Weather Monitoring Station

A

Report submitted in partial fulfilment of the requirement for the

degree of

B.Tech.

In

Computer Science & Engineering

By

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DECLARATION

This is to certify that Report entitled "Weather Monitoring Station" which is submitted by me in partial fulfilment of the requirement for the award of degree B.Tech. in Computer Science and Engineering to Pranveer Singh Institute of Technology, Kanpur Dr. A P J A K Technical University, Lucknow comprises only our own work and due acknowledgement has been made in the text to all other material used.

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Certificate

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It gives us a great sense of pleasure to present the report of the B.Tech. Project undertaken during B.Tech. Third Year (Session: 2024-25). We owe special debt of gratitude to our project supervisor ***Dipti Yadav, Assistant Professor, Department of Computer Science and Engineering, Pranveer Singh Institute of Technology, Kanpur*** *for his constant support and guidance throughout the course of our work. His sincerely, thoroughness and perseverance have been a constant source of inspiration for us. It is only his cognizant efforts that our endeavours have seen light of the day.*

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ABSTRACT

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An Abstract is required for every paper; it should succinctly summarize the reason for the work, the main findings, and the conclusions of the study. The abstract should be no longer than 250 words. Do not include artwork, tables, elaborate equations or references to other parts of the paper or to the reference listing at the end. The reason is that the Abstract should be understandable in itself to be suitable for storage in textual information retrieval systems.

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LIST OF ABBREVIATIONS

AQI- Air Quality Index

OS- Operating System

SDK- Software Development Kit

IFTTT- If This Then That

CHAPTER-1

INTRODUCTION

1.1. OVERVIEW

Assemble all system as per circuit diagram. Program the NodeMCU using Arduino IDE. You will get confirmation on your screen once The NodeMCU is a programable controller which has inbuilt wi-fi module. We connect three sensors 1) BMP180 2) DHT11 and 3) Rain Sensor to NodeMCU. By using these three sensors, we can collect the required weather data for monitoring purpose. This pooled data is stream over the Internet to display it or read it from anywhere. After the successfully programmed hardware, the NodeMCU get one IP address. We can browse this IP address from any of WEB browser like Chrome, Firefox, Internet Explorer etc.so we display the required live data which fetched by sensors in beautiful Graphical User Interface format. The weather parameters that we monitor are Temperature, Pressure, Humidity and Rain. Also, you can check whether data through anywhere using Internet as we hosted this server publicly. We developed an android application for easy access to our weather monitoring system.

1.2. Literature Review

[1] In this project, we have elaborated how the weather prediction system is becoming a crucial challenge in every Weather extreme event that causes an adverse effect of the system on lives and property as well. Hence the accuracy of weather data is being one of the critical challenges to enhance the weather prediction skills and build up the resilience to effect of detrimental weather report condition. The research done during the project describes that Uganda and various other developing countries have looked challenges in developing timely & accurate weather data due to scarce weathers observation. The scarce weather monitoring is a part of the high cost of developing automatic weather situations. The restricted funding is available to national meteorological services of the respective countries. In this proposed system the author firstly takes care of the problems and then applies them. The author proposed an Automatic weather monitoring Station based on a wireless sensor network. The planning of the author is to develop three generations of Automatic weather stations or AWS prototypes. In this research, the author evaluates the 1st-generation AWS prototype to improve the 2nd generation depending upon the need and generation. The author provides a suggestion to improve the nonfunctional requirement such a power consumption, data accuracy, reliability, and data transmission in order to have an Automatic Weather Station. The non-functional requirement collapsed with cost reduction in order to produce a robust and affordable Automatic Weather Station (AWS) Therefore the proposed work, like developing countries like Uganda will be able to acquire the AWS in suitable quantities.

CHAPTER-2

DESIGN METHODOLOGY

2.1. Features of purposed system

[2] In IOT enabled weather monitoring system project, Arduino Uno measures 4 weather parameters using respective 4 sensors. These sensors are a temperature sensor, humidity sensor, light sensor, and rain level sensor. These 4 sensors are directly connected to Arduino Uno since it has an inbuilt Analog to digital converter. The weather monitoring system gives high accuracy and reliability for weather monitoring and climate changing. It uses the renewable energy source like solar panel for charging the connected battery. Through the web, it access real time weather information and data. This system can be communicated over general packet radio service (GPRS) network. Low maintenance is required for end users. It is capable for storing data and providing it to the users as required.

2.2. Purposed Hardware Architecture

The implemented system consists of a microcontroller (ESP8266) as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller. The sensors can be operated by the microcontroller to retrieve the data from them and it processes the analysis with the sensor data and updates it to the internet through Wi-Fi module connected with via blynk app then we can measure temperature, humidity, pressure and rain fall.

2.3. List of required hardware components

1. Node MCU(ESP8266)
2. I2C Module
3. DHT11
4. BMP180
5. Rain Sensor
6. 16*2 LCD Display
7. Beard Board
8. Jumper Wire
9. Data Cable

2.4. Details of Hardware Component

2.4.1. Node MCU(ESP8266)

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines “node” and "MCU" (micro-controller unit). Strictly speaking, the term "NodeMCU" refers to the firmware rather than the associated developmental kit.Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS, a flash file system for embedded controllers. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

Fig-1:Node MCU(ESP8266) Board

2.4.2 DHT 11 Sensor

The DHT-11 Digital Temperature and Humidity Sensor is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed).

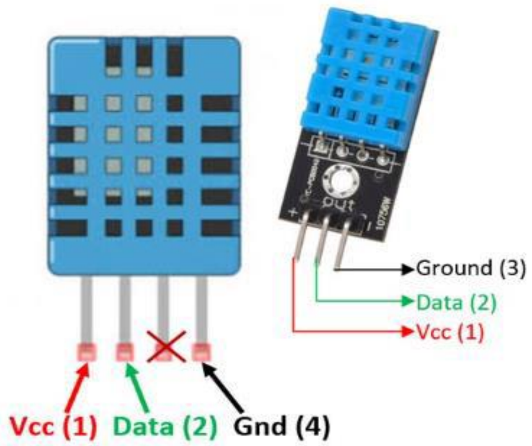


Fig-2: DHT-11 Temperature Sensor

2.4.3 LCD Display

A LCD or fluid precious stone show is a type of display that uses fluid precious stone innovation. We neea 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.

Fig-3: LCD Display

2.4.4 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.

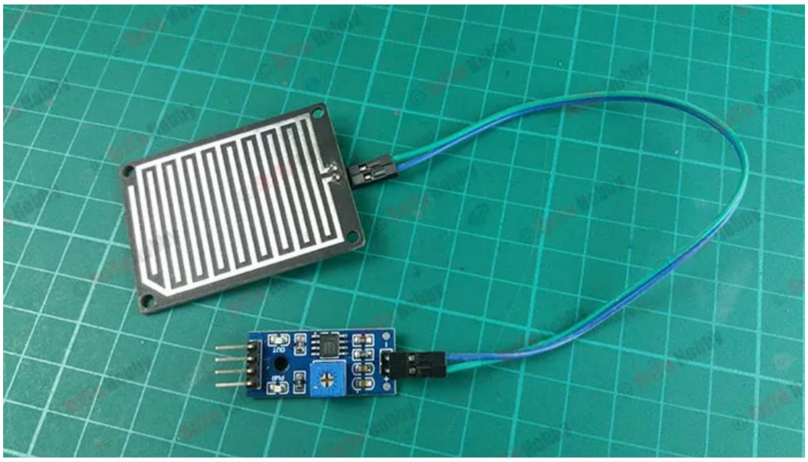


Fig-4: Rain Sensor

2.4.5 BMP180 (Pressure Sensor)

BMP180 is one of sensor of BMP XXX series. They are all designed to measure Barometric Pressure or Atmospheric pressure. BMP180 is a high precision sensor designed for consumer applications. Barometric Pressure is nothing but weight of air applied on everything. The air has weight and wherever there is air its pressure is felt. BMP180 sensor senses that pressure and provides that information in digital output. Also, the temperature affects the pressure and so we need temperature compensated pressure reading. To compensate, the BM180 also has good temperature sensor.

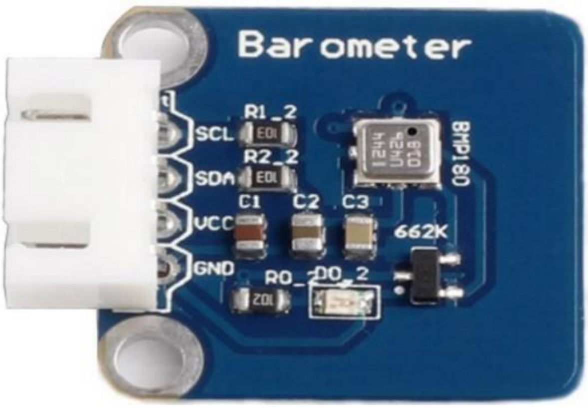


Fig-5:BMP180 Pressure Sensor

CHAPTER-3

IMPLEMENTATION

3.1 Design

In the IoT-enabled weather monitoring system, the Node MCU (ESP8266) 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.

3.2 Block Diagram

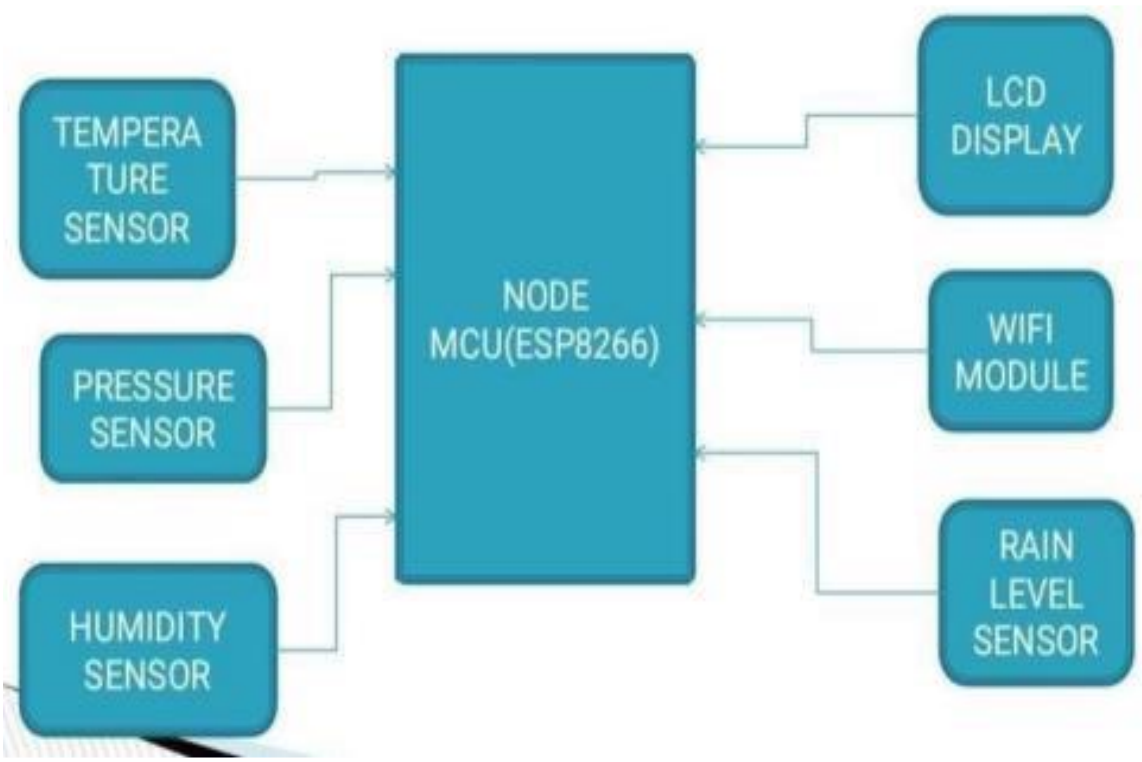


Fig-6: [3] Weather Monitoring Block Diagram

3.3 Circuit Diagram

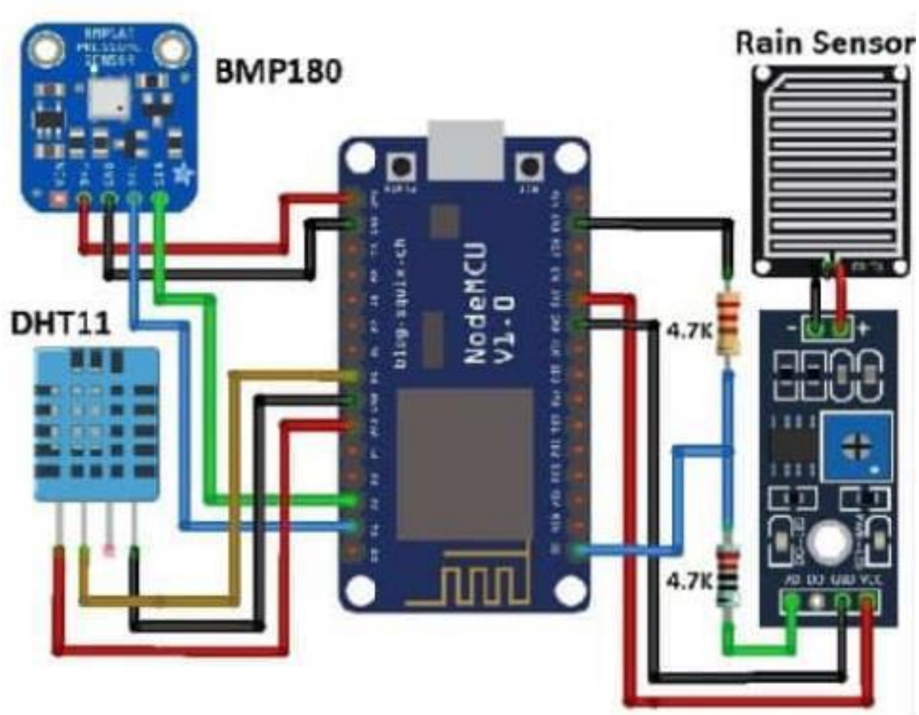


Fig-7: [4] Circuit Diagram

3.4 Working

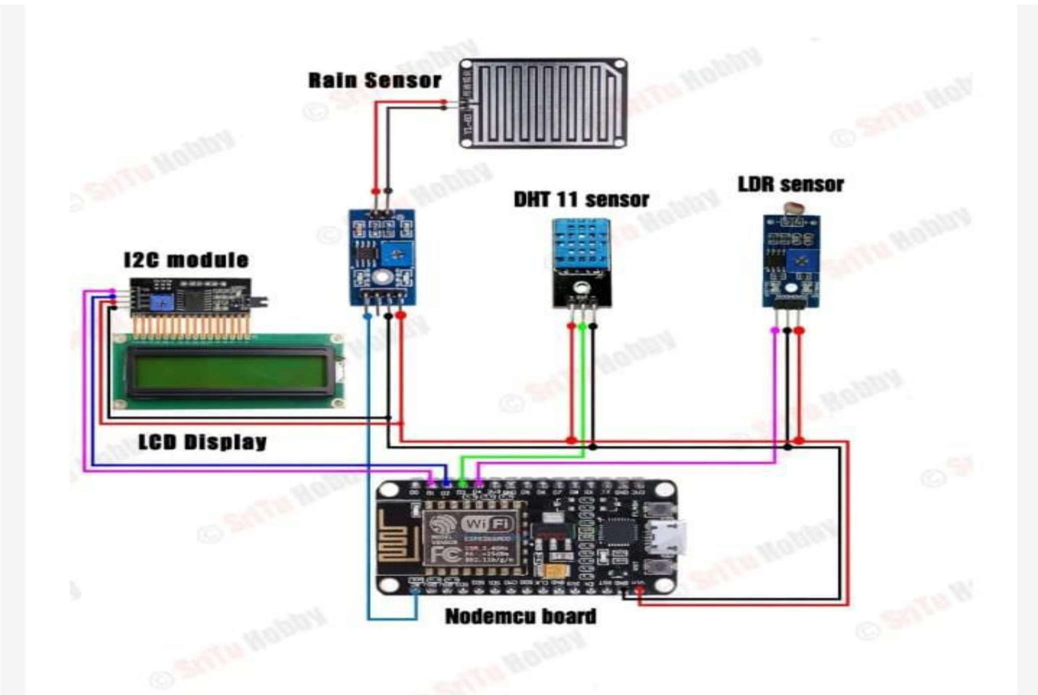


Fig-8: [5] Working and Implementation Diagram

CHAPTER-4

RESULT AND ANALYSIS

4.1 Performance Analysis

The ‘BMP180 and DHT11(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 ESP8266 microcontroller controls. Then it is controlled by a USB link to transfer the coding portrayal to the ESP8266 microcontroller. The serial monitor displays the sensor data in the Arduino IDE software. The ESP8266 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. It depicts the communication between the sensor station and the weather station over a Wi-Fi hotspot,

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 ESP8266 readings of all sensors and sent to ThingSpeak as a result of this projects objective.

4.2 ThingSpeak display and data analysis

Following testing with the web server, the ThingSpcak 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. 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.

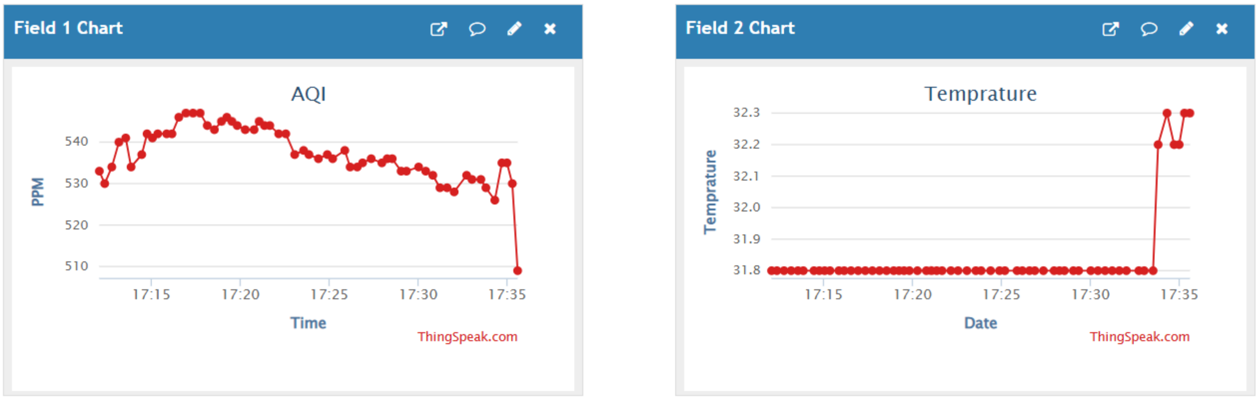


Fig-9: (a) [6] AQI and Temperature graph plotted on ThingSpeak

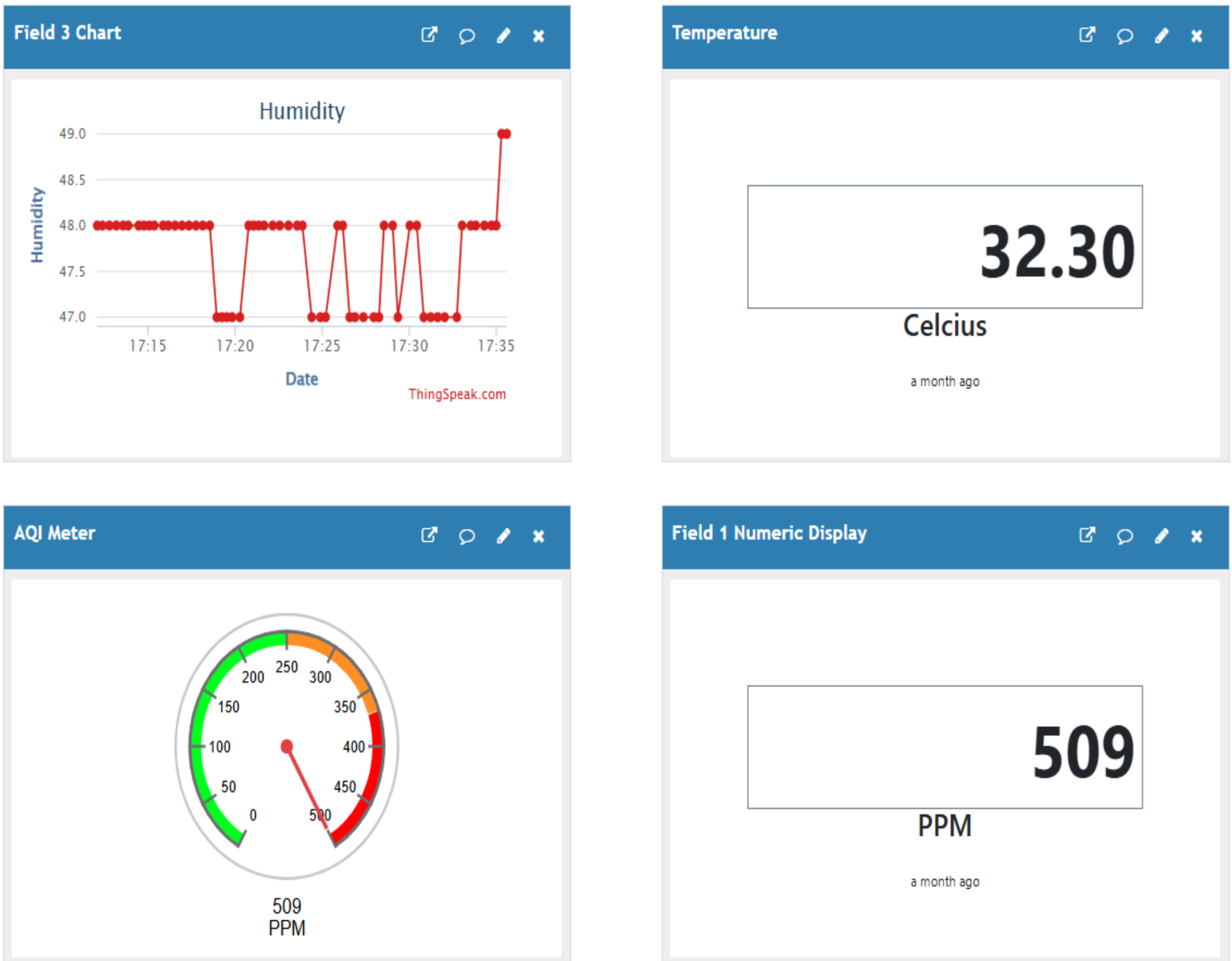
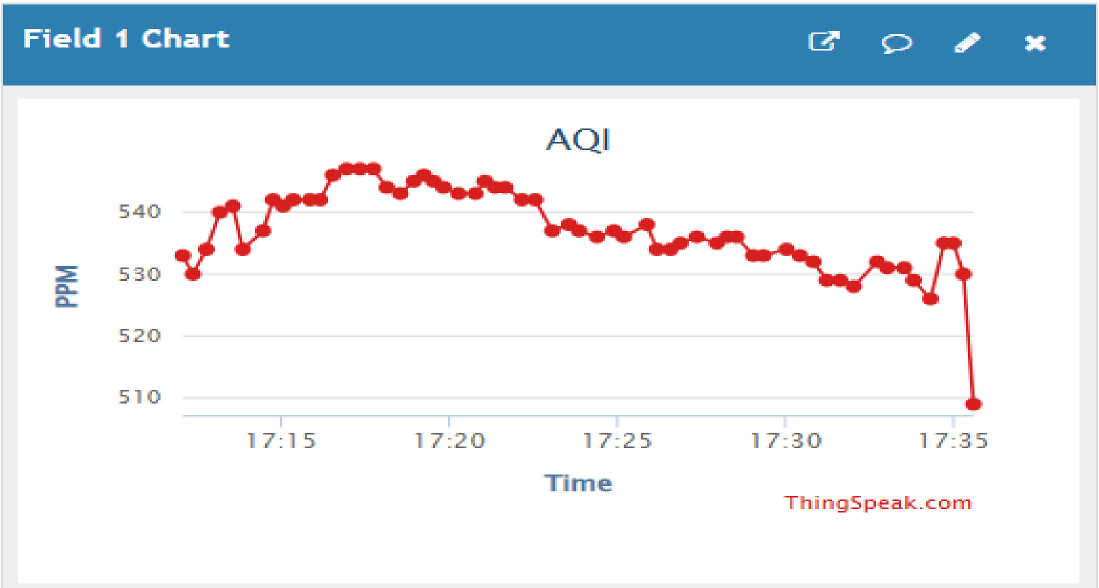


Fig-9: (b) [6] Humidity chart plotted on ThingSpeak

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.



	A	B	C	D	E
1	created_at	entry_id	AQI	Temprature	Humidity
2	2024-10-15T15:07:51+05:30	1	233	32.3	49
3	2024-10-15T15:08:08+05:30	2	232	32.1	49
4	2024-10-15T15:08:32+05:30	3	231	31.8	50
5	2024-10-15T15:08:50+05:30	4	230	31.8	49
6	2024-10-15T15:09:08+05:30	5	232	32.3	52
7	2024-10-15T15:10:07+05:30	6	223	32.3	51
8	2024-10-15T15:10:31+05:30	7	224	32.3	50
9	2024-10-15T15:10:54+05:30	8	223	31.9	49
10	2024-10-15T15:11:41+05:30	9	220	31.8	49
11	2024-10-15T15:12:11+05:30	10	220	31.8	49
12	2024-10-15T15:12:35+05:30	11	220	31.8	49
13	2024-10-15T15:12:53+05:30	12	218	31.8	49
14	2024-10-15T15:13:16+05:30	13	213	31.8	50
15	2024-10-15T15:13:40+05:30	14	213	31.8	51
16	2024-10-15T15:14:10+05:30	15	213	31.8	50
17	2024-10-15T15:14:27+05:30	16	213	31.8	50
18	2024-10-15T15:14:51+05:30	17	214	31.8	49
19	2024-10-15T15:15:33+05:30	18	213	31.8	50
20	2024-10-15T15:15:51+05:30	19	220	31.8	51
21	2024-10-15T15:16:08+05:30	20	208	31.8	51
22	2024-10-15T15:16:32+05:30	21	216	32	52
23	2024-10-15T15:16:56+05:30	22	216	32.3	52
24	2024-10-15T15:17:20+05:30	23	211	32.3	52
25	2024-10-15T15:17:50+05:30	24	214	32.3	51
26	2024-10-15T15:18:20+05:30	25	216	32.3	52

Fig-10: [6] AQI Time stamp graph and chart

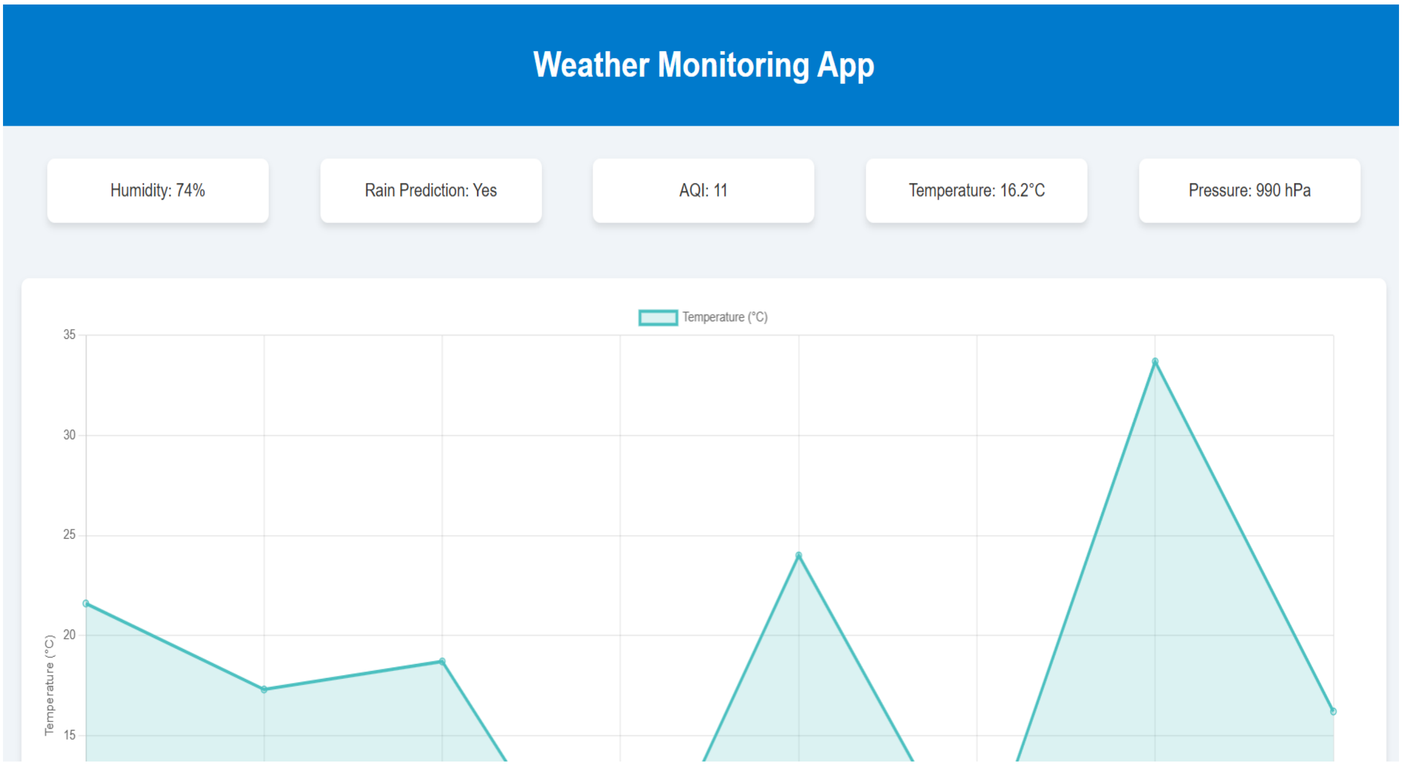
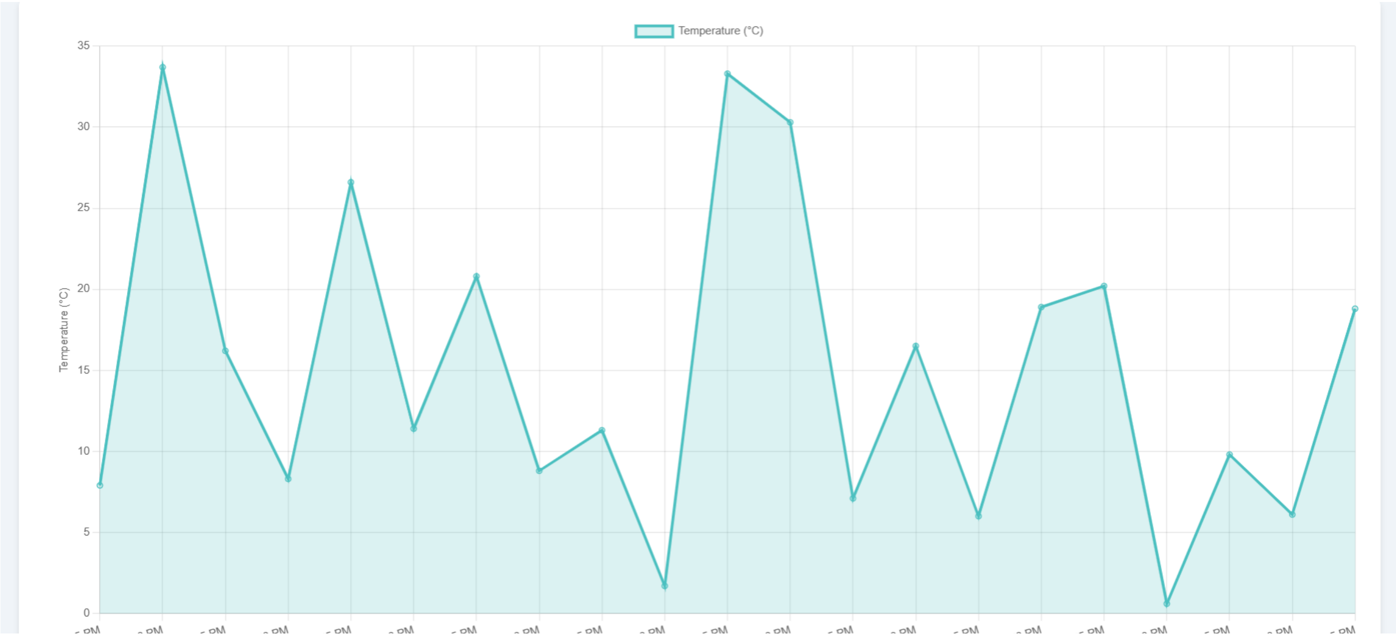


Fig-11: Weather monitoring application that we developed shows real time weather data collected



Weather History

Time	Humidity	Temperature	Pressure	AQI	Rain Prediction
12:02:55 PM	96%	34.9°C	992 hPa	266	No
12:02:50 PM	24%	31.8°C	993 hPa	177	Yes
12:02:45 PM	64%	22.0°C	960 hPa	72	Yes
12:02:40 PM	25%	26.2°C	984 hPa	56	Yes
12:02:35 PM	19%	30.3°C	991 hPa	4	No
12:02:30 PM	65%	15.0°C	969 hPa	128	No
12:02:25 PM	50%	20.9°C	965 hPa	91	Yes
12:02:20 PM	12%	22.9°C	979 hPa	105	No
12:02:15 PM	76%	18.8°C	993 hPa	229	Yes
12:02:10 PM	89%	6.1°C	971 hPa	153	No
12:02:05 PM	77%	9.8°C	960 hPa	216	No
12:02:00 PM	82%	0.6°C	979 hPa	134	No
12:01:55 PM	99%	20.2°C	971 hPa	110	Yes
12:01:50 PM	31%	18.9°C	963 hPa	141	Yes
12:01:45 PM	57%	6.0°C	971 hPa	167	Yes
12:01:40 PM	6%	16.5°C	974 hPa	178	No

Fig-12: Graph and Weather history chart plotted on our application.

4.3 Discussion

[7] 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. 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-5

CONCLUSION

5.1 CONCLUSION

[8] 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 loT. When the accuracy of weather reporting systems and prediction system data is compared, the values recorded in Google Sheets and Tables 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. By keeping the weather station in the environment for monitoring enables self-protection (i.e., smart environment) to the environment. To implement this need to use the sensor devices in the environment for collecting the data and analysis. By using sensor devices in the environment, we can bring the environment into real life. Then the collected data and analysis results will be available to the user through the Wi-Fi. The smart way to monitor the environment an efficient, low-cost embedded system is presented in this paper. It also sent the sensor parameters to the cloud. This data will be helpful for future analysis and it can be easily shared to other users also. This model can be expanded to monitor the developing cities and industrial zones for pollution monitoring. To protect the public health from pollution, this model provides an efficient and low-cost solution for continuous monitoring of environment.

5.2 FUTURE SCOPE

[9] 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.

One can implement a few more sensors and connect it to the satellite as a global feature of this system. Adding more sensors to monitor other environmental parameters such as CO_2, Pressure and Oxygen Sensor. In aircraft, navigation and the military there is a great scope of this real-time system. It can also be implemented in hospitals or medical institutes for the research & study in "Effect of Weather on Health and Diseases", hence to provide better precaution alerts.

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