. precipitation sensor.

Chapter - 6

Observation And Result

6.1. Experimental Analysis along with Results



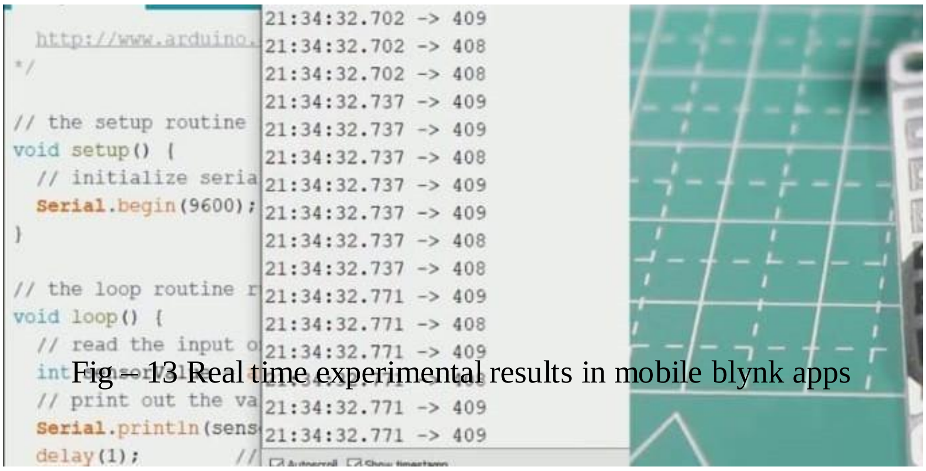


Fig – 13 Real time experimental results in mobile blynk apps

Real Time Experimental Result

Date	Temperature	Humidity	Pressure
June - 12	29.1	95%	999 mbar
June - 12	29.4	95%	100 mbar
June - 12	29.5	95%	1003 mbar
June - 12	29.6	95%	999 mbar
June - 12	29.7	95%	998 mbar
June - 12	29.8	95%	997 mbar
June - 12	29.9	95%	999 mbar

Chapter - 7
Conclusion And Future Scope

7.1. Conclusion

Self-protection (also known as a smart environment) is made possible for the environment by keeping the weather station there for observation. Utilizing sensor devices in the surrounding area to gather and analyze data is necessary to put this into practice. We can make the surroundings seem more lifelike by utilizing ambient sensing devices. The user will then have access to the gathered data and analysis outcomes via Wi-Fi. This research presents an intelligent approach to an effective, low-cost embedded system for environmental monitoring. The sensor parameters were also transmitted to the cloud. This data is easily shared with other users and will be useful for analysis in the future. This model can be extended to keep an eye on industrial zones and emerging cities for pollution monitoring. This concept offers an effective and affordable way to monitor the environment continuously in order to safeguard public health from pollution.

Future Scope

As an international feature of this system, a few more sensors might be added and connected to the satellite. Including extra sensors to keep an eye on environmental variables including CO_2, pressure, and oxygen levels. There is a wide application for this real-time technology in aviation, navigation, and the military. In order to improve precautionary alarms, it can also be used in hospitals or other medical facilities for research and studies on the "Effect of Weather on Health and Diseases."

Chapter - 8

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