

A
PROJECT REPORT
on
Weather Reporting System using Raspberry Pi

Submitted
In partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology
in
Electronics and Communication Engineering

by

- | | |
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SAHARSA COLLEGE OF ENGINEERING
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Under the Supervision of

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MAY, 2025

CANDIDATE'S DECLARATION

We hereby declare that the work which is being presented in this project progress report entitled, **“Weather Reporting System using Raspberry Pi”** in partial fulfillment of requirement for the 06 credit course Project-I Course code-100709) of the degree of **Bachelor of Technology** in **Electronics and Communication Engineering**, submitted in the department of ELECTRONICS AND COMMUNICATION ENGINEERING, SCE Saharsa, is an authentic record of our own work/study carried out under the guidance of **Neha Rani** (Assistant Professor), Department of Electronics and Communication Engineering, SCE Saharsa.

The matter embodied in this report has not been submitted anywhere by us for the award of any other credit/degree or diploma.

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CERTIFICATE

This is to certify that project report entitled “**WEATHER REPORTING SYSTEM USING RASPBERRY PI**” which is submitted by “Rohit Raj, Ravi Ranjan Kumar, Kumar Samdarshi, Aparna, Priti Gadhwal” in partial fulfilment of the requirement, for the award of the degree of **Bachelor of Technology** in department of **Electronics & Communication Engineering** of Saharsa College of Engineering, Saharsa is a record of the candidate own work carried out by them under my/our supervision. The matter embodied in this project report is original and has not been submitted anywhere for the award of any other credit/degree or diploma.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

The environment significantly impacts individuals' lives. The extraordinary rise in industry and automobile traffic has drastically affected air quality and overall environmental conditions. While the current situation is reported by satellite weather systems, they do not accurately reflect the state of each specific location. Precise meteorological data for specific locations, such as buildings, is essential for enhancing the calibration of energy simulation programs. The building industry, in particular, has a high potential for energy savings when provided with accurate weather data. To address this issue, a controlled local weather reporting system can be constructed using Raspberry Pi. By implementing this system, errors in weather forecasting at specific locations can be minimized. Equipped with environmental sensors, the system collects and transmits real-time weather data to the cloud. This data helps individuals monitor current weather conditions at specific sites, such as school grounds or construction sites, without relying solely on generalized weather reports.

The science and art of using technology to improve agricultural yield is known as precision agriculture. Water is a finite resource, yet approximately 50% of the water used in agriculture is wasted due to improper irrigation scheduling. Real-time monitoring of water usage in fields can help prevent water wastage and optimize irrigation practices. The integration of technology into agriculture is essential for increasing productivity and reducing labor requirements. Recent research has focused on improving environmental and climate change monitoring. Weather stations should be deployed in various locations to keep up with the rapidly changing global climate. This essay discusses the implementation of a weather station equipped with environmental sensors that provide real-time weather data. By utilizing a Raspberry Pi and various environmental sensors such as the DHT11, soil moisture sensor, and raindrop sensor, real-time climate data can be transmitted to the cloud, offering accessible weather reports.

The use of the Internet of Things (IoT) plays a crucial role in environmental monitoring. A system based on IoT can eliminate the need for manual weather checks by providing real-time online updates. Thing Speak, a cloud-based platform, can be used to display, analyze, and monitor weather parameters remotely. This platform enables users to access weather data from anywhere in the world, enhancing the efficiency of environmental monitoring systems.

1.2 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 minimize the losses suffered by the mankind.

1.3 OBJECTIVES

- **Real-time Weather Monitoring** – Collect temperature, humidity, pressure, and rainfall data using sensors connected to Raspberry Pi.
- **Data Processing & Storage** – Process and store weather data in a database for analysis and historical trends.
- **Remote Access & Display** – Show real-time weather reports on an LCD screen, web dashboard, or mobile app
- **Alerts & IoT Integration** – Send alerts for extreme weather conditions and optionally integrate with IoT/cloud platforms for remote access.

1.4 PROJECT OVERVIEW

The Weather Reporting System using Raspberry Pi is a real-time weather monitoring solution that collects, processes, and displays environmental data. Using sensors like DHT11/DHT22 (temperature & humidity) and BMP180 (pressure), the system continuously measures weather conditions. The Raspberry Pi acts as the central controller, processing sensor data and displaying it on an LCD screen or a web-based interface.

The project offers remote access capabilities through IoT integration, allowing users to monitor weather conditions from anywhere. Data can be logged for analysis, making it useful for research, agriculture, and smart city applications. This system provides an efficient, low-cost, and scalable approach to weather monitoring, reducing the need for manual data collection.

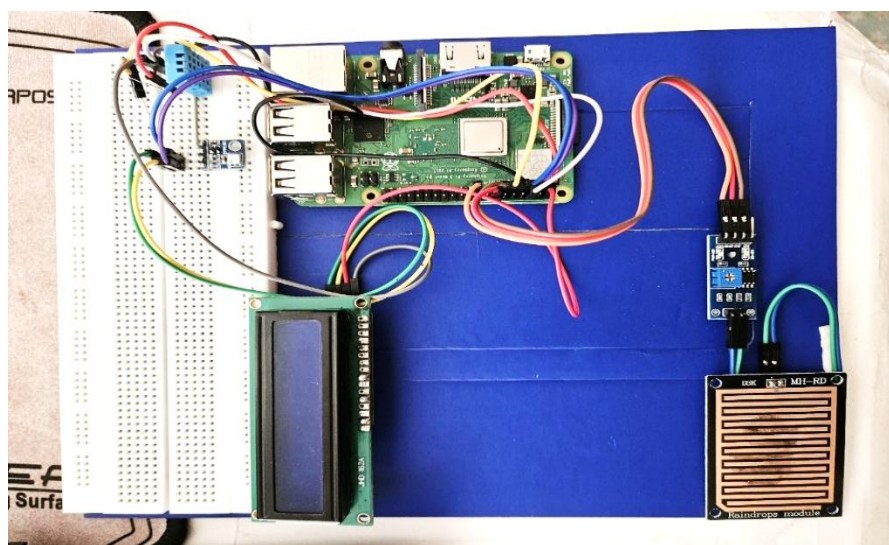


Figure 1.1: System Overview

1.5 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 RASPBERRY PI 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.

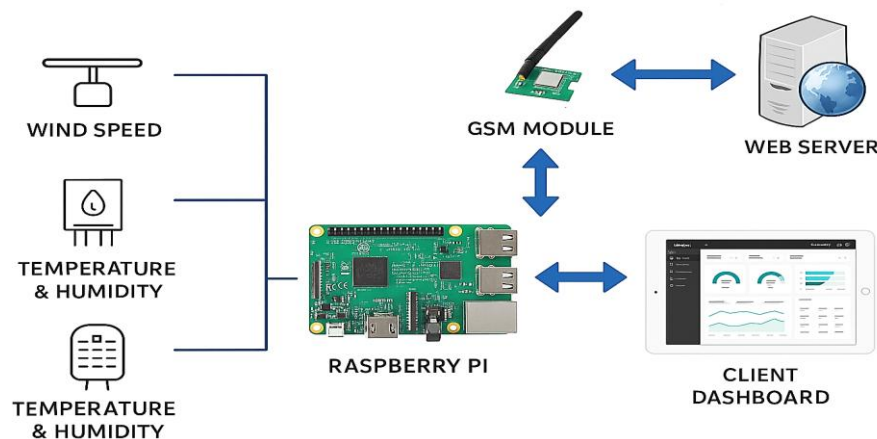


Figure 1.2: Block Diagram of Weather Reporting System

Source: Created through Photoshop

1.5.1.a 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 RASPBERRY PI microcontroller configures all of the sensors and begins reading data from them, the system procedure begins. The RASPBERRY PI Wi-Fi network is used to wirelessly transmit the data to the IoT platform ThingSpeak. The RASPBERRY PI'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.

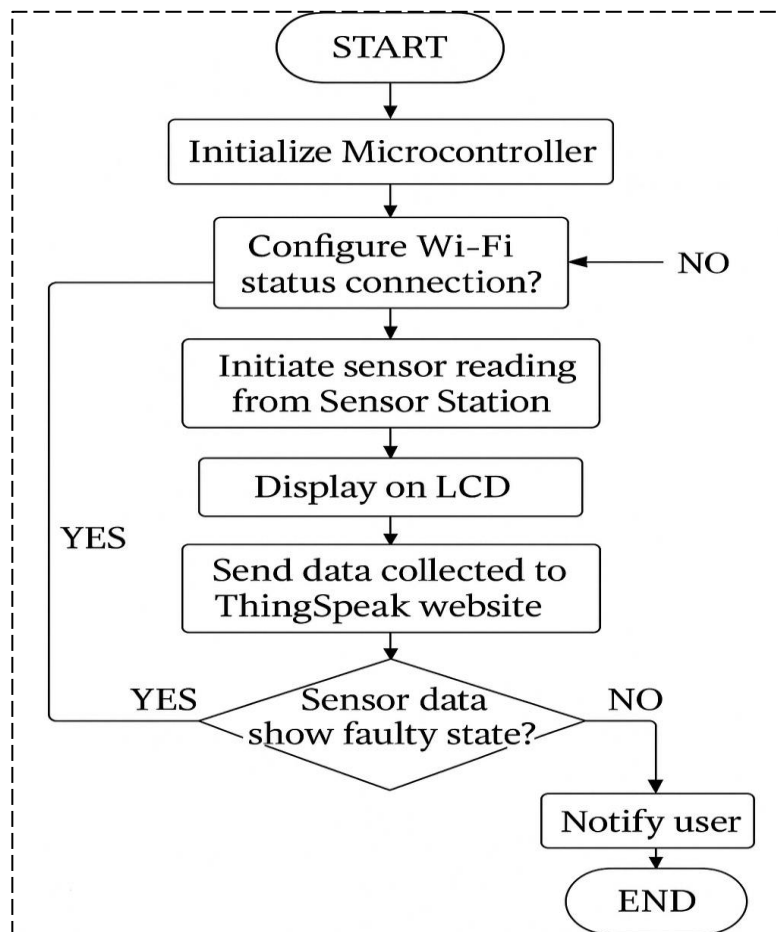


Figure 1.3 Flow chart of weather reporting system

Source: Photoshop

1.5.1.b 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.

1.5.2 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 RASPBERRY PI, BMP 180, MQ135 rain sensor, LCD, and DHT11 sensors are used in this project.

CHAPTER 2

LITERATURE SURVEY

2.1 TABULAR REPRESENTATION

This table of literature survey contains year& title, objective, methods, findings and research gaps, which shows the basic purpose and their limitation in a simple and understandable form.

S.No.	Year & Title	Objective	Methods	Findings	Research Gaps
01.	2016 Rohini Shete and Sushma Agrawal	Develop an IoT system for real-time urban environmental monitoring.[1]	-Raspberry Pi for hardware -Python for programming -Monitored parameters: temperature, humidity, pressure, CO, air pollutants data accessible via internet-enabled devices	Effective real-time data collection - Accessible on multiple devices Feasibility of low-cost IoT framework.	-Scalability for larger environments -Data integration with IoT ecosystems -Energy optimization - Sensor accuracy and calibration -Data security.
02.	2017 Suprita M. Patil Vijayalashmi M. Rakesh Tapaskar	Monitor and analyze renewable energy usage, focusing on solar energy.[2]	-IoT integration with Raspberry Pi -Flask framework for web interface -Monitored daily solar energy usage.	-Successful monitoring of solar energy -Analysis of energy consumption trends -Potential for IoT in smart infrastructure.	-Scalability for larger installations -Lack of advanced data analytics -Minimal Interoperability with existing platforms -Focus on solar energy only -Security and privacy concerns.

03.	<p>2018</p> <p>Salai Thillai Thilagam.J, T. Sarath Babu, B. Siva Reddy</p>	Develop a weather monitoring system using LabVIEW.[3]	<p>-NI LabVIEW for data acquisition</p> <p>-Sensors for environmental parameters</p> <p>-GSM module for alerts.</p>	<p>- Effective monitoring of environmental parameters</p> <p>-Alerts for critical thresholds</p> <p>-Validates use of GSM for remote alerts.</p>	<p>-Limited sensor variety</p> <p>-Scalability for larger areas</p> <p>-Energy efficiency not addressed</p> <p>-No predictive analytics</p> <p>-Alert customization options lacking.</p>
04.	<p>2020</p> <p>A F Pauzi1 and M Z Hasan1</p>	Design a real-time weather reporting system using IoT.[4]	<p>-ThingSpeak for data display</p> <p>-RASPERRY PI and Wemos D1 Mini microcontrollers</p> <p>-Data stored in Google Sheets.</p>	<p>-Provides real-time weather data globally</p> <p>-Accurate monitoring compared to satellite systems</p> <p>-Easy data analysis via Google Sheets.</p>	<p>-Data accuracy and calibration issues</p> <p>-Scalability not discussed</p> <p>-Energy optimization lacking</p> <p>-No predictive analytics</p> <p>-Limited integration with other systems.</p>
05.	<p>2020</p> <p>Vinod B. Shende , S.B. Gaikwad, Vijay Aware</p>	Develop a realtime weather monitoring system for localized insights.[5]	<p>-Monitored parameters: temperature, humidity, rainfall</p> <p>-Raspberry Pi 3 for processing</p> <p>-Data displayed on LCD and remotely via gecko.com.</p>	<p>-Real-time monitoring of localized weather</p> <p>-Remote access for user convenience</p> <p>-Cost effective IoT approach.</p>	<p>-Limited parameter scope</p> <p>-Scalability not mentioned</p> <p>-Absence of advanced analytics</p> <p>-Lack of integration with other systems</p> <p>-Data security not discussed.</p>

2.2 SUMMARY OF THE SURVEY

This report presents a comprehensive survey of various research studies focused on the development and implementation of weather reporting systems, particularly utilizing Internet of Things (IoT) technologies. The survey spans several years, highlighting objectives, methods, findings, and research gaps in each study.

2.2.1. Key Studies Reviewed

- **Rohini Shete and Sushma Agrawal (2016)**
 - a. **Objective:** Develop an IoT system for real-time urban environmental monitoring.
 - b. **Methods:** Utilized Raspberry Pi and Python; monitored parameters included temperature, humidity, pressure, CO, and air pollutants.
 - c. **Findings:** Effective real-time data collection accessible on multiple devices; demonstrated feasibility of a low-cost IoT framework.
 - d. **Research Gaps:** Scalability, data integration, energy optimization, sensor accuracy and data security.
- **Suprita M. Patil, Vijayalakshmi M. Rakesh Tapaskar (2017)**
 - a. **Objective:** Monitor and analyse renewable energy usage, focusing on solar energy.
 - b. **Methods:** IoT integration with Raspberry Pi and Flask framework for web interface; monitored daily solar energy usage.
 - c. **Findings:** Successful monitoring and analysis of energy consumption trends; potential for IoT in smart infrastructure.
 - d. **Research Gaps:** Scalability, lack of advanced data analytics, minimal interoperability, focus on solar energy only, and security concerns.

2.3 OVERALL INSIGHTS

- The studies indicate a growing trend towards utilizing IoT for weather monitoring, with a focus on real time data collection and accessibility.
- Common research gaps include scalability, advanced analytics, integration with existing systems, and data security.
- Future research could address these gaps to enhance the effectiveness and reliability of weather reporting.

CHAPTER 3

SYSTEM DEVELOPMENT

3.1 DESIGN

In the IoT-enabled weather monitoring system, the Raspberry Pi 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 Raspberry Pi. The Raspberry Pi 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 COMPONENTS REQUIRED

- Raspberry Pi
- DHT11 sensor
- BMP180 sensor
- Rain Sensor
- LCD Display
- Jumper Wires

3.2.1 Raspberry Pi

Open-source prototyping board designs are included in the open-source firmware known as Raspberry Pi is a small, affordable, single-board computer developed by the Raspberry Pi Foundation. It is designed for learning programming, DIY electronics projects, and even as a low-power desktop or server. The latest models come with ARM-based processors, USB ports, HDMI outputs, and support for various operating systems like Raspberry Pi OS (formerly Raspbian), Ubuntu, and more.

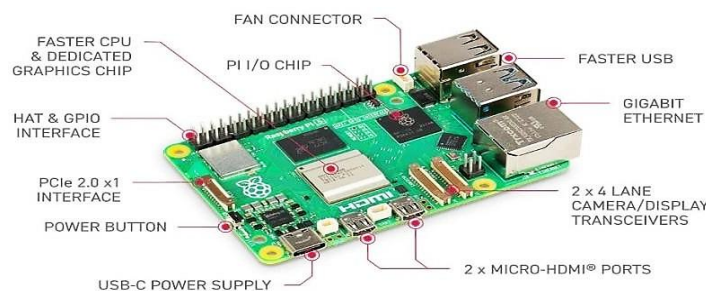


Figure 3.1: Raspberry Pi

Source: Internet

3.2.2 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.

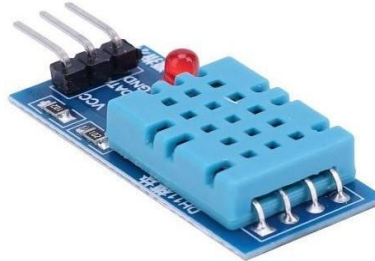


Figure.3.2: DHT11 sensor

Source: Internet

3.2.3 BMP180 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.

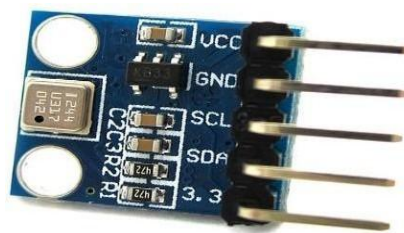


Figure. 3.3: BMP 180 Sensor

Source: Internet

3.2.4 Rain Sensor

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



Figure. 3.4: Rain sensor

Source: Internet

3.2.5 LCD-display

An LCD (Liquid Crystal Display) uses liquid crystal technology to display information. It is essential in electronic projects for showing output values and messages. Unlike 7- segment displays, LCDs offer better versatility and come in various sizes. Basic LCDs like 16x1 and 16x2 are widely used in embedded systems. These displays operate with control pins, mainly Enable (EN) and Register Select (RS). The contrast and READ/WRITE pins are rarely needed, simplifying functionality

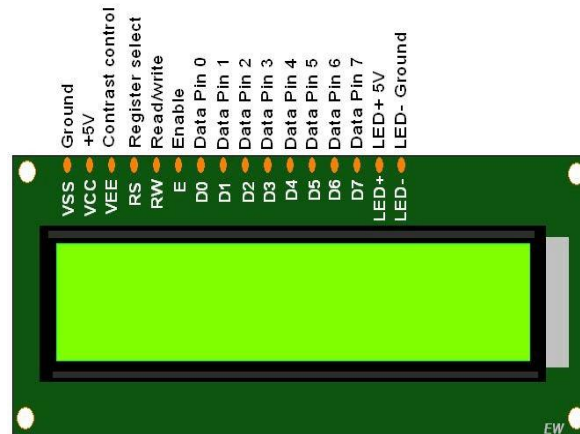


Figure. 3.5: LCD Display

Source: Internet

3.2.6 Jumper wires

Jumper wires are short, insulated wires with connector pins at both ends, used to connect different components on a breadboard, microcontroller, or circuit without the need for soldering. They are commonly used in prototyping and electronics projects



Figure. 3.6: Jumper wires

Source: Internet

3.3 METHODOLOGY

When the system is activated. Through the ThingSpeak cloud, the Raspberry Pi board communicates with the ThingSpeak web. In addition, it acquires sensor data. The qualities are then shipped off the ThingSpeak webpage and LCD show by the Raspberry Pi board. Sensor values can be shown on the LCD and in the ThingSpeak interface as a result of this procedure.

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 RASPBERRY PI microcontroller and Wemos client will manage all of the data, receiving sensor data from the RASPBERRY PI and displaying it on an LCD screen. Moreover, the system will be accessible through the ThingSpeak channel, which has been designed to allow users to check the data online, which will display the sensor data. The collected data will be analyzed and compared 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.

3.4 WORKING

3.4.1 General

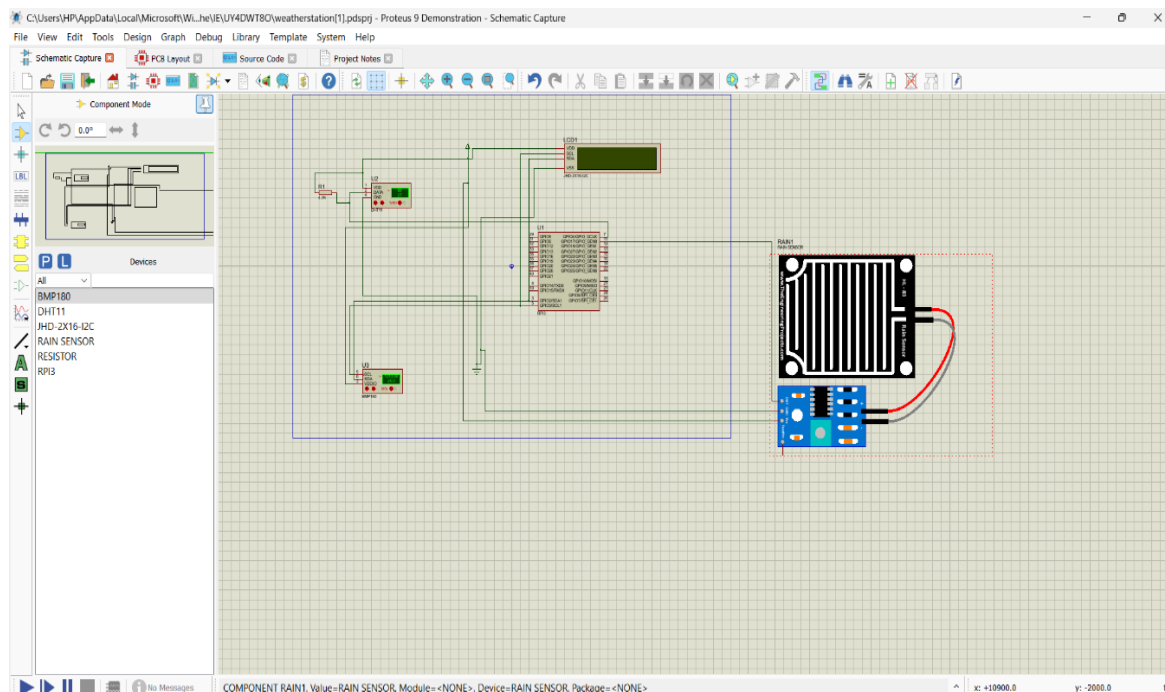


Figure. 3.7: Working of Weather Reporting System

Source: Proteus

Stage 1: Sensor Data Collection

The **sensors** continuously monitor environmental parameters and send their readings to the **Raspberry Pi**. The key sensors and their roles are:

- a. **DHT 11 (Temperature, humidity, and pressure sensor)**
 - Measures **temperature, humidity, and atmospheric pressure**.
 - Outputs digital data via the **I2C** or **SPI** interface.
- b. **BMP 180 (biometric pressure)**
 - It accurately measures atmospheric pressure
- c. **Rain Sensor**
 - Detects **rainfall presence and intensity** based on water conductivity.
 - Provides an **analog output**:
 - **>800** (No rain)
 - **<800** (Rain detected)
- d. **Wind Speed Sensor (Anemometer)**
 - Measures **wind velocity** using pulse signals.

Stage 2: Data Processing

The **Raspberry Pi** reads sensor values at set intervals and processes them using **Python scripts**. It converts analog readings into meaningful weather data using calibration formulas and reference values.

- Data Processing Example:
- Rain Sensor: Converts analog values into rain status (Yes/No).

Stage 3: Data Transmission and Storage

Once the data is processed, it is sent to multiple output platforms for storage and visualization.

- a. **Real-time Display on LCD Screen**
 - The Raspberry Pi updates an **LCD screen** with real-time weather parameters.
- b. **Web Server Display**
 - A **Flask-based web server** is hosted on the Raspberry Pi, allowing users to monitor weather conditions via a web interface.
- c. **Cloud Storage & Visualization using ThingSpeak**
 - Sensor readings are sent to **ThingSpeak**, which generates real-time **graphs and charts** for trend analysis.

d. Historical Data Logging using Google Sheets

- Sensor data is uploaded to **Google Sheets** via a Python API for long-term record-keeping.

Stage 4: Data Analysis & Comparison

- The recorded sensor data is compared with **official meteorological data** from sources like **Jabatan Meteorologi Malaysia** to verify accuracy.
- The system calculates **deviation percentages** to determine sensor reliability.

Stage 5: Decision-Making & Alerts

- a. Based on the collected data, the system can send alerts and notifications.

Example:

- If **temperature > 35°C**, an alert is triggered for **extreme heat**.
- If **air quality index > 400**, a warning is issued for **poor air quality**.
- If **rain is detected**, a notification is sent via ThingSpeak.

The weather reporting system is built around a control unit that includes sensors such as the BMP180 (Barometric Pressure Sensor) and a rain sensor, all of which are managed by a Raspberry Pi microcontroller. These sensors continuously monitor environmental parameters and feed real-time data into the Raspberry Pi. The connection between the sensors and the Raspberry Pi is facilitated via a USB interface, which is used to upload the control code and establish communication between the hardware components and the system software.

Sensor data is captured and displayed using the Blynk application, which features a serial monitor for real-time visualization. The Raspberry Pi connects to a predefined Wi-Fi hotspot, acting as a network node to host a web server. This web server collects and displays all sensor data, allowing remote monitoring through any internet-enabled device. This communication setup between the sensor station and the weather monitoring interface over Wi-Fi ensures seamless data transfer and user interaction. In addition, the weather data is shown locally on an OLED display connected to the Raspberry Pi, ensuring accessibility even without remote devices. The communication link between all components has been successfully established and tested, making the system fully operational.

Below is a sample table representing weather data collected using the Raspberry Pi along with sensors such as the DHT11 (for temperature and humidity) and BMP180 (for barometric pressure). This data reflects real-time environmental monitoring as part of the Weather Reporting System project:

Table 3.1: Sample Data of weather reporting system

Date	Time	Temperature (°C)	Humidity (%)	Pressure (hPa)	Rainfall (mm)
2025-02-20	10:00 AM	22.5	65	1012	0.2
2025-02-20	02:00 PM	26.3	55	1010	0.0
2025-02-20	06:00 PM	24.1	60	1011	0.1
2025-02-21	10:00 AM	23.0	67	1013	0.3
2025-02-21	02:00 PM	27.5	52	1009	0.0

3.4.2 ThingSpeak display and data analysis

ThingSpeak can be used in a weather reporting system as a platform to collect, visualize, and analyze data from various sensors. It allows real-time monitoring of weather parameters like temperature, humidity, pressure, and soil moisture. The platform is often used in conjunction with microcontrollers like ESP32 and ESP8266 & raspberry pi to collect sensor data and send it to the cloud, enabling remote access and data analysis.

3.4.2.a Working Description:

- **Data Collection:** Sensors like DHT11, BMP180, gather weather data.
- **Data Transmission:** Raspberry pi acts as a central unit, collecting data from the sensors and sending into
- **Data Storage and Visualization:** ThingSpeak stores the incoming data in the cloud and provides instant visualizations, allowing users track trends and create custom charts.
- **Data Analysis:** MATLAB, a software from MathWorks, can be used to further analyze the data collected on ThingSpeak, including trend analysis, histogram plotting, and dew point calculation.

3.4.2.b Advantages:

This tool is designed with user-friendliness in mind, featuring a simple and intuitive interface that makes it easy for beginners to navigate and use without requiring prior technical expertise. One of its key advantages is that it offers a free basic version, allowing users to access core features and start working without the need for any initial payment, making it accessible to a wider audience. It supports real-time data monitoring, meaning users can view data as it is collected or changes over time, which is particularly useful for applications that require immediate feedback or live updates. In addition to this, the tool includes powerful visualization capabilities, enabling users to generate clear and visually appealing graphs and charts that make it easier to interpret complex data sets. Moreover, the tool is compatible with MATLAB, a high-level programming and numeric computing environment, allowing users to perform more advanced data analysis and extend the tool's functionality for more sophisticated projects and research applications.

3.4.2.c Disadvantages:

The free version of the tool comes with limited functionality, particularly in terms of data upload capacity and storage, which may not be sufficient for large or long-term projects. It also requires a constant internet connection, meaning it cannot function in offline environments, which can be a drawback in remote areas with poor connectivity. Furthermore, to fully utilize advanced features and perform complex analyses, users need to be familiar with MATLAB or have basic programming skills, which can be a barrier for beginners.

3.4.2.d Limitations:

There is a data rate restriction in the free plan, where data can only be uploaded once every 15 seconds, making it unsuitable for applications that require high-frequency updates. Storage is also constrained, with a limited number of channels and data points available for each account. Additionally, the platform is not designed for handling sensitive or confidential data, so it may not be appropriate for applications that require strict data privacy and security standards.

3.4.2.d Uses:

This tool is widely used in various IoT and sensor-based applications. It is ideal for monitoring environmental conditions such as temperature, humidity, and air quality in real-time. In smart agriculture, it helps in tracking soil moisture levels and weather conditions to optimize crop health and water usage. It is also used in home automation systems for managing lights, appliances, and energy consumption. Moreover, it supports remote weather stations and energy monitoring systems, such as those used with solar panels and smart meters, making it a versatile tool for both hobbyists and professionals.

3.5 CODE:

```
import RPi.GPIO as GPIO  
from RPLCD.i2c import CharLCD
```



```

import dht11
from smbus import SMBus
from time import sleep
import requests
import pandas as pd
from Sklenar.linear model imports Linear Regression
import numpy as np

# ===== CONFIGURATION =====

GPIO.setmode(GPIO.BCM)
GPIO.setwarnings(False)

DHT11_PIN = 4
RAIN_SENSOR_PIN = 17
GPIO.setup(RAIN_SENSOR_PIN, GPIO.IN)

lcd = CharLCD(i2c_expander='PCF8574', address=0x27, port=1,
cols=16, rows=2, charmap='A02', auto_linebreaks=False)

dht_sensor = dht11.DHT11(pin=DHT11_PIN)
bus = SMBus(1)
BMP180_ADDR = 0x77

CHANNEL_ID = "2921297"
READ_API_KEY = "B7FH3YZCM8W4HX1U"
WRITE_API_KEY = "OJKPZ2MJ4F84N9FE"
BASE_URL = "https://api.thingspeak.com"

# ===== LCD LOADING =====

lcd.write_string("System Loading")

```

```

lcd.cursor_pos = (1, 0)
for i in range(16):
    lcd.write_string(".")
    sleep(0.1)
    lcd.clear()
    lcd.write_string("Wait..")
    sleep(2)
    lcd.clear()

# ===== FUNCTIONS =====

def read_dht11():
    result = dht_sensor.read()
    if result.is_valid():
        temp = result.temperature
        hum = result.humidity
        print (f'DHT11 => Temp: {temp}C Humidity: {hum}%")
        return temp, hum
    return None, None

def read_bmp180():
    try:
        bus.write_byte_data (BMP180_ADDR, 0xF4, 0x2E)
        sleep(0.005)

        ut = (bus.read_byte_data(BMP180_ADDR, 0xF6) << 8) +
              bus.read_byte_data(BMP180_ADDR, 0xF7)

        bus.write_byte_data(BMP180_ADDR, 0xF4, 0x34)
        sleep(0.005)

        up = (bus.read_byte_data(BMP180_ADDR, 0xF6) << 8) +
              bus.read_byte_data(BMP180_ADDR, 0xF7)

        pressure = up
        print(f'BMP180 => Pressure: {pressure} hPa")
        return int(pressure)
    
```

```

except Exception as e:
    print("BMP180 error:", e)
    return None

def read_rain():
    rain = GPIO.input(RAIN_SENSOR_PIN)
    print("Rain Detected" if rain == 0 else "No Rain")
    return 1 if rain == 0 else 0

def safe_post(url, data, retries=3):
    for i in range(retries):
        try:
            response = requests.post(url, data=data, timeout=10)
            if response.status_code == 200:
                return response
            else:
                print(f"POST failed (status {response.status_code}): {response.text}")
        except Exception as e:
            print(f"Attempt {i+1} POST error:", e)
            sleep(3)
    print("All retry attempts for POST failed.")
    return None

def safe_get(url, retries=3):
    for i in range(retries):
        try:
            response = requests.get(url, timeout=10)
            if response.status_code == 200:
                return response
            else:
                print(f"GET failed (status {response.status_code}): {response.text}")

```

```

except Exception as e:
    print(f'Attempt {i+1} GET error:", e)
    sleep(3)
    print("All retry attempts for GET failed.")
    return None

def send_actual_to_thingspeak(temp, hum, pres, rain):
    url = f'{BASE_URL}/update'
    data = {
        'api_key': WRITE_API_KEY,
        'field1': temp,
        'field2': hum,
        'field3': pres,
        'field4': rain
    }
    response = safe_post(url, data)
    if response:
        print("Actual data sent to ThingSpeak.")

def send_predictions_to_thingspeak(p1, p2, p3, p4):
    url = f'{BASE_URL}/update'
    data = {
        'api_key': WRITE_API_KEY,
        'field5': p1,
        'field6': p2,
        'field7': p3,
        'field8': p4
    }
    response = safe_post(url, data)
    if response:
        print(f'Predicted data sent: T={p1}, H={p2}, P={p3}, R={p4}')

```

```

def fetch_data_from_thingspeak():

    url =
    f"{BASE_URL}/channels/{CHANNEL_ID}/feeds.json?api_key={READ_API_KEY}
    &results=40"

    response = safe_get(url)

    if response:

        feeds = response.json()["feeds"]

        df = pd.DataFrame(feeds)

        df = df[["field1", "field2", "field3", "field4"]].dropna()

        df = df.astype(float)

        return df

    return None

```

```

def make_predictions(df):

    try:

        X = df.index.values.reshape(-1, 1)

        preds = []

        for field in ['field1', 'field2', 'field3', 'field4']:

            y = df[field].values

            model = LinearRegression()

            model.fit(X, y)

            pred = model.predict([[len(X)]])

            preds.append(round(pred[0]))

        return preds

    except Exception as e:

        print("Prediction error:", e)

        return [0, 0, 0, 0]

```

```

# ===== MAIN LOOP =====

```

```

try:

```

```

while True:

# Step 1: Read actual sensors

    temperature, humidity = read_dht11()
    pressure = read_bmp180()
    rain_status = read_rain()

# Step 2: Display actual data

    lcd.clear()
    lcd.write_string(f'T: {temperature}C H: {humidity}%")
    lcd.cursor_pos = (1, 0)
    lcd.write_string(f'P: {pressure} R: {'Yes' if rain_status else 'No'}")

# Step 3: Send actual to ThingSpeak

    if None not in (temperature, humidity, pressure):
        send_actual_to_thingspeak(temperature, humidity, pressure, rain_status)

# Step 4: Predict values

    df = fetch_data_from_thingspeak()
    if df is not None:
        pred_temp, pred_hum, pred_pres, pred_rain = make_predictions(df)

# Step 5: Display prediction

    print(f'Predicted => Temp: {pred_temp}C, Hum: {pred_hum}%, Pres: {pred_pres},
    Rain: {pred_rain}')
    send_predictions_to_thingspeak(pred_temp, pred_hum, pred_pres, pred_rain)
    sleep(15) # ThingSpeak rate limit
except KeyboardInterrupt:
    print("Exiting...")
    lcd.clear()
    GPIO.cleanup()

```

3.6 CIRCUIT CONSTRUCTION

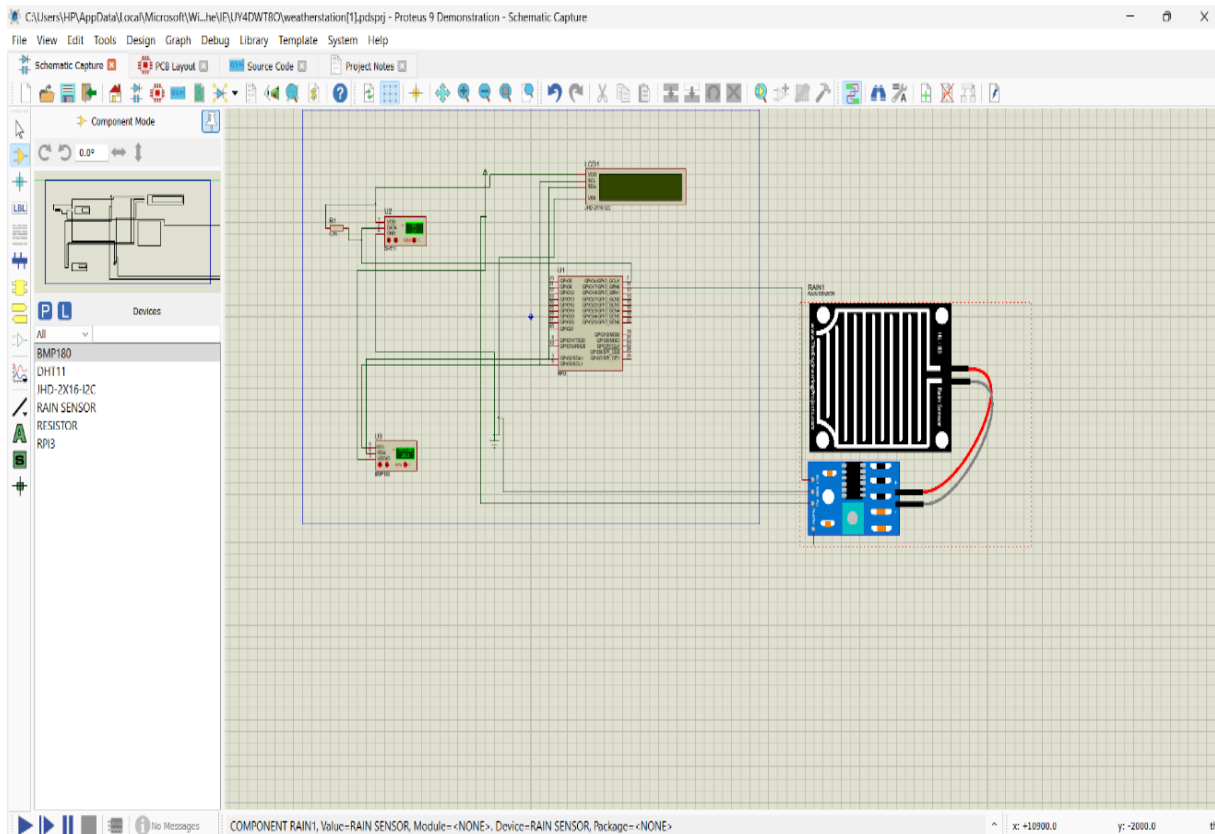


Figure. 3.8: Circuit diagram of weather reporting system

Source: Proteus

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.

3.6.1 Implementation

This weather reporting system model is used to monitor environmental conditions like temperature, humidity, pressure, and rainfall. When implemented using a Raspberry Pi, it becomes a cost-effective and programmable IoT device suitable for remote weather stations, schools, research, and home automation.

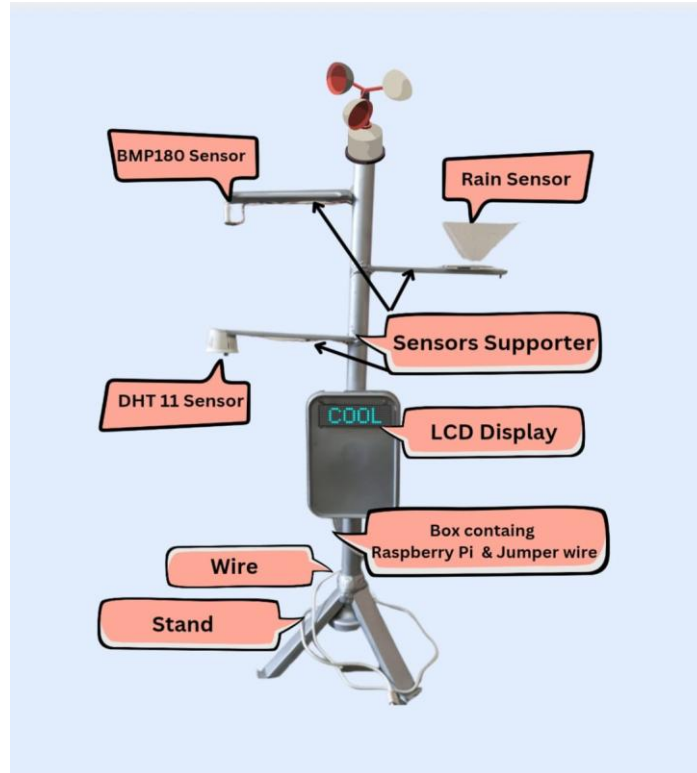


Figure.3.9: Physical Model

3.7 RESULTS AND DATA PRESENTATION

The developed weather reporting system provided real-time readings through multiple interfaces including an I2C LCD display, terminal output on Raspberry Pi, cloud visualization on ThingSpeak, and logging to CSV files. A prediction module was also integrated to forecast environmental parameters and rain status.

3.7.1 LCD Readings (Real-time Display)

An I2C LCD (16x2) was used to show live environmental data. The display was updated every few seconds with temperature, humidity, pressure, and rain status.

Example Output on LCD:

Table 3.2: LCD Output

Temp: 32°C Hum: 50%
Pres: 1010 hPa Rain: No

- Line 1: Temperature and humidity
- Line 2: Atmospheric pressure and rain detection
- If rain was detected, the display updated to show “Rain: Yes”

3.7.2 Terminal Output (Raspberry Pi Console)

The terminal provided serial output for debugging and logging purposes. Each sensor reading was printed with a timestamp for easy reference.

Example Terminal Log:

Table 3.3: Terminal Data

[2025-05-10 14:00:01]
Temperature: 32°C
Humidity: 50%
Pressure: 1010 hPa
Rain Detected: No

This output helped verify sensor accuracy and troubleshoot any issues during testing.

3.7.3 ThingSpeak Graphs (Cloud Visualization)

All sensor readings were uploaded to individual fields on a ThingSpeak channel. Real-time graphs were automatically plotted and updated at each reading interval (e.g., every 60 seconds).

Table 3.4: Fields Used

Field 1: Temperature
Field 2: Humidity
Field 3: Pressure
Field 4: Rain Status
Field 5: Predicted Temperature
Field 6: Predicted Humidity
Field 7: Predicted Rain Status

Sample Observations from Graphs:

- Temperature increased steadily from 10 AM to 2 PM.
- Humidity dropped as temperature increased.
- Pressure showed minor fluctuations, decreasing slightly before rain.
- Predicted values closely matched real readings.

3.7.4 CSV File (Local Data Logging)

A CSV file was maintained on the Raspberry Pi to record all sensor readings for offline analysis. This file was updated in real-time and could be opened in any data analysis tool.

Table 3.5: CSV file Data

Timestamp	Temperature	Humidity	Pressure	Rain
2025-05-10 14:00	32	50	1010	0
2025-05-10 14:05	33	48	1008	1

Rain value: 0 for No Rain, 1 for Rain Detected

The CSV helped in training machine learning models and exporting data for research.

3.7.5 Prediction Data (ML Model Results)

A simple machine learning model was implemented using previous CSV logs to predict future weather parameters. The predicted values were uploaded back to *ThingSpeak* and also displayed in the terminal.

Table 3.6: Prediction Example (Uploaded to ThingSpeak)

Time (Predicted) Temp (°C) Humidity (%) Rain Likelihood			
04:00 PM	34	45	No Rain (0)
06:00 PM	31	56	Rain Expected (1)

Terminal Prediction Log: [Prediction for 06:00 PM]

- Predicted Temperature: 31°C
- Predicted Humidity: 56%
- Rain Forecast: Yes

These predictions were based on simple decision tree or regression models trained on past data. Accuracy was validated by comparing with actual values on ThingSpeak.

3.8 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. 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.

Weather has a profound impact on human activity, influencing agriculture, transportation, disaster preparedness, and daily life. Accurate, timely, and accessible weather information is essential for both individuals and organizations. With advancements in technology, weather reporting systems have evolved from static newspaper forecasts to dynamic, data-driven platforms powered by sophisticated software. This article explores the role of software development in building modern weather reporting systems, detailing the architecture, tools, challenges, and future directions.

Software development is at the heart of modern weather reporting systems, enabling the transformation of complex atmospheric data into actionable insights. As technologies evolve, these systems will become even more intelligent, reliable, and user-centric. Whether for public safety, agriculture, or travel, the continued advancement of weather software ensures society can better prepare for and respond to the ever-changing skies.

CHAPTER 4

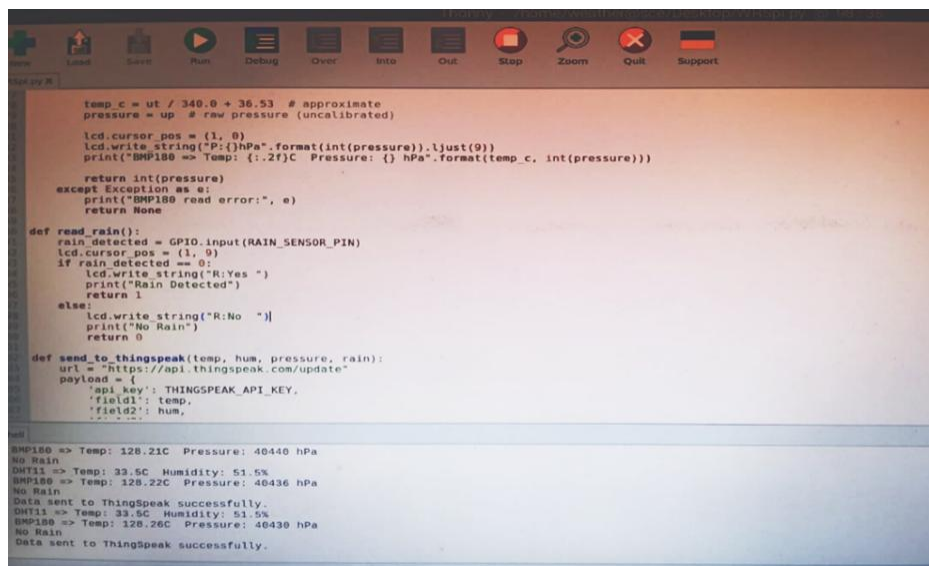
PERFORMANCE ANALYSIS

4.1 SIMULATION RESULT

Simulation is the process of creating a virtual model of a real-world system to study its behaviour without physical implementation. In electronics, simulation allows testing of circuits, sensors, and code using software tools like Tinkercad or Proteus. It helps visualize how components interact, detect errors, and optimize design before actual construction. This saves time, cost, and resources, making it a vital step in engineering projects. 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. In order to refresh sensor data, the graph will continue to receive data every one minute. Four graphs are available to the public, displaying all of the sensor data: temperature, pressure, humidity, rain sensors. The website of ThingSpeak can turn any sensor data into a table of tables. 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.

4.1.1 Actual data

This image shows Thonny IDE displaying real-time weather data from sensors like DHT11 and BMP180. The code reads temperature, humidity, pressure, and rain status. It processes and sends the data to ThingSpeak for remote monitoring.



```
temp_c = ut / 340.0 + 36.53 # approximate
pressure = up # raw pressure (uncalibrated)

lcd.cursor_pos = (1, 0)
lcd.write_string("P: {}hPa".format(int(pressure)).ljust(9))
print("BMP180 => Temp: {:.2f}C Pressure: {} hPa".format(temp_c, int(pressure)))

return int(pressure)
except Exception as e:
    print("BMP180 read error:", e)
    return None

def read_rain():
    rain_detected = GPIO.input(RAIN_SENSOR_PIN)
    lcd.cursor_pos = (1, 0)
    if rain_detected == 0:
        lcd.write_string("R:Yes ")
        print("Rain Detected")
        return 1
    else:
        lcd.write_string("R:No ")
        print("No Rain")
        return 0

def send_to_thingSpeak(temp, hum, pressure, rain):
    url = "https://api.thingSpeak.com/update"
    payload = {
        'api_key': THINGSPEAK_API_KEY,
        'field1': temp,
        'field2': hum,
    }

    # ... (rest of the code) ...

BMP180 => Temp: 128.21C Pressure: 40440 hPa
No Rain
DHT11 => Temp: 33.5C Humidity: 51.5%
BMP180 => Temp: 128.22C Pressure: 40436 hPa
No Rain
Data sent to ThingSpeak successfully.
DHT11 => Temp: 33.5C Humidity: 51.5%
BMP180 => Temp: 128.26C Pressure: 40430 hPa
No Rain
Data sent to ThingSpeak successfully.
```

Figure :4.1 Weather Reporting System actual platform representation

Source: Raspbian OS Thonny IDE

```
Shell
DHT11 => Temp: 33.5C Humidity: 51.5%
BMP180 => Temp: 128.20C Pressure: 40441 hPa
No Rain
Data sent to ThingSpeak successfully.
DHT11 read error
BMP180 => Temp: 128.19C Pressure: 40440 hPa
No Rain
DHT11 => Temp: 33.5C Humidity: 50.0%
BMP180 => Temp: 128.24C Pressure: 40432 hPa
No Rain
```

Figure 4.2 Actual Output of the system

Source: Thonny IDE Shell

- This graph shows the real time changes in temperature of a certain place from 03 May to 09 of May. We can see a certain kind of change in temperature with the help of graph which is gradually increasing from 03rd May to 09th May.

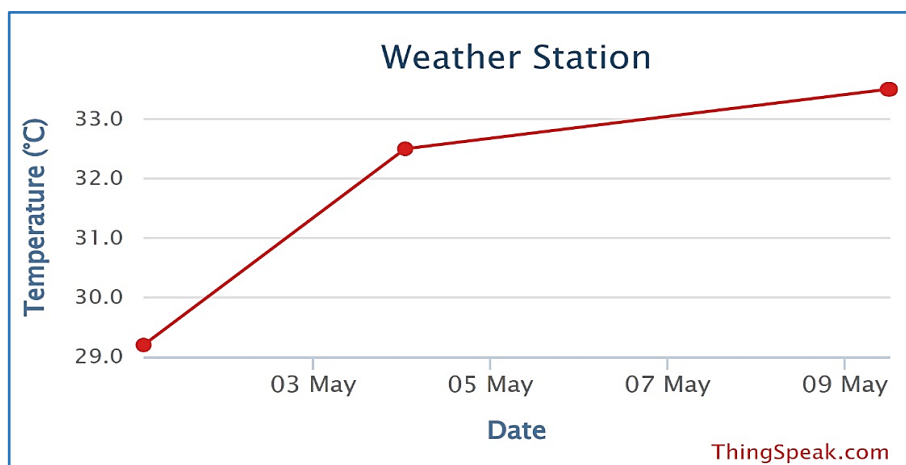


Fig:4.3. Actual data regarding temperature

Source: ThingSpeak

- This image shows how the area is affected by humidity for a certain period of time and its nature by the help of a graph.

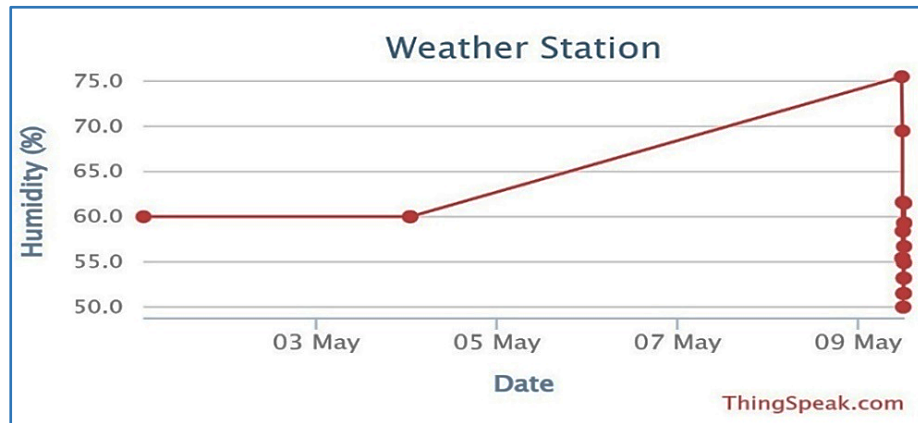


Figure 4.4 Actual humidity in surrounding

Source: ThingSpeak

- This graph shows weather there is a condition of rain or not in a certain place at a certain place. This graph shows only in yes/no about the rain condition at a place. We can see that from 03rd to 08th May there is no possibility of rain in that place but on 09th of May there is rain in that place.

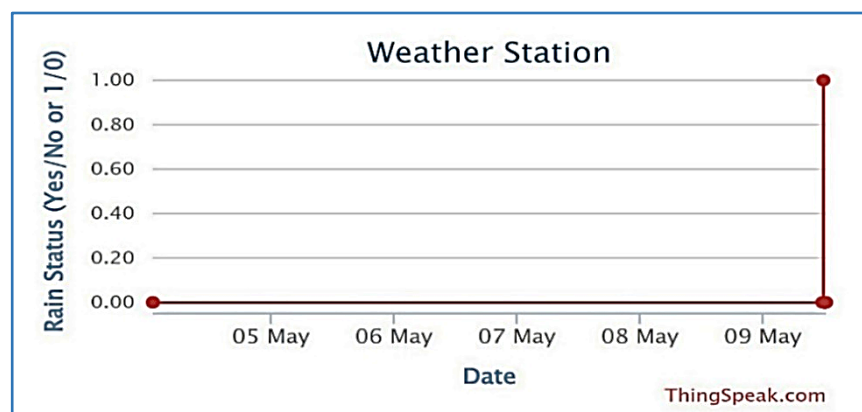


Figure 4.5: Rain status

Source: ThingSpeak

- This image shows all the parameters shown by our thinkspeak platform and there by using this we can predict the weather condition of that place.



Figure 4.6: Combined image of all actual parameters

Source: ThingSpeak Dashboard

4.1.2 Predicted data

This is the estimated future data based on historical trends using ML models or statistical forecasting (e.g., linear regression, LSTM, ARIMA). By implementing various machine learning techniques like PCA we can now predict the future weather condition of place.

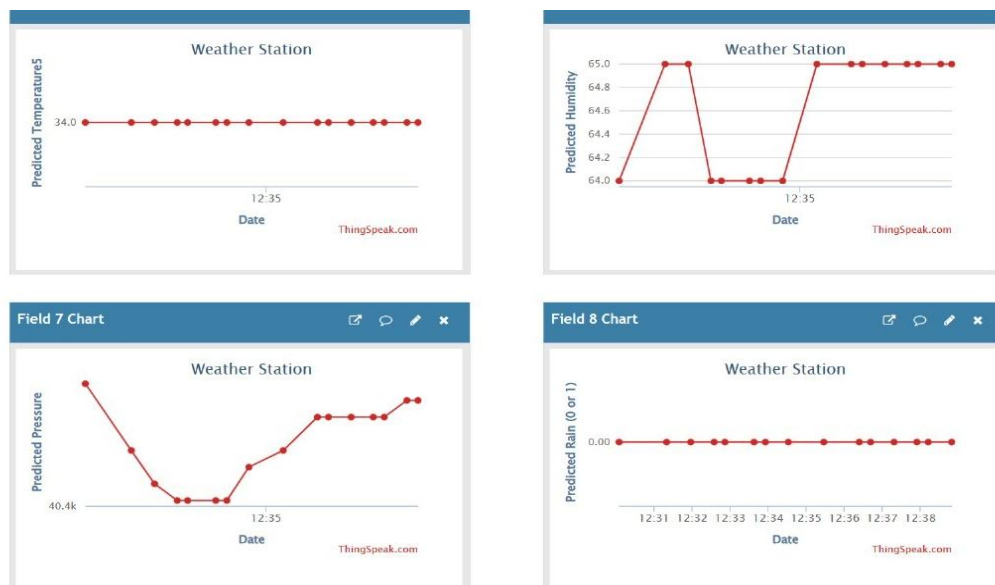


Figure 4.7: Combined image of all predicted parameters

Source: ThingSpeak Dashboard

- This is the predicted humidity of a place for the tenure of 10 minutes from 12:30 to 12:40. We can see that fluctuating from 12:30 to 12:35, after 12:35 there is a steady and constant humidity from 12:35 to 12:40.

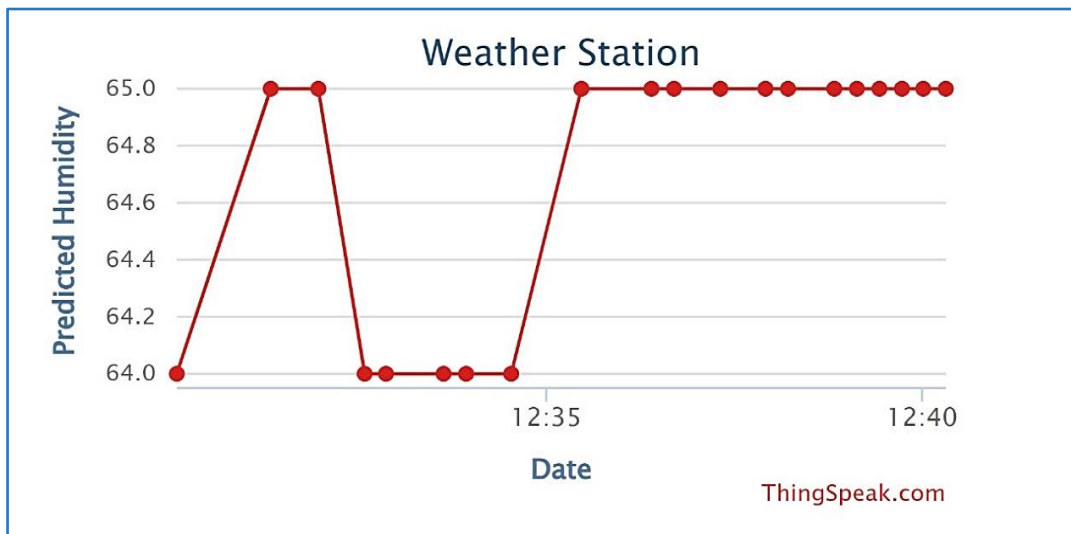


Figure 4.7: Predicted Humidity

Source: ThingSpeak

- By using machine learning techniques, we can predict that from the data that the temperature before and after 12:35 is constant at 34.0.

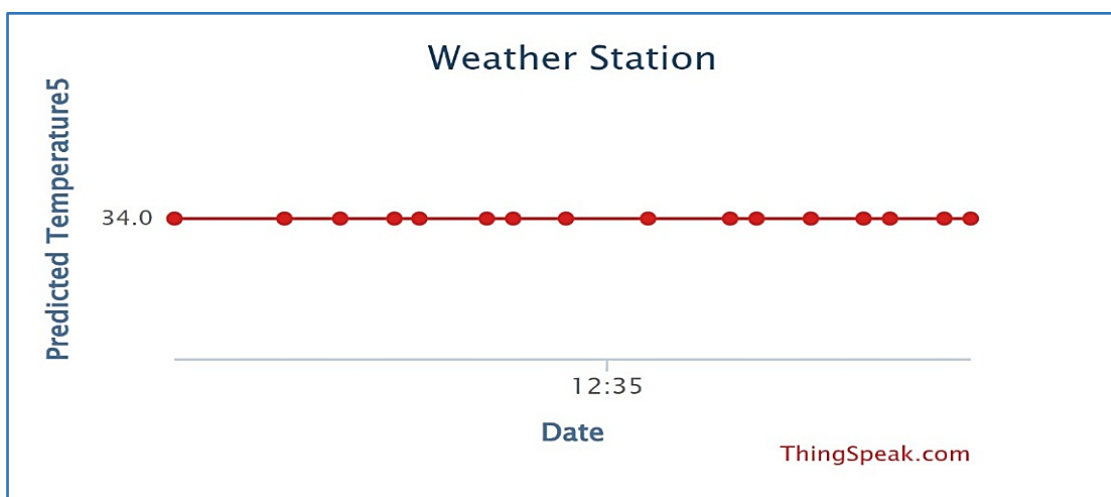


Figure 4.8 Predicted Temperature

Source: ThingSpeak

- This graph represents whether there is possibility of rain in a certain place or not.

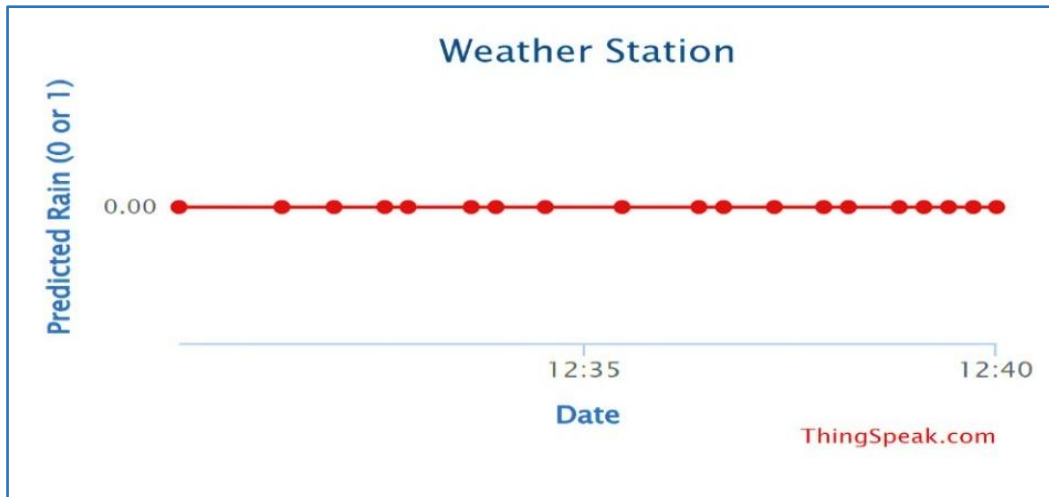


Figure 4.9: Predicted Rain Status

Source: ThingSpeak

- This thingSpeak graph shows the prediction of the pressure of the wind.

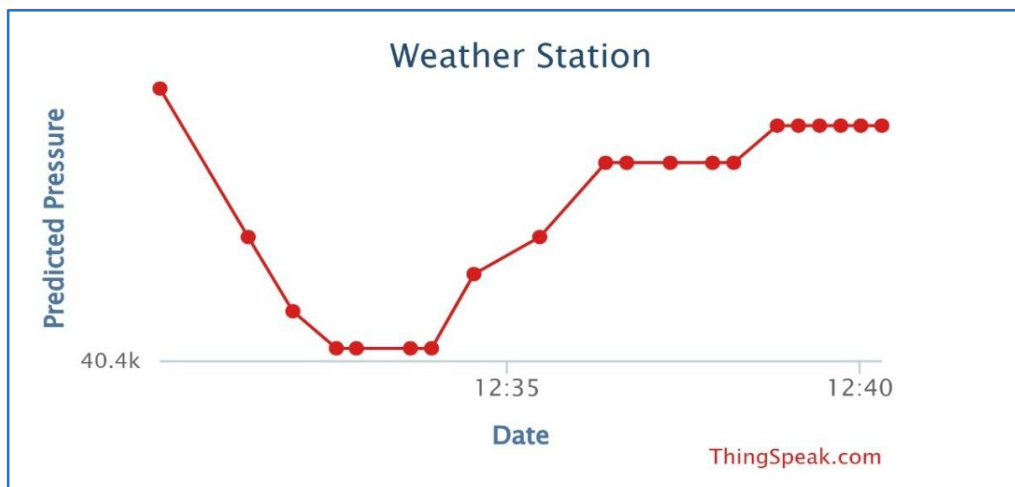


Figure 4.10: Predicted Pressure

Source: ThingSpeak

4.1.3 Quick analysis of each graph:

1. Predicted Humidity:

- Values oscillate sharply between 64% and 65%.
- There are two clear transitions, suggesting rapid fluctuations or sensor/model jitter.
- Stabilizes at 65% after a certain time.

2. Predicted Pressure:

- Starts around 40.45k Pa, dips to a low, and then rises again.
- Shows a clear U-shape pattern, suggesting a pressure trough and recovery.
- May indicate changing weather patterns or local disturbances.

3. Predicted Rain (Binary: 0 or 1):

- Stays flat at 0.0 throughout, indicating no predicted rainfall.

4.2 EXPERIMENTAL RESULT

These data are received from our different observation using the Weather Reporting System Model.

Where:

- Field1: Temperature
- Field2: Humidity
- Field3: Wind Pressure
- Field4: Rain

Table 4.1: Experimental data

Created at	Entry_ID	Field1	Field2	Field3	Field4
2025-04-29T19:51:51+00:00	1	29.2	60.0	40883	0
2025-04-29T19:53:21+00:00	2	29.2	60.0	40884	0
2025-04-29T19:53:39+00:00	3	29.2	60.0	40893	0
2025-04-29T19:59:13+00:00	4	29.2	60.0	40894	0
2025-04-29T20:37:33+00:00	5	28.4	60.0	40992	0
2025-04-29T20:38:06+00:00	6	28.4	60.0	40995	1
2025-04-29T20:38:38+00:00	7	28.4	60.0	40985	1
2025-04-29T20:39:26+00:00	8	28.4	60.0	40992	1
2025-04-29T20:39:45+00:00	9	28.4	60.0	40991	1
2025-04-29T20:40:12+00:00	10	28.4	60.0	40988	1
2025-04-29T20:40:28+00:00	11	28.4	60.0	40994	1
2025-04-29T20:41:02+00:00	12	28.4	60.0	40992	1
2025-04-29T20:41:19+00:00	13	28.4	60.0	40990	1
2025-04-30T04:16:34+00:00	14	28.4	60.0	41076	0
2025-04-30T04:17:10+00:00	15	29.2	60.0	41074	0
2025-04-30T06:42:40+00:00	16	30.3	60.0	40868	0

2025-04-30T06:43:11+00:00	17	30.3	60.0	40859	1
2025-04-30T06:44:22+00:00	18	30.3	60.0	40852	0
2025-04-30T13:19:53+00:00	19	30.3	64.8	40744	0
2025-04-30T13:28:27+00:00	20	31.4	64.8	40653	0
2025-04-30T13:34:53+00:00	21	31.4	75.7	40650	0
2025-04-30T18:38:13+00:00	22	29.2	60.0	40896	0
2025-04-30T18:39:20+00:00	23	30.3	60.0	40880	0
2025-04-30T18:40:26+00:00	24	30.3	60.0	40876	0
2025-04-30T18:40:58+00:00	25	30.3	60.0	40867	0
2025-04-30T18:42:20+00:00	26	30.3	60.0	40874	0
2025-04-30T18:43:13+00:00	27	30.3	60.0	40872	0
2025-04-30T19:05:16+00:00	28	30.3	60.0	40872	0
2025-04-30T19:05:34+00:00	29	30.3	60.0	40870	0
2025-04-30T19:06:06+00:00	30	30.3	60.0	40862	0
2025-04-30T19:07:15+00:00	31	30.3	60.0	40862	0
2025-04-30T19:07:48+00:00	32	30.3	60.0	40861	0
2025-04-30T19:08:47+00:00	33	30.3	60	40868	0
2025-04-30T19:25:24+00:00	34	30.3	60	40850	0
2025-04-30T19:26:02+00:00	35	30.3	60	40837	0
2025-04-30T19:27:04+00:00	36	30.3	60	40849	0
2025-04-30T19:29:07+00:00	37	30.3	60	40828	0
2025-04-30T19:30:10+00:00	38	30.3	60	40848	0
2025-04-30T19:30:57+00:00	39	30.3	60	40840	0
2025-04-30T19:32:15+00:00	40	30.4	60	40843	0
2025-04-30T19:32:32+00:00	41	30.4	60	40848	0
2025-04-30T19:33:04+00:00	42	30.4	60	40860	0
2025-04-30T19:33:22+00:00	43	30.4	60	40864	0
2025-04-30T19:33:54+00:00	44	30.4	60	40865	0
2025-04-30T19:34:56+00:00	45	30.4	60	40858	0
2025-04-30T19:35:58+00:00	46	30.4	60	40859	0
2025-04-30T19:36:15+00:00	47	30.4	60	40858	0

2025-04-30T19:37:04+00:00	48	30.4	60	40851	0
2025-04-30T20:30:21+00:00	49	29.2	60	40934	0
2025-04-30T20:30:53+00:00	50	29.2	60	40938	0
2025-04-30T20:33:51+00:00	51	29.4	60	40942	0
2025-04-30T20:34:55+00:00	52	29.2	60	40934	0
2025-04-30T20:35:28+00:00	53	29.2	60	40936	0
2025-04-30T20:36:00+00:00	54	29.2	60	40937	0
2025-04-30T20:36:47+00:00	55	29.2	60	40920	0
2025-04-30T20:37:19+00:00	56	29.2	60	40925	0
2025-04-30T20:37:50+00:00	57	29.2	60	40924	0
2025-05-03T19:29:45+00:00	58	32.5	60	40520	0
2025-05-03T19:30:01+00:00	59	32.5	60	40518	0
2025-05-03T19:30:54+00:00	60	32.5	60	40520	0
2025-05-03T19:31:10+00:00	61	32.5	60	40520	0
2025-05-09T06:08:44+00:00	62	33.5	75.5	40476	0
2025-05-09T06:19:55+00:00	63	33.5	69.5	40458	0
2025-05-09T06:20:12+00:00	64	33.5	55.4	40457	0
2025-05-09T06:20:44+00:00	65	33.5	55.4	40455	0
2025-05-09T06:21:01+00:00	66	33.5	55.4	40457	0
2025-05-09T06:21:32+00:00	67	33.5	55.4	40454	0
2025-05-09T06:22:10+00:00	68	33.5	55.4	40458	1
2025-05-09T06:22:26+00:00	69	33.5	55.4	40456	0
2025-05-09T06:23:14+00:00	70	33.5	55.4	40449	0
2025-05-09T06:24:14+00:00	71	33.5	58.4	40453	0
2025-05-09T06:29:29+00:00	72	33.5	58.4	40447	0
2025-05-09T06:33:13+00:00	73	33.5	61.6	40442	0
2025-05-09T06:33:30+00:00	74	33.5	50	40444	0
2025-05-09T06:34:24+00:00	75	33.5	51.5	40441	0
2025-05-09T06:35:59+00:00	76	33.5	51.5	40436	0
2025-05-09T06:36:51+00:00	77	33.5	51.5	40438	0
2025-05-09T06:37:07+00:00	78	33.5	51.5	40438	0

2025-05-09T06:37:39+00:00	79	33.5	51.5	40438	0
2025-05-09T06:37:55+00:00	80	33.5	51.5	40438	0
2025-05-09T06:38:17+00:00	81	33.5	53.2	40440	0
2025-05-09T06:39:04+00:00	82	33.5	53.2	40438	0
2025-05-09T06:39:20+00:00	83	33.5	53.2	40437	0
2025-05-09T06:39:42+00:00	84	33.5	53.2	40439	0
2025-05-09T06:39:59+00:00	85	33.5	51.5	40438	0
2025-05-09T06:40:32+00:00	86	33.5	51.5	40440	0
2025-05-09T06:40:50+00:00	87	33.5	51.5	40441	0
2025-05-09T06:41:13+00:00	88	33.5	51.5	40439	0
2025-05-09T06:37:39+00:00	89	33.5	51.5	40438	0
2025-05-09T06:37:55+00:00	90	33.5	51.5	40438	0
2025-05-09T06:38:17+00:00	91	33.5	53.2	40440	0
2025-05-09T06:39:04+00:00	92	33.5	53.2	40438	0
2025-05-09T06:39:20+00:00	93	33.5	53.2	40437	0
2025-05-09T06:39:42+00:00	94	33.5	53.2	40439	0
2025-05-09T06:39:59+00:00	95	33.5	51.5	40438	0
2025-05-09T06:40:32+00:00	96	33.5	51.5	40440	0
2025-05-09T06:40:50+00:00	97	33.5	51.5	40441	0
2025-05-09T06:41:22+00:00	98	33.5	51.5	40439	0
2025-05-09T06:41:29+00:00	99	33.5	51.5	40440	0
2025-05-09T06:42:47+00:00	100	33.5	51.5	40436	0
2025-05-09T06:43:03+00:00	101	33.5	51.5	40430	0
2025-05-09T06:43:35+00:00	102	33.5	51.5	40429	0
2025-05-09T06:44:07+00:00	103	33.5	53.2	40433	0
2025-05-09T06:44:23+00:00	104	33.5	53.2	40430	0
2025-05-09T06:44:55+00:00	105	33.5	53.2	40436	0
2025-05-09T06:45:57+00:00	106	33.5	54.9	40434	0
2025-05-09T06:46:13+00:00	107	33.5	54.9	40436	0
2025-05-09T06:46:45+00:00	108	33.5	56.7	40431	0
2025-05-09T06:47:01+00:00	109	33.5	56.7	40428	0

2025-05-09T06:47:48+00:00	110	33.5	59.3	40434	0
2025-05-09T06:48:05+00:00	111	33.5	59.3	40434	0
2025-05-09T06:48:22+00:00	112	33.5	59.3	40434	0
2025-05-09T06:48:53+00:00	113	33.5	61.5	40433	0
2025-05-09T06:50:26+00:00	114	33.5	61.5	40432	0
2025-05-09T06:50:42+00:00	115	33.5	59.3	40426	0
2025-05-09T06:50:59+00:00	116	33.5	59.3	40424	0
2025-05-09T06:51:15+00:00	117	33.5	59.3	40418	0
2025-05-09T06:51:32+00:00	118	33.5	59.3	40420	0
2025-05-09T06:52:18+00:00	119	33.5	61.5	40423	0
2025-05-09T06:52:35+00:00	120	33.5	61.5	40422	0
2025-05-09T06:53:19+00:00	121	33.5	61.5	40426	0
2025-05-09T06:53:36+00:00	122	33.5	61.5	40424	0
2025-05-09T06:53:53+00:00	123	33.5	61.5	40423	0
2025-05-09T06:54:09+00:00	124	33.5	61.5	40423	0
2025-05-09T06:54:25+00:00	125	33.5	63.8	40423	0
2025-05-09T06:54:42+00:00	126	33.5	63.8	40419	0
2025-05-09T06:54:58+00:00	127	33.5	63.8	40420	0
2025-05-09T06:55:30+00:00	128	33.5	63.8	40421	0
2025-05-09T06:55:47+00:00	129	33.5	66.2	40424	0
2025-05-09T06:56:03+00:00	130	33.5	63.8	40422	0
2025-05-09T06:56:20+00:00	131	33.5	66.2	40420	0
2025-05-09T06:58:08+00:00	132	33.5	68.9	40416	0
2025-05-09T06:58:24+00:00	133	33.5	68.9	40416	0
2025-05-09T06:58:41+00:00	134	33.5	68.9	40417	0
2025-05-09T06:59:13+00:00	135	33.5	66.2	40416	0
2025-05-09T06:59:44+00:00	136	33.5	68.9	40417	0

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

The Weather Reporting System project was developed to monitor and report real-time atmospheric conditions such as temperature, humidity, and pressure. The primary goal was to create a system that could accurately gather weather data using sensors and display it in a user-friendly format. This objective was successfully achieved through the integration of both hardware and software components.

Throughout the development process, we applied key concepts from embedded systems, programming, and data handling. The system collects environmental data, processes it efficiently, and presents it on an interface that is easy to interpret. This project has enhanced our technical understanding and improved our skills in circuit design, coding, and system integration.

One of the major strengths of this system is its adaptability. It can be used in various environments such as schools, farms, and smart cities for continuous weather observation. The modular design also allows for future enhancements like cloud connectivity, mobile alerts, and advanced data analysis through machine learning algorithms.

In conclusion, the Weather Reporting System is a practical and scalable solution for monitoring weather conditions. It demonstrates the importance of real-time data in daily life and opens up new possibilities for environmental monitoring. This project not only fulfilled its technical goals but also contributed significantly to our learning and hands-on experience.

5.2 FUTURE SCOPE

- **Enhanced Sensors** – Add CO₂, dust, and UV sensors for better environmental monitoring.
- **AI-Based Predictions** – Implement machine learning for weather forecasting.
- **Cloud & IoT Integration** – Store data on cloud platforms for remote access.
- **Real-time Visualization** – Use dashboards and charts for better data representation.
- **Automated Alerts** – Send weather notifications via SMS or email.
- **Solar Power** – Implement solar panels for energy efficiency.

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