

# **Weather Reporting System Using IoT**

Major project report submitted in partial fulfilment of the requirement.

for the degree of Bachelor of Technology

in

**Information Technology**

By

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UNDER THE SUPERVISION OF

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## **Candidate's Declaration**

I hereby declare that the work presented in this report entitled “Weather Reporting System Using IoT” in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Computer Science and Engineering/Information Technology submitted in the department of Computer Science & Engineering and Information Technology, Jaypee University of Information Technology Wagnaghat is an authentic record of my own work carried out over a period from January 2023 to May 2023 under the supervision of Dr. Nishant Sharma Assistant Professor(Grade-2)Department of Computer Science And Engineering . I also authenticate that I have carried out the above mentioned project work under the proficiency stream Data Science.

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

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## **ACKNOWLEDGMENT**

Firstly, I express my heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the project work successfully.

I really grateful and wish my profound my indebtedness to Supervisor Dr NISHANT SHARMA. Assistant Professor (Grade-2), Department of CSE Jaypee University of Information Technology. Wagnaghat. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project.

I would like to express my heartiest gratitude to Dr NISHANT SHARMA, Department of CSE, for his kind help to finish my project.

I would also generously welcome each one of those individuals who have helped me straight forwardly or in a roundabout way in making this project a win. In this unique situation, I might want to thank the various staff individuals, both educating and non-instructing, which have developed their convenient help and facilitated my undertaking.

Finally, I must acknowledge with due respect the constant support and patients of my parents.

Ayush Sharma (191515)

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## List of Abbreviations

<b>DI</b>	Direct Investment
<b>FIG</b>	Figure
<b>IP</b>	Internet Protocol
<b>IOT</b>	Internet Of Thing
<b>IFTTT</b>	If This Then That
<b>LCD</b>	Liquid Crystal Display
<b>NTP</b>	Network Time Protocol
<b>OLED</b>	Organic Light Emitting Diodes
<b>WIFI</b>	Wireless Fidelity

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## **Abstract**

The Weather Monitoring and Reporting System that is based on the Internet of Things (IoT) is used to provide real-time updates on weather conditions such as temperature, humidity, moisture, and rain levels. For instance, if scientists or nature analysts need to monitor changes in a specific environment like a volcano or a rainforest, they may face limitations with an SMS-based weather monitoring system that only sends messages to a few recipients, and the time required for sending messages increases with the number of mobile numbers. In such cases, individuals would need to visit specific sites to access information on the weather conditions, which is visible to everyone.

Due to drastic changes in climate, weather forecasts are becoming increasingly unpredictable. As a result, Weather Reporting Systems are being primarily used for real-time monitoring of continuously changing weather and climatic conditions in controlled areas like homes, industries, and agriculture. The IoT platform, ThingSpeak, is utilized for displaying weather parameters and information globally. This information is also displayed on an OLED using two-way microcontroller communication via Wi-Fi hotspots. Reports on weather conditions for particular places that are based on satellite systems may not provide exact weather conditions, which can be problematic when accurate weather reports are needed in real-time. In the Weather Reporting System, all weather parameters sensors are controlled by an ESP32 microcontroller acting as the server that sends all the data collected by sensors to the ThingSpeak database, which is visible worldwide and displayed on the OLED using a Wemos DI mini as the client microcontroller. The collected data is then compared to weather forecast data and statistics generated by forecast stations. To simplify data analysis, all collected data is saved in Google Sheets format using the IFTT tool. This system monitors changes in weather conditions occurring in the environment and provides users with the quickest way to access information.

# CHAPTER 01

## INTRODUCTION

Environment essentially affects individuals' life. Air quality and the quality of the environment have been significantly impacted by the extraordinary rise in industry and automobile traffic. The current situation is provided by the satellite weather reporting system, but it does not accurately reflect the state of each location. Although precise meteorological data for the specific location of the building is required to enhance the calibration of energy simulation programs, the building industry has a high potential for energy savings. By constructing a controlled local weather reporting system with Wemo's D1 small microcontroller and the ESP32, the error in the weather forecasting system at the specific location can be minimized. The science and art of using technology to increase agricultural yield is known as precision agriculture. Even though water is a finite resource, 50% of the water used in agriculture is wasted due to improper irrigation scheduling. In this scenario, real-time monitoring of the amount of water used in fields can help prevent water waste. The use of technology in agriculture is essential for increasing output and reducing human labor requirements. A lot of attention has been paid to some recent research that aims to improve environmental and climate change monitoring. Individuals want to understand what the current weather patterns are at a particular site, like a school grounds or other construction. Because the world is changing so rapidly, weather stations should be put in place. We'll talk about a weather station that can be really useful anywhere in this essay. This is outfitted with environmental sensors that send measurements to the cloud in real time from a specific location. To accomplish this, we made use of an Arduino Uno and a wide range of environmental sensors, such as a DHT11, soil moisture sensor, and raindrop sensor. The climate boundaries are moved to the cloud, which accordingly gives realtime weather conditions detailing. It focuses on how the Internet of Things will be used in the next generation of environmental data. The technology is primarily intended to assist in the development of a smart city. what's more, basic circumstances wherein individuals should physically check the weather patterns at different areas, which takes time except if the framework is on the web. The Internet of Things (IoT), smart cities, and wireless technologies have changed the world. Thing Speak, which connects the user to the Internet and is visible worldwide, should be used to display, analyze, and monitor weather parameters. Examination and observing framework in light of ThingSpeak that associates with the Web and is visible from anyplace in the globe. Through the utilization of software, the Internet, and embedded devices, is leading the way in providing solutions for a wide variety of applications.

Microcontrollers like the Arduino and NodeMCU, as well as ARM processors like the Raspberry Pi, are used to build current technologies. The information gathered by the stations may targets, including air quality administration to limit contaminations in the nearby climate and environment observing to increment crop yields in the locale.

### **1.1 Problem Statement**

First, gathering data is easy on land, but difficult in the air and at sea, where no one lives, and in the air, which is also not a good place for a meteorological instrument. Moreover, where surface qualities change quickly over a brief distance (like along the coast or in the mountains), an illogically high thickness of climate perceptions is required. Second, there are limitations to a computer, which is used to make all current weather forecasts: Weather forecasts can, of course, become more precise as computational power increases. They might also get better if new mathematical rules or computer algorithms that explain nature more precisely are made. The method a computer uses to solve equations is one reason for different weather patterns. The main problem is to gather data from all possible environments. Further this acquired data is to be used to monitor and report weather so as to be prepared for any adverse weather conditions. This will lead us to minimise the losses suffered by the mankind.

### **1.2 Objectives**

1. Live reporting of accurate weather conditions.
2. To predict weather using the data from the previous seven days.
3. To report the adverse weather conditions as soon as possible.

### **1.3 Methodology:**

This project concentrates on ThingSpeak, an Internet of Things platform for displaying sensor data. The cycle is broken into two areas: both software and hardware development Hardware development includes the creation of the circuit and the prototype. In the interim, the IOT coding, schematic, circuit re-enactment, and information securing are all important for the product. The framework will really desire to demonstrate the atmospheric condition by assessing the current climate using sensor esteem data.

The ESP32 microcontroller and Wemos client will manage all of the data, receiving sensor data from the ESP32 and displaying it on an OLED screen. Moreover, the system will be accessible through the ThingSpeak channel, which has been designed to allow users to check

the data online, as well as an Android application named Blynk, which will display the sensor data. The collected data will be analyzed and compared with the information provided by Jabatan Meteorologi Malaysia to ensure that the data is accurate and reflects the current weather conditions. With the help of the Internet of Things (IoT), users will be able to access the system wirelessly and online without requiring manual verification.

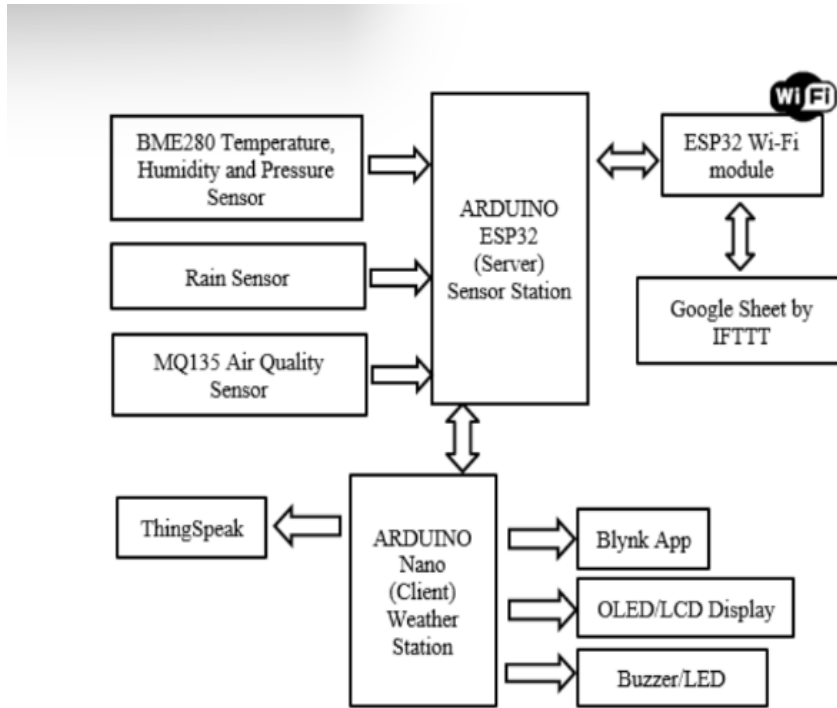
### **1.3.1 Project Block Diagram**

The block diagram shows the components used in this project. There are two ways this project works. The WeMo's DI small is used for monitoring, and the ESP32 is used for control. Through wireless communication and hotspot, these two microcontroller boards connect to each other so that the monitoring mode can obtain sensor data from the control mode.

Wi-Fi. The control mode gathers and transfers all sensor information to the ThingSpeak site, while the checking mode shows it on the OLED. The customer can see the sensor data both on the OLED and in the Blynk app. The acquired data are examined to configure the real state and the current state using the fundamental formula in Equation 1. The weather condition that this system uses to inform the user about the current state's rain and air quality is the result of this data analysis.

### **1.3.2 Control Unit (Sensor Unit)**

This undertaking expects to utilize Part innovation as a correspondence medium overall. as stated in the section before it. After the ESP32 microcontroller configures all of the sensors and begins reading data from them, the system procedure begins. The ESP32 Wi-Fi network is used to wirelessly transmit the data to the IoT platform ThingSpeak. The ESP32's sensors collect all data and act as the system's control unit. The temperature, dampness, pressure, downpour, air quality, and weather patterns are naturally displayed on a particular Parcel site page in ThingSpeak, as well as on the weather conditions station show. The control mode procedure's flowchart can be seen in Figure 1.



**Figure 1. Project block diagram.**

### **1.3.3 Monitoring Unit (Weather Station)**

A wireless weather station with Wi-Fi capabilities is used for monitoring in the interim. All of this is controlled by a tiny Wemos D1 microcontroller that connects through Wi-Fi, gathers real-time sensor data, and displays it on an OLED screen. The Client server protocol or master-slave network protocol is replicated in this connection to ensure perfect data input and output from a control unit to a monitoring device.. In order to guarantee the safety of the system, the buzzer will sound if the sensor data is incorrect. The Android smartphone's Blynk

app is used to send a push notification to the user.

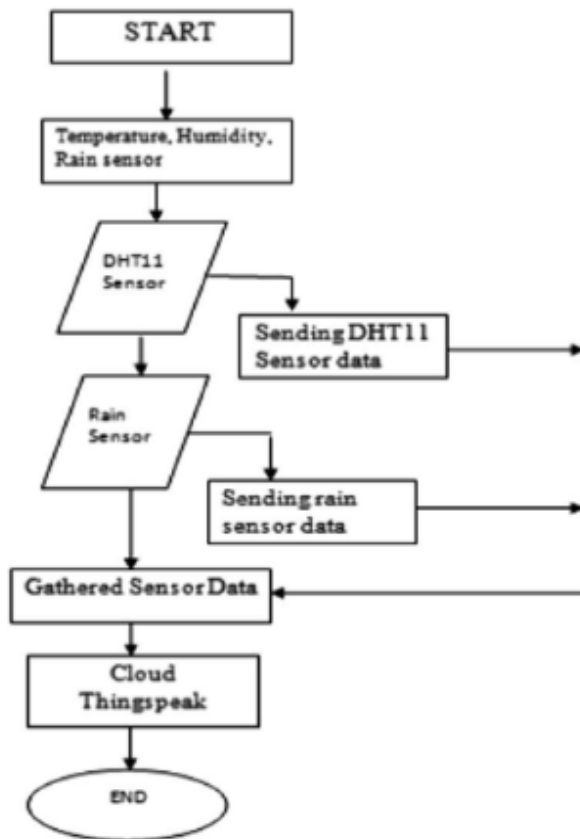


Figure 2. Control unit flowchart.

### 1.3.4 Hardware Development

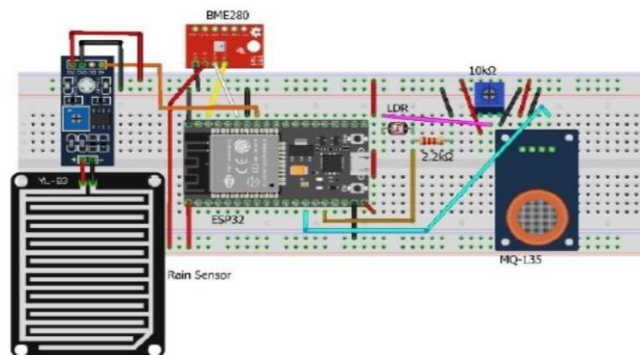
The choice of hardware is crucial for this project. Before being selected for the project, each hardware component must be thoroughly examined. Each component's functionality is fulfilled by utilizing its advantages and characteristics in component selection. The ESP32, BME280, MQ135 rain sensor, OLED, LCD, buzzer, and LED are used in this project.

### 1.3.4.1 Circuit Construction

This system is divided into two parts. The weather station is the first, and it displays the values of all of the weather parameters. In contrast, the control unit circuit regulates and transmits all sensor data to websites and Thing Speak. The weather station communicates with the control unit via client-server communication, and the weather station receives all sensor control unit data for display. Additionally, this station has an emergency alert for bad weather. Figure 3 portrays the sensor's electrical circuit.

### 1.3.5 Components Required

- Node MCU
- DHT11 sensor
- BMP180 sensor
- Breadboard
- Jumper Wires
- Rain Sensor

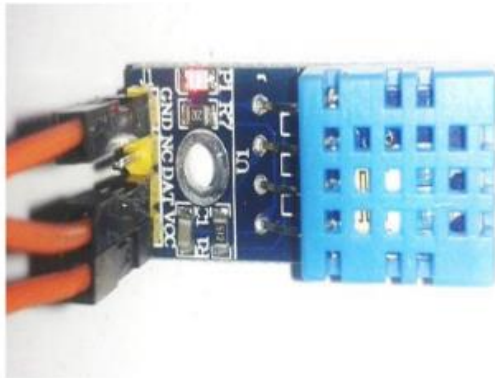


#### 1. DHT11 Sensor:

The dampness and temperature complex on the DHT11 module has an aligned computerized signal result. The DHT11 sensor module is a module that measures temperature and humidity



and gives out a digital signal that has been calibrated.



## 2. BMP 180 Sensor

It is an I2C-interfaced barometric pressure sensor. This sensor's surrounding air's absolute pressure is measured. Weather and altitude both have an impact on the pressure



## 3. Rain Sensor

The rain sensor detects water on the gadget and measures it in millimetres.



## 4. ESP8266 Wifi Module

This module is an independent SOC with an installed TCP/IP J convention stack that gives admittance to your WiFi organization.

The ESP8266 might have an application or assume control over all WiFi network errands .



## 5. Breadboard

The breadboard's capability is to make quick electrical associations between parts like resistors, LEDs, capacitors, etc, permitting you to test your circuit before forever sticking it together. There are numerous small sockets on breadboards, and some groups of sockets are electrically.



## 6. Node MCU

Open-source prototyping board designs are included in the open-source firmware known as NodeMCU. The words "node" and "microcontroller unit" are combined to create the term

"NodeMCU." The firmware, not the associated development kits, are the sole focus.



### 1.4 Software Development

In most cases, various kinds of software are used to examine the hardware arrangement in projects. This technique can at any rate help the undertaking part in investigating and examining the venture settings and results. Therefore, different kinds of programming are utilized in this task to develop it. The Arduino IDE is used in this project. with the tools to build and upload the code, SolidWorks for 3D design, and Proteus.



Figure 7. My applets for project Weather System.

Information might be effortlessly caught utilizing this stage, and Table 1 can be directed without genuinely observing the sensor station. Basically visit the IFTTT site and pursue a free record. After that, start a new project and save it to Google Drive or Google Sheet forms with a connection to the server.

This data comes from the sensor station. However, this mod uses IFTTT.ca, which has access to three sets of data, so the temperature, air quality, and rain data were chosen.

	A	B	C	D	E	F
1	October 21, 2019 at 08:45PM	Weather Station	30	15	55	
2	November 19, 2019 at 03:11PM	Weather Station	31.03	1003.76	68.05	
3	November 19, 2019 at 03:11PM	Weather Station	30.96	1003.82	68.33	
4	November 19, 2019 at 03:35PM	Weather Station	30.81	466	872	
5	November 19, 2019 at 03:37PM	Weather Station	30.72	464	832	
6	November 19, 2019 at 03:39PM	Weather Station	30.6	442	931	
7						
8						

**Figure 6.** Data save in Google Sheet.

In order to perform analysis without collecting any data, IFTTT is used to collect it. IFTTT has restricted the number of weather parameters that can be sandboxed to three, and this IOT platform converts the readings into a table. 2.7 Security and alarm at the weather station. The user is informed of potentially hazardous weather conditions outside. LED Green indicates that the weather is favorable right now, whereas LED Red indicates that the weather is not favorable right now. The operation of the switch keeps the LED lit while the buzzer alert is silenced. In order to warn the user of potentially hazardous circumstances, Figure 9 depicts the weather metrics of temperature, rainfall, and air quality.



**Figure 7.** Sensor station and Weather station.

## CHAPTER 02

### LITERATURE SURVEY

Cloud-based weather monitoring systems are categorised according to the technology used:

1) Wireless Sensor Network Based System(WSN), 2) Satellite, 3) Microcontroller, 4) Arduino, 5) GSM Based System (GSM) 6) Radar Based System. 6) Radar, 7) Zigbee, 8) Prediction-based system, 9) Sensor-Based System 10) Camera-Based System.

#### 1. Wireless Sensor Network Based System

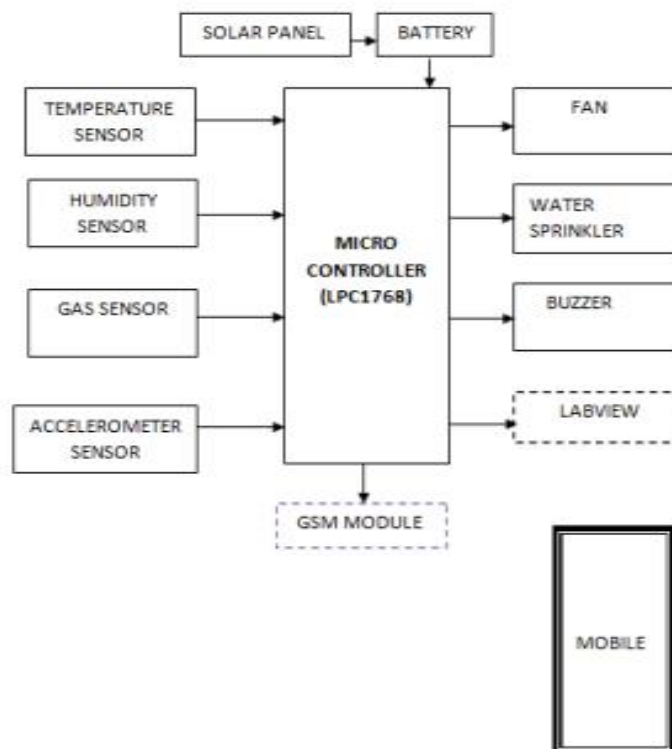
Networks of physically dispersed sensors that can communicate, process, and compute are known as wireless sensor networks (WSNs) [1]. The base-station receives the data on a regular basis after it has been detected. Here, data is processed and kept up in real time. By utilizing virtual sensor and overlay technology to organize a WSN basis for various climatic advancements, one suggested approach [2] overcomes the aforementioned limitation. providing SaaS and interpersonal organization catastrophe warnings based on the ID3 system and cloud validation using secure shell, as well as checking climate data and for sending and transporting ongoing applications, an excellent arrangement has been constructed.

#### 2. Satellite Based System

In the concise inquiry and traditional climate gauge to focus data, satellite data are increasingly being used in conjunction with standard meteorological perceptions [4]. CanSat [5] is a scale model of the design, construction, and launch of a real satellite. It stands out because it is simple to use. Climate observation is the application of science and new technology to predict a location's climate. The built CanSat can be sent out and used sparingly to monitor the climate in the neighborhood. The creators have explained on our work in this distribution.

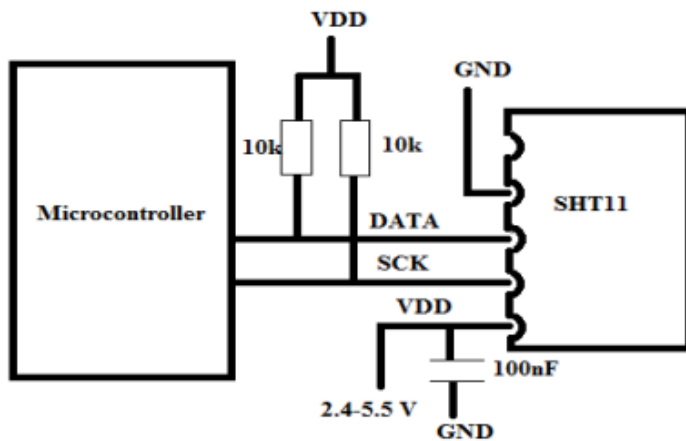
### 3. Microcontroller Based System

The essential objective of a microcontroller-based exertion [7] is to make an embedded structure to foster an air checking system that empowers the observing of climatic boundaries in an organization. It makes use of a complex circuit that was made with an ARM 9 CPU.



In the work shown in [8], it uses simple and complex phases to screen and display the temperature, weight, and similar moisture of the sky. In Figure, the microcontroller is depicted. 2 connected to a sensor that sends the microcontroller a digital signal. The sensor

module transforms analogue signals to digital signals and feeds them serially.

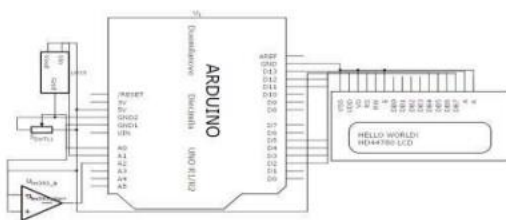


**2: SHT11 Connections with Microcontroller**

This framework has a lot of sensors that can collect data on things like humidity, temperature, wind speed, and direction. This data can be signed into the cloud by any verified user and viewed from anywhere..

#### **4. Arduino Based System**

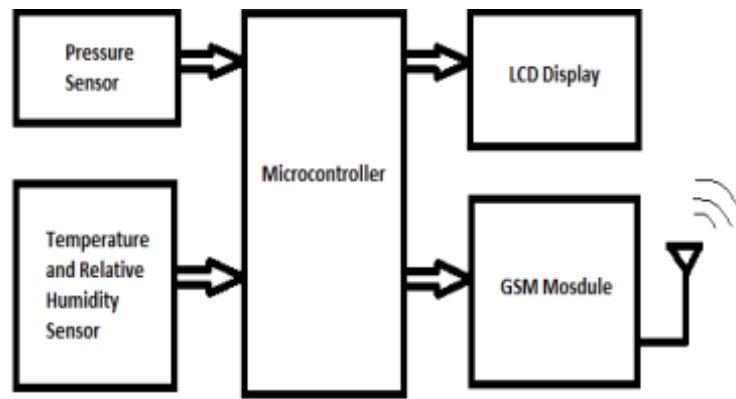
Using a predefined architecture, it can naturally capture temperature and stickiness data []. Using this method, authors can automatically collect temperature and stickiness data. The spots of interest are saved in a data set, and scholars can give the outcomes in a graphical way in the structure in view of current and verifiable information.



**Fig.3: Arduino based System**

#### **5. GSM Based System**

A gadget for ceaseless environment observing is shown to show the steady temperature, surrounding weight, relative wetness, and air's dew point temperature by means of such framework that utilizes fundamental and high level parts.



**Fig. 4: Weather Monitoring System with Transmitter**

## 6. Radar Based System

The creators of radar-based systems like developed a method that coordinates both information sources to provide strategically organized climate radar.

## 7. ZIGBEE Based System

Build a weather station monitoring and sensor networking system that does not require human intervention using Wireless ZigBee Technology. The most recent method for remotely monitoring the weather is Zigbee. At the time, the verification frameworks for the Weather Monitoring System were manual.

## 8. Prediction Based systems

In this show, an individual-driven distinguishing framework is utilized to build the framework's precision, and the legitimacy of data gained utilizing standard sensors is affirmed. Likewise, Mattlach et al. saw the customary environment armada as an important device for observing the air. The wave soul range, as reported by each NDBC climate float every hour. It provides a wealth of information regarding the location, quality, and duration of maritime storms. Simple accelerometers from an adult, well-established innovation provide these estimates. Another method that can be used as sun-based observation equipment is SWAP. There are annoyed side perspective limit conditions in the control group; or, representation error representation employing either stochastically bothered parameterization propensities or stochastic active soul backscatter.



**Table 1. Weather Monitoring Systems using Communication Media**

Sr no	Techniques	Ref	Problems
1	WSN	[1], [2], [3]	Specific substitution of sensor, lower speed, less secure because programmer can read information like username and password.
2	Satellite	[4], [5], [6]	Tremendous initial cost, noise and interference, propagation delay, time delay lessens efficiency.
3	GSM	[12], [13]	Various client offers same bandwidth transmission experience interference, is because of heat beat transmission, GSM has settled max call locales range up to 35 km that is exceptionally limited.
4	Radar	[14], [15]	Time radar can take up to 2 sec to bolt on, radar has wide pillar spread, more obstructions sources.
5	Zigbee	[16], [17]	Shorter range, lesser complexity, less information speed, high cost.

The problem of figuring out how accurate environmental forecasts are has always been hard to solve for a number of different reasons. In a unique study, the accuracy of zone prediction is investigated using a fundamental semi-target technique. Zone projections were picked since they are in many cases what the overall people will gain either straightforwardly or by implication from different media channels. A framework based on flight environment gauge has been developed and implemented by the Meteorological Development Laboratory (MDL) in recent research. It runs consistently and gathers information for about 25 hours to approve the Public Weather conditions Administration (NWS) norms. This paper delineates how the NCEP GFS wind and temperature models might be improved by adapting surface breeze recuperations utilizing the Breeze Sat satellite.

## 9. Sensor Based System

Mittal and co. wanted to effortlessly isolate the geographical reaches for sun-based and wind imperativeness periods in a new work. The framework is based on a framework that can be operated remotely and has sensors that collect data about the weather and send measured characteristics to the ground. Since the framework is powered by a battery, it needs to last a long time. In a special exploration, static sensor center points and lowered sensor networks are connected in natural check. The lowered sensor bid can be improved by joining a sensor framework with a circulated PC innovation. A collection of sensors for detecting wind speed and direction, air temperature, relative humidity, and precipitation are included in the climate station, which was just built recently. It helps to have a snowflake connection. DCOMP is a revolutionary system that works on sensors with similar channel setups and has been successfully implemented on the majority of current meteorological imagers . DCOMP is extremely invaluable for air research in view of this norm. DCOMP performance is calculated using correlations with the MODIS 5 dataset. In a new report , wind sensor, wind heading sensor, dampness and temperature sensor are used to impart continuous information to the Thing Talk cloud, which can be promptly watched and dissected by approved people or might be openly accessible. It utilizes the Raspberry Pi improvement board, which has proactively been used by a few creators for easy to use undertakings. A powerful CPU is Arm 7. Utilizing this methodology, the plane may not be restricted to flying straight. Also, it might continue straightforwardly along the objective locale. That speculation introduced the work speculation of electronic visual perceivability system (DPVS), edge of system, design of gear and programming stream, lastly correspondence among host and outdoors cell .

## CHAPTER 03

### SYSTEM DEVELOPMENT

#### **Design:**

In the IoT-enabled weather monitoring system, the Arduino Uno and four associated sensors measure four weather parameters. A temperature sensor, a stickiness sensor, a dampness sensor, and a downpour level sensor are among the sensors. These four sensors are wired directly to the Arduino Uno. The Arduino Uno has a simple to-computerized converter. The LCD display shows these weather parameters that are calculated by Arduino. After that, IOT methods are used to send the parameters to the internet. At regular intervals, the process of sending data via Wi-Fi to the internet is repeated. This weather data can only be accessed by the user via a specific website. The undertaking interfaces with the web and saves the information on a web server. Consequently, the user is provided with real-time weather updates.

#### **Arduino Uno:**

Arduino is the company that developed the Arduino Uno microcontroller board. It is an electronics platform based on the Atmega328 AVR microprocessor that is free and open source. For connecting to other electrical circuits, the current Arduino Uno has a USB interface, six analog input pins, and fourteen digital I/O ports. PWM output is possible on six of the 14 I/O ports. Designers can use it to operate and detect electrical equipment from the outside in real time. The board has all of the usefulness expected to run the regulator and might be promptly connected to a PC through a USB association with communicate code to the regulator utilizing the product IDE, which is fundamentally intended for Arduino programming. In IDE, programming dialects, for example, C and C++ are utilized. The most official version of the Arduino is the Arduino Uno, which has 32 KB of RAM memory and an 8-bit AVR Atmel microprocessor.

**Rain level sensor:**

A straightforward instrument for detecting rain is the rain sensor module. When a raindrop passes through the rain panel, it can be used as a switch and to measure the amount of rain. Rainfall amounts can be measured with the analog output. When the induction board lacks a raindrop and the output DO is high, the LED will light up when connected to the 5 V power source. The DO output drops and the switch indication lights up when just a little water falls. Brush off the water drops when the initial condition is restored, and the output is high.

**Temperature & Humidity Sensor:**

A digital output and an 8-bit microprocessor provide power to the DHT11 temperature and humidity sensor. The technology it uses has exceptional dependability and stability over time. It has the ability to block interference, respond quickly, and perform well. The humidity calibration chamber in each DHT11 sensor is extremely precise. We ought to allude to the alignment coefficients kept in the OTP program memory as inside sensors distinguish signals during the activity. The technology behind single-wire serial interfaces is made to be quick and easy to use. Little size, low power utilization, and sign transmission distances of up to 20 meters empower a large number of uses, including the most requesting. The product comes in a packaging with four pins and a single row of pins. convenient connection; based on the requirements of the user, distinct packages may be offered.

**Soil Moisture Sensor:**

Since direct gravimetric estimation of free soil dampness requires taking, drying, and gauging in a roundabout way measure volumetric water content by involving one more property of the dirt as an intermediary for dampness content, like electrical resistivity, dielectric steady, or communication with neutrons.

The association between the deliberate property and soil dampness content should be adjusted and can change in view of natural circumstances such soil type, temperature, or electrical conductivity. Reflected microwave radiation is affected by soil dampness and is used in hydrology and farming for far off detecting. Portable probing tools are available to gardeners and farmers.

**WiFi module:**

An Arduino Uno with a built-in WiFi module is the Arduino Uno WiFi. An ESP8266 WiFi module is included on the board connects to your WiFi network (or serves as an access point). The Uno WiFi upholds OTA (over-the-air) programming, which is great for moving Arduino portrayals or WiFi firmware.

**LCD-display:**

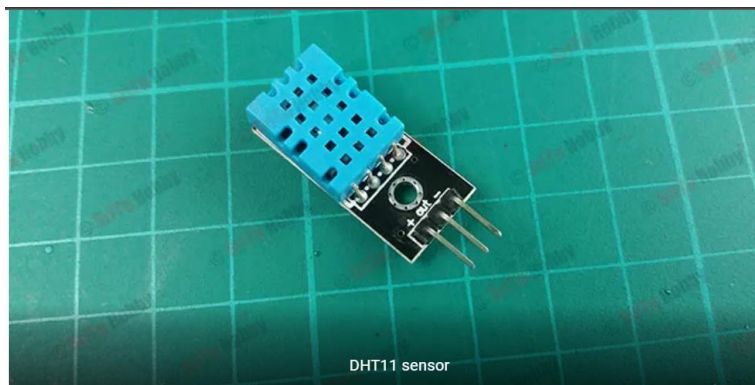
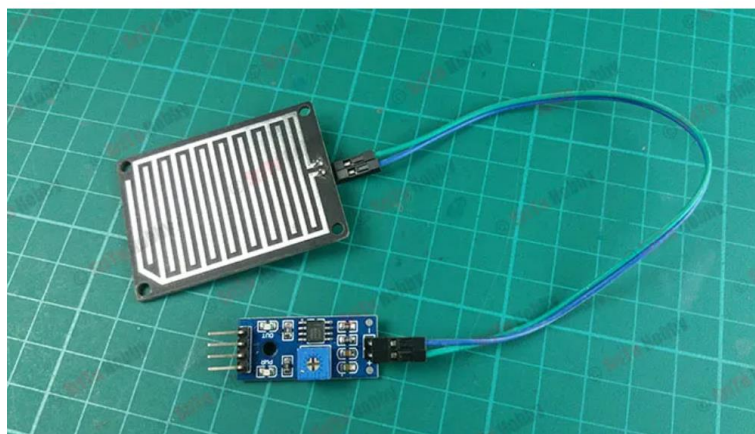
A LCD or fluid precious stone show is a type of display that uses fluid precious stone innovation. We need a means or device to display yield values and messages in genuine gadgets project development. The 7-part show is the most common type of electronic presentation, however it has several limitations. Liquid crystal displays, which come in a range of sizes, are the next best option. In order to establish effective communication between the worlds of machines and humans, display devices play a crucial role. Consequently, they are an essential part of embedded systems. Regardless of their size, display devices all operate from the same fundamental principle. Notwithstanding high level showcase units, for example, realistic presentations and 3D shows, the capacity to work with basic shows, for example, 16x1 and 16x2 units is required. There are 16 characters on a single line in the 16x1 display unit. The 16x2 LCD highlights 32 characters altogether, 16 on the principal line and one more 16 on the subsequent line. There are two control pins for versatility. The contrast bit and READ/WRITE can be skipped because they are rarely used. The LCD's maximum contrast and read mode will be activated by this. To send characters, we just have to control the pins Empower and RS.

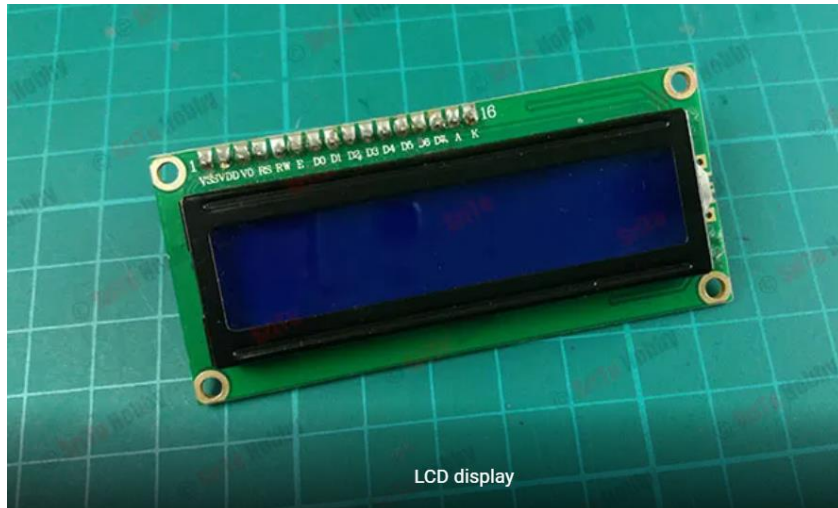
**Process of this system:**

When the system is activated. Through the Blynk cloud, the Nodemcu board communicates with the Blynk application. In addition, it acquires sensor data. The qualities are then shipped

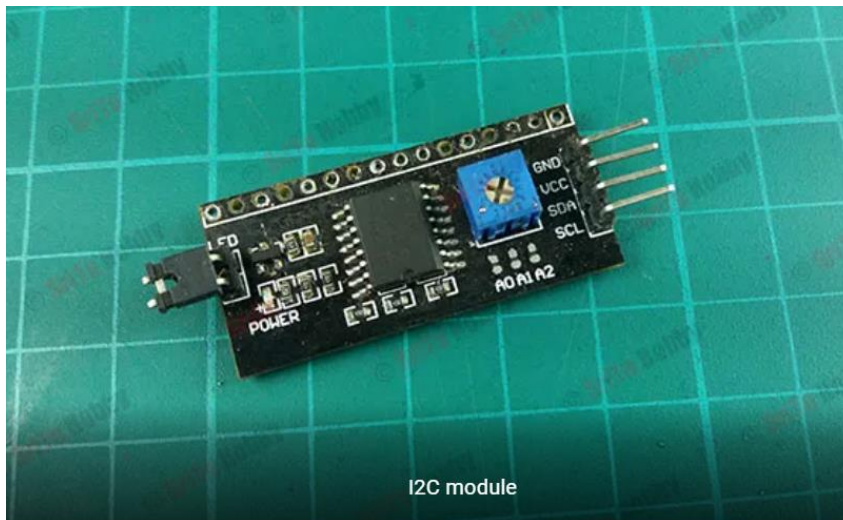
off the Blynk application and LCD show by the Nodemcu board. Sensor values can be shown on the LCD and in the Blynk app interface as a result of this procedure.

### 3.1 Components

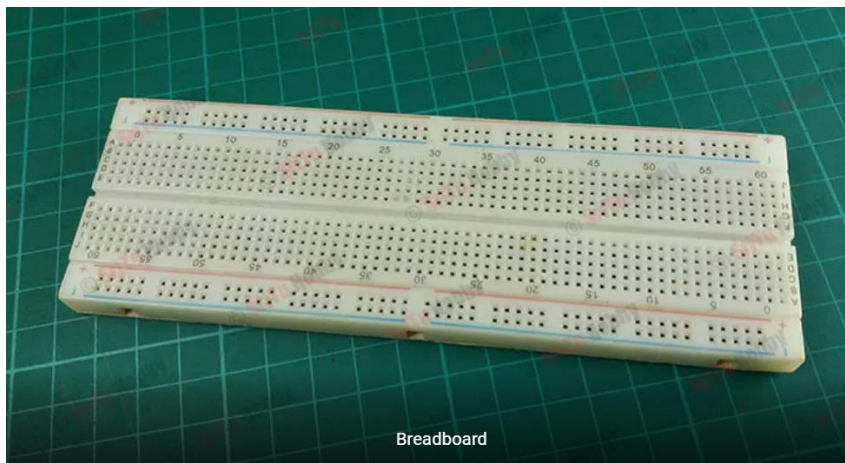




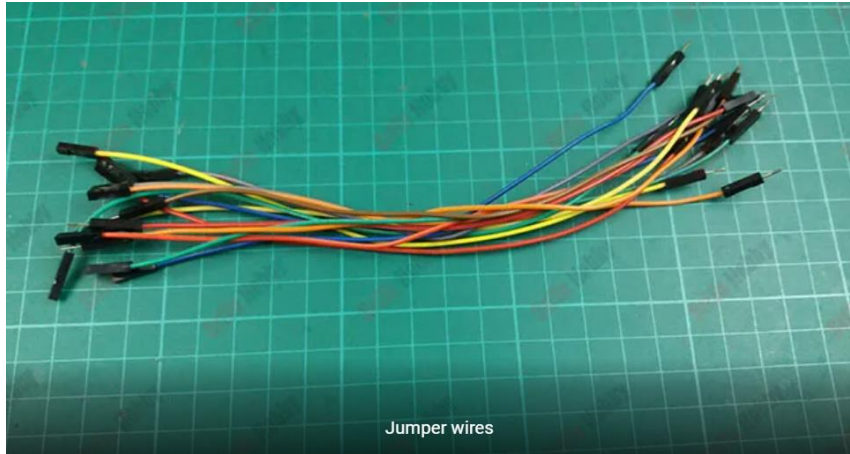
LCD display



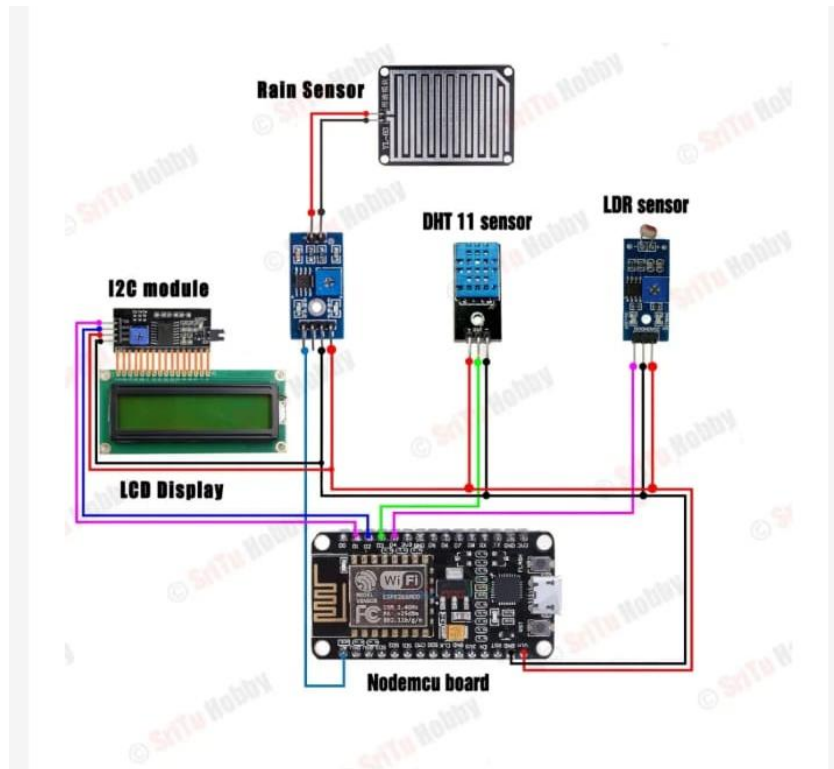
I2C module



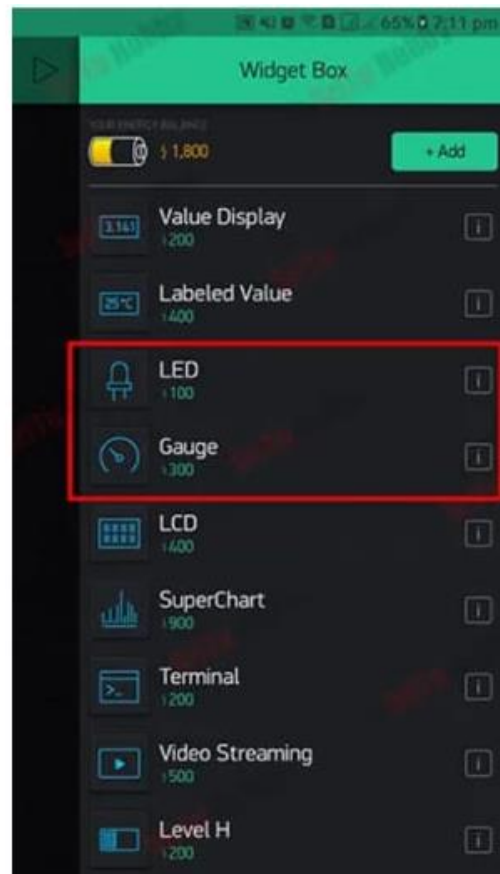
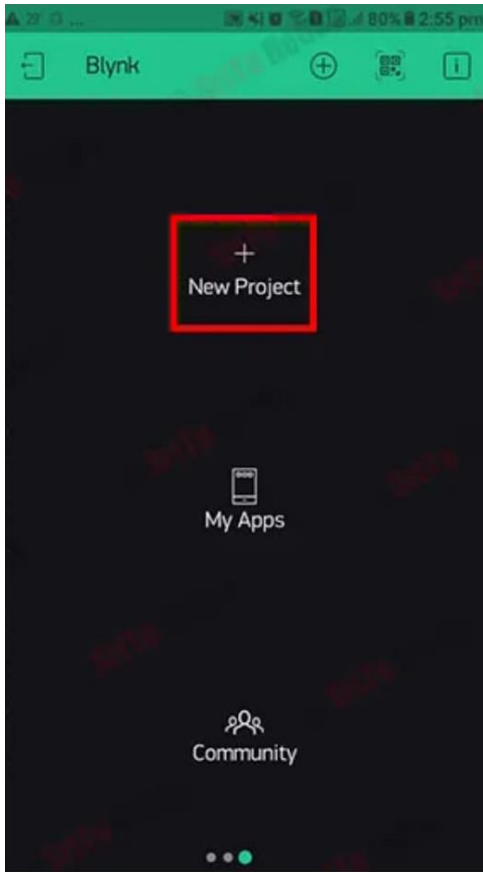
Breadboard

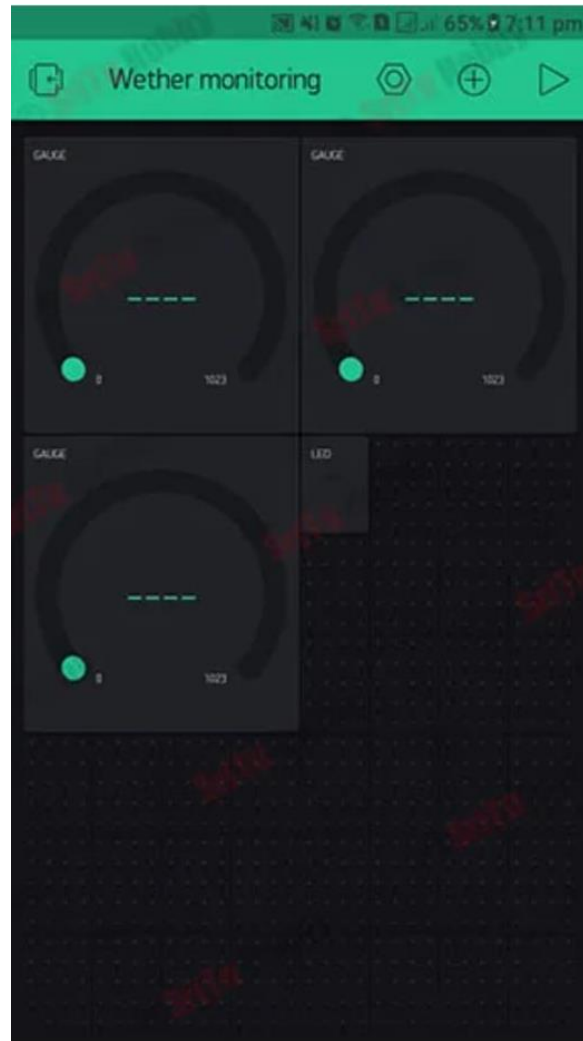


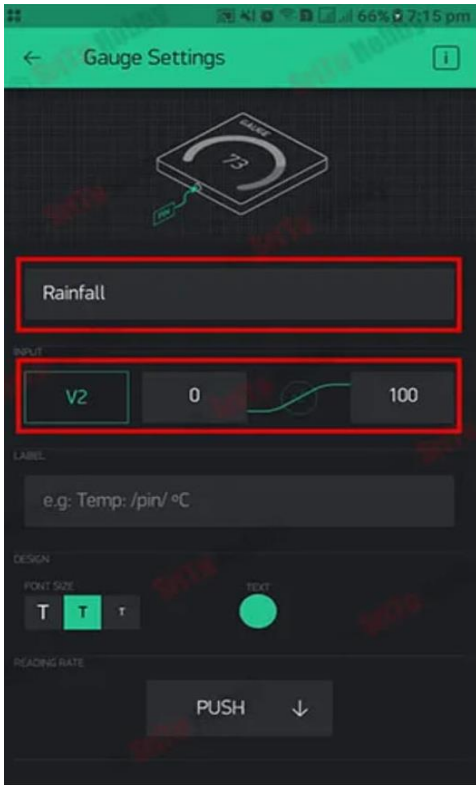
### 3.2 Working











### 3.3 Code

```
1  /*Weather monitoring system with Nodemcu
2  * http://srituhobby.com
3  */
4
5  #include <LiquidCrystal_I2C.h>
6  #define BLYNK_PRINT Serial
7  #include <ESP8266WiFi.h>
8  #include <BlynkSimpleEsp8266.h>
9  #include <DHT.h>
10
11  LiquidCrystal_I2C lcd(0x27, 16, 2);
12  DHT dht(D3, DHT11); //(sensor pin,sensor type)
13  BlynkTimer timer;
14
15  char auth[] = ""; //Enter the Auth code which was se
16  char ssid[] = ""; //Enter your WIFI Name
17  char pass[] = ""; //Enter your WIFI Password
18
19  void weather() {
20    float h = dht.readHumidity();
21    float t = dht.readTemperature();
22    int r = analogRead(A0);
23    bool l = digitalRead(D4);
24
25    r = map(r, 0, 1023, 100, 0);
26    if (isnan(h) || isnan(t)) {
27      Serial.println("Failed to read from DHT sensor!");
28      return;
29    }
30
```

```

31 Blynk.virtualWrite(V0, t); //V0 is for Temperature
32 Blynk.virtualWrite(V1, h); //V1 is for Humidity
33 Blynk.virtualWrite(V2, r); //V2 is for Rainfall
34
35 if (l == 0) {
36   WidgetLED led1(V3);
37   led1.on();
38   lcd.setCursor(9, 1);
39   lcd.print("L :");
40   lcd.print("High");
41   lcd.print(" ");
42 } else if (l == 1) {
43   WidgetLED led1(V3);
44   led1.off();
45   lcd.setCursor(9, 1);
46   lcd.print("L :");
47   lcd.print("Low");
48   lcd.print(" ");
49 }
50
51 lcd.setCursor(0, 0);
52 lcd.print("T :");
53 lcd.print(t);
54
55 lcd.setCursor(0, 1);
56 lcd.print("H :");
57 lcd.print(h);
58
59 lcd.setCursor(9, 0);
60 lcd.print("R :");
61 lcd.print(r);
62 lcd.print(" ");
63
64 }

```

## Code explanation

```

1 #include <LiquidCrystal_I2C.h>
2 #define BLYNK_PRINT Serial
3 #include <ESP8266WiFi.h>
4 #include <BlynkSimpleEsp8266.h>
5 #include <DHT.h>

```

```
1 | LiquidCrystal_I2C lcd(0x27, 16, 2); //I2C address, l
2 | DHT dht(D3, DHT11); //(sensor pin,sensor type)
3 | BlynkTimer timer;
```

```
1 | char auth[] = "VEIfTIAm3vxrTMCNwrE8VA695EIE
2 | char ssid[] = "Dialog 4G 025"; //Enter your WIFI Na
3 | char pass[] = "b2016ee3"; //Enter your WIFI Passv
```

```

1 void weather() {
2   float h = dht.readHumidity(); //Gets the humidity
3   float t = dht.readTemperature(); //Gets the tempe
4   int r = analogRead(A0); //Gets the rainfall value th
5   bool l = digitalRead(D4); //Gets the light value thro
6
7   r = map(r, 0, 1023, 100, 0); //Converts the rainfall v
8   //The functionality of the DHT11 sensor is checke
9   if (isnan(h) || isnan(t)) {
10    Serial.println("Failed to read from DHT sensor!");
11    return;
12  }
13  //Sensor values are sent to the Blynk app
14  Blynk.virtualWrite(V0, t); //V0 is for Temperature
15  Blynk.virtualWrite(V1, h); //V1 is for Humidity
16  Blynk.virtualWrite(V2, r); //V2 is for Rainfall
17  //LDR sensor values are checked using the IF conc
18  if (l == 0) {
19    WidgetLED led1(V3);
20    led1.on();
21    lcd.setCursor(9, 1);
22    lcd.print("L:");
23    lcd.print("High");
24    lcd.print(" ");
25    //If the value is 1, the LED widget is dimmed
26  } else if (l == 1) {
27    WidgetLED led1(V3);
28    led1.off();
29    lcd.setCursor(9, 1);
30    lcd.print("L:");
31    lcd.print("Low");
32    lcd.print(" ");
33  }

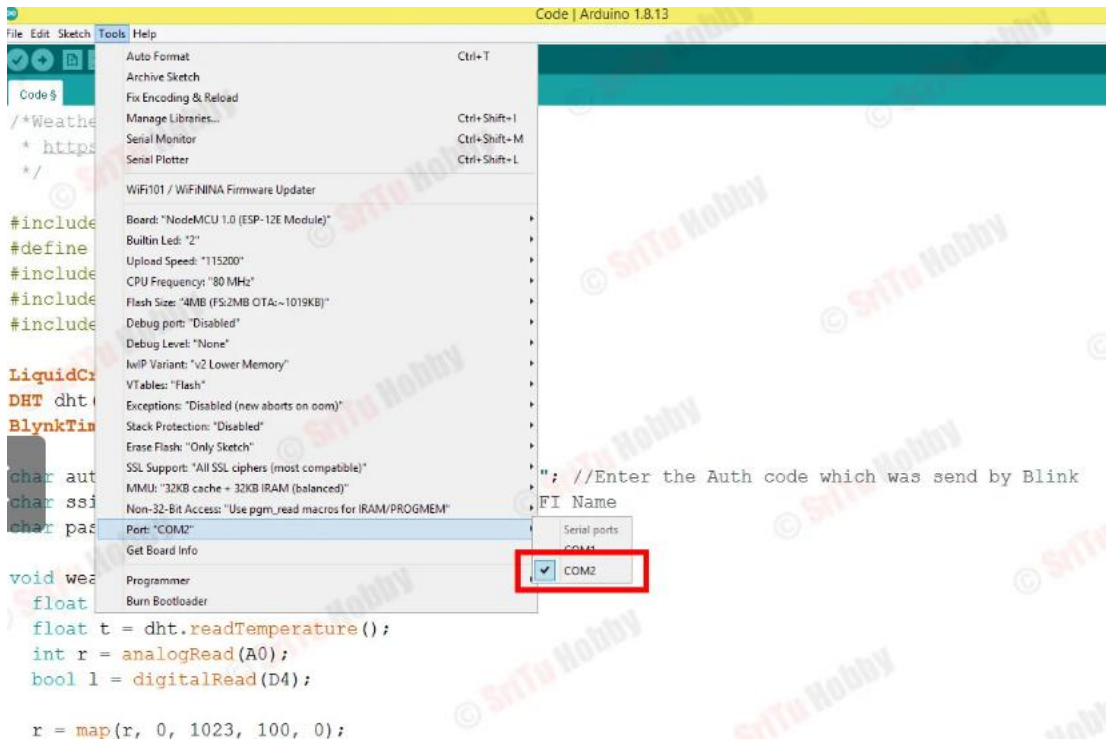
```

```
34 //Sensor values are printed on the LCD
35 lcd.setCursor(0, 0);
36 lcd.print("T :");
37 lcd.print(t);
38
39 lcd.setCursor(0, 1);
40 lcd.print("H :");
41 lcd.print(h);
42
43 lcd.setCursor(9, 0);
44 lcd.print("R :");
45 lcd.print(r);
46 lcd.print(" ");
47
48 }
```

```
1 void setup() {
2   Serial.begin(9600); // The serial monitor is beginn
3   //The LCD, Blynk, and DHT11 libraries are starts
4   lcd.init();
5   lcd.backlight();
6   Blynk.begin(auth, ssid, pass);
7   dht.begin();
8   // This code the main function is called
9   timer.setInterval(10L, weather);
10 }
```

```
1 void loop() {
2   Blynk.run(); // Initiates Blynk
3   timer.run(); // Initiates SimpleTimer
4 }
```





## CHAPTER 04

### 4.1 PERFORMANCE ANALYSIS

The 'BME280 (Temperature, Humidity, and Pressure) sensor, the MQ135 (Air quality sensor)', the LDR sensor, and the rain sensor are all part of a control unit system circuit that the ESP32 microcontroller controls. Then it is controlled by a USB link to transfer the coding portrayal to the ESP32 microcontroller. The serial monitor displays the sensor data in the Arduino IDE software. The ESP32 will associate with the Wi-Fi area of interest that has been relegated to this framework to develop a web server that will show all of the sensor information.

Figure 8, which depicts the communication between the sensor station and the weather station over a Wi-Fi hotspot, will show the data received by the weather station on the OLED. Correspondence has been effectively settled.

Figure 9 shows the web server including html that might show sensor information utilizing fundamental code and association is expected to complete this capability. From that point onward, it will peruse all of the sensor esteems and impart them to the cloud through ThingSpeak. The sensor value will be saved and displayed on the channel you created by ThingSpeak. The climate boundary might be checked through ThingSpeak sites. Data was gathered from ESP32 readings of all sensors and sent to ThingSpeak as a result of this projects objective.





**Figure 9.** Web Server construction.

As can be seen, the ESP32 sensor data are clearly displayed in all of the weather parameters on the web server. In the wake of dissecting the outcomes from the web waiter and What talk chart, these figures show that the sensor information is capricious. To ascertain the sensor's accuracy, the data are gathered in the morning, at noon, and at night. The remaining data are obtained through the ThingSpeak platform, while Google Sheets is used to obtain.

**Table 1.** BME280 Sensors data taken from different time.

Weather parameters	Time	Sensor value/Condition
Temperature	10am	24~28 (Normal)
Temperature	1 pm	29~31 (Normal)
Temperature	10pm	27~29 (Normal)
Temperature	~	24~31
Humidity, (%)	10am	78
Humidity, (%)	1 pm	80
Humidity, (%)	10pm	77
Humidity, (%)	~	81
Pressure	10am	1001~1800
Pressure	1 pm	1005~1829
Pressure	10pm	997~1560

Using the information in Table 1 above, we have calculated the proposed sensor's accuracy. According to the information got from met.malaysia.com for Jabatan Meteorologi Malaysia, the climate at my area was kept in Table 4 and contrasted with information from Tables 1,2,3.

**Table 2.** Data read by MQ135 Air Quality Sensor.

Weather parameter	Time	Sensor value/Condition
MQ135 Air Quality	10am	148~210
MQ135 Air Quality	1 pm	166~230
MQ135 Air Quality	10pm	145~190
MQ135 Air Quality	~	< 200
Mq135 Air Quality	~	<600

**Table 3.** Rain sensor to collect the actual data for comparison with real time data.

Weather parameter	Time	Sensor value/Condition
Rain	10am	1025 (No Rain)
Rain	1 pm	977 (No Rain)
Rain	10pm	841 (No Rain)
Rain	~	300<Rainy>600
Rain	~	< 300 (Heavy Rain)

Table 3 shows the results of rain sensor data collection to compare with the real-time situation of whether or not it rains. There is no rain while the sensor value is high, but there may be rainy.

Weather Parameters	value
Temperature, °C (Min)	25
Temperature, °C (Max)	32
Air Quality	~
Humidity, %	72
Rain, Morning	No Rain
Rain, Afternoon	No Rain
Rain, Night	Rainy

Condition 1 is utilized to ascertain the information in Table 4. To determine whether a value is accurate, compare it to the acceptable value. Since these qualities can be anything, an idea known as percent mistake has been made.

For data with significant differences,  $100\% \text{ error} = \frac{|\text{Forecast}-\text{Actual}|}{\text{Actual}} * 100\%$  Error=+4.35 and also +7.14.

Get the average of your data and subtract each measurement from it to see if a figure is accurate. A deviations table is the result of this. After that, the variances are averaged. Uncertainty is the value created as a result. A positive or negative number meaning the precision of an estimation;

Standard deviation is the total deviation divided by the number of measurements (-3) and has been calculated using Equations 2 and 3.  $\text{Average} - \text{Actual} \text{ -(2) } = \text{Deviation}$

The difference is -0.43144.

t1.64 is the standard deviation.

According to the results of the calculations made from the aforementioned equations 1, 2, and 3, there are fewer than +4.35 percentage errors in the forecast and the temperature that was collected from the sensor, respectively.

### 4.1.1. ThingSpeak display and data analysis

Following testing with the web server, the ThingSpeak channel got similar sensor information as the web server however with a superior showcase of the diagram plot. The analysis of sensor data is made easier by this graph. ThingSpeak will plot analog data for each weather parameter on the graph to highlight its characteristics.

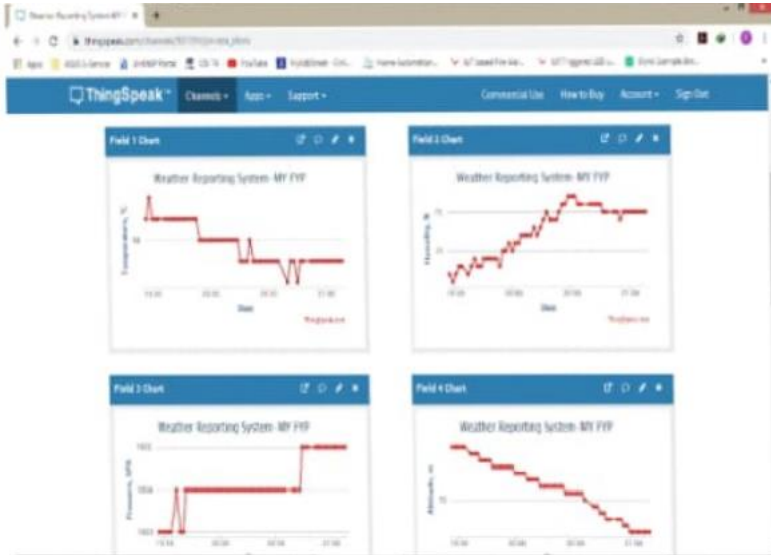
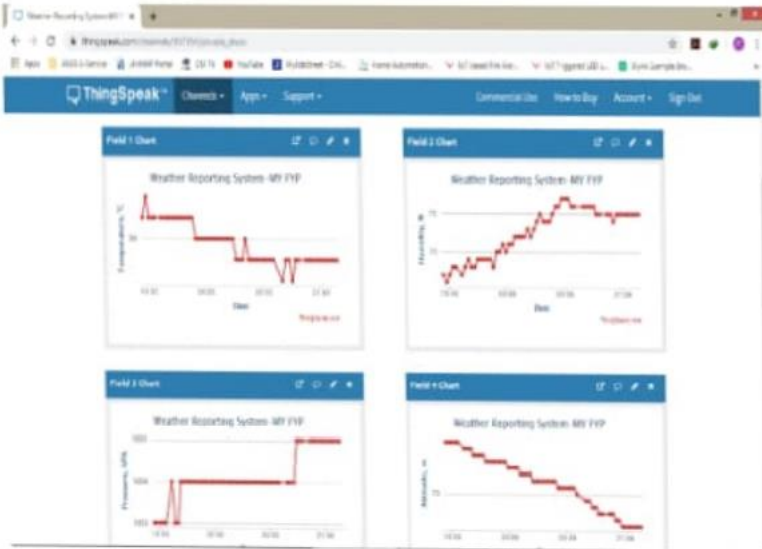


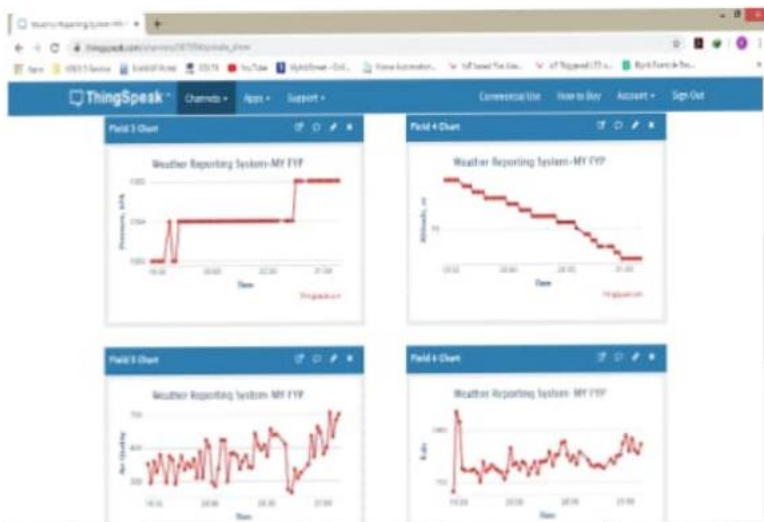
Figure 10 and Figure 11 show the graph of collected result from sensor.

In order to refresh sensor data, the graph will continue to receive data every one minute. Six graphs are available to the public, displaying all of the sensor data: temperature, stickiness, pressure, elevation, downpour, and air quality. The website of ThingSpeak can turn any sensor data into a table of tables.

With ThingSpeak serving as the IOT platform for anyone seeking a straightforward and quick method of monitoring an online system. Using an online system and a computer or smartphone with an internet connection, users of the website can check the condition at a specific location.



**Figure 10.** Sensor data plot on graph in ThingSpeak.



**Figure 11.** Sensor data plot on graph.

Tables 1, 2, and 3 might be constructed utilizing these diagrams and the web waiter test. Three sensors are present: the MQI35 (Air Quality Sensor), the BME280 (Temperature, Humidity, and Pressure), and the Rain Sensor. This sensor data analysis was made with all of the sensor data that was obtained.

A comparison of the actual condition and the prediction was made on the basis of the graph. The results of this data are shown in Table 5 alongside the precise condition and sensor data comparison.

Most temperature ever recorded in Malaysia was close to 40°C, and people died of heat stroke because it was so dangerous. People may be prompted to plan or prepare for their daily activities by this analysis. This has been closed in view of the assessment of sensor information obtained from chosen sensors and tried for a couple of days.

**Table 5.** Temperature data comparison with forecast data.

Sensor	Data	Forecast	Data
Temp, °C	24	Temp, °C	24
Temp, °C	23	Temp, °C	24
Temp, °C	31	Temp, °C	30
Temp, °C	30	Temp, °C	31
Temp, °C	32	Temp, °C	31
Temp, °C	28	Temp, °C	30
Temp, °C	29	Temp, °C	28

Since the MQ135 and Downpour sensors show simple qualities, investigation is expected to figure out what esteem the sensor read under genuine circumstances. Table 6 listed the analog value for each sensor as well as the actual state for each reading.

**Table 6.** Analysis for MQ135 sensor and Rain sensor.

Sensor	Sensor data/value	Actual condition
MQ135	405	Not good
MQ135	587	Not good
MQ135	322	Fair
MQ135	255	Fair
MQ135	122	Good
MQ135	100	Good
MQ135	421	Not good
MQ135	366	Fair
MQ135	303	Fair
MQ135	289	Fair
Rain Sensor	3888	No rain
Rain Sensor	3752	No rain
Rain Sensor	3774	No rain
Rain Sensor	3445	No rain
Rain Sensor	2551	No rain
Rain Sensor	1552	Rainy
Rain Sensor	1007	Rainy
Rain Sensor	1248	Rainy
Rain Sensor	831	Heavy rain
Rain Sensor	2897	No rain



For the purposes of the results, the 'MQ135 sensor' and the 'Rain sensor' are split into three parts. The sensor data characteristic for the original state which is used to set the sensor data value, will be shown in the results.

- An analogue value greater than 400 for the MQ135 sensor indicates poor air quality.
- Analog values between 250 and 250 indicate that the air quality is acceptable.
- The 'actual state is No Rain when the Raindrop sensor's analog value exceeds 800'.
- The actual weather state is rainy if the analog number falls below 800.

#### 4.1.2. Blynk display sensor data

Another Internet of Things (IoT) product that can wirelessly display sensor data is Blynk. This app can be used for any IOT development activity. This program was developed so that the framework for weather announcements could display sensor data and be recognized from anywhere on Earth. The entire sensor data is displayed by the Blynk app.





**Figure 12.** Blynk display data.

#### **4.1.3. OLED display sensor data**

The Wemos DI small monitoring method functions as a client that receives sensor data from the ESP32 server. Through wireless transmission, the data were finalized and displayed on the OLED in the manner depicted in Figure 13. The circuit was designed to identify the 12C pin and power supply for LCD and OLED, with LCD needing 5V and OLED requiring 3.3V, respectively. The weather conditions station will receive a package of information from the sensor station to display on the OLED. Between the two boards, connectivity via a Wi-Fi hotspot will be used. Actual time and data that will be updated by the NTP client via internet connectivity will be displayed on the LCD. All of the outcomes are connected to the IOT.



**Figure 13.** OLED display sensor data send by ESP32 via hotspot.

#### **4.1.4. Discussion**

Based on the information that the sensors gather and transmit to ThingSpeak for the user to view. The tracking of meteorological variables will be made simpler as a result. Once connected to Wi-Fi, ThingSpeak will start graphing sensor data, which can then be analysed in ThingSpeak. The weather parameter from the forecast station is not particularly accurate, as indicated by the comparison of the data in Tables 1, 2, 3, and 4. As a consequence, a weather reporting system makes it simple for users to obtain the real situation where they are. Even in the worst case scenario, people may use wireless monitoring network devices to check the weather online on a website and take specified actions and monitor. The purpose of the weather reporting system is to use all of the data to monitor the weather in order to eliminate the most significant factor in determining the success or failure of agricultural businesses and to prevent users from receiving incorrect Forecast Company forecasts for their location. The ESP32 and Wemos DI are tiny LoT components that used a Wi-Fi hotspot to connect the microcontroller boards.

## CHAPTER 05

### 5.1 CONCLUSION

It will connect via 'Wi-Fi', which has limited coverage but is still preferable to wireless communication. A system that can monitor meteorological parameters using a wireless system and IoT. When the accuracy of weather reporting systems and prediction system data is compared, the values recorded in Google Sheets and Tables 1, 2, and 3 demonstrate that the weather at a particular location differs from the actual situation. As per the exploration, the weather conditions revealing framework is more precise than the conjecture framework. This weather conditions revealing framework will utilize ThingSpeak and IFTTT to save sensor information. It might likewise be checked by means of the Blynk application, which can be downloaded.

Saving a weather conditions station in the climate for checking permits the biological system to guard itself (i.e., savvy climate). Data must be gathered and analyzed by environment-based sensor devices in order to carry out this. We can rejuvenate the climate by utilizing sensor gadgets in the climate. The user will then be able to access the data that was collected and the results of the analysis via Wi-Fi. This study portrays a cunning procedure to screen the climate utilizing a productive, minimal expense installed innovation. Additionally, it uploaded sensor data to the cloud. Saving a weather conditions station in the climate for observing permits the biological system to protect itself (i.e., savvy climate). Information can be analysed by environment-based sensor devices in order to carry out this. We can rejuvenate the climate by utilizing sensor gadgets in the climate. Then we will be able to access information that was collected and the results of the analysis via Wi-Fi. This study portrays a cunning procedure to screen the climate utilizing a productive, minimal expense installed innovation. Additionally, it uploaded sensor data to the cloud.

## 5.2 FUTURE SCOPE

A few additional sensors can be added and connected to monitor additional environmental parameters, additional sensors, such as oxygen sensors, can be added. There are numerous applications for this real-time technology in the military, navigation, and aviation. It might likewise be used in clinics or clinical foundations for weather conditions examination and examination.

It is possible to arrive at the conclusion that real-time data is advantageous due to low agricultural yields and inaccurate weather forecasts. The future of this system is very bright. You will be welcomed into the Internet of Things. Multiple applications, including remote data control, data transmission, and monitoring, can be carried out with the same system.

## 5.3 REFERENCES

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