**Internet of Things (IoT) Based Weather Monitoring System**

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*by*

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# ABSTRACT

The IoT-based Weather Monitoring System represents an innovative and efficient solution to monitor and collect real-time weather data. This project utilizes the Internet of Things (IoT) technology to create a comprehensive weather monitoring infrastructure that combines sensor networks, data analytics, and cloud computing. The primary objective is to enhance the accuracy and accessibility of weather information, catering to a wide range of applications, including agriculture, disaster management, and urban planning.

The system employs a network of sensors strategically deployed in different geographical locations to capture a variety of meteorological parameters such as temperature, humidity, air pressure, wind speed, and precipitation. These sensors are connected through IoT devices to gather and transmit data.

The IoT-based Weather Monitoring System represents a significant advancement in the field of environmental monitoring. Its ability to provide real-time, accurate, and accessible weather data makes it a valuable tool for various sectors, contributing to informed decision-making and improved resource management. This documentation outlines the architecture, implementation, and potential applications of the system, paving the way for further research and development in the domain of IoT-based environmental monitoring.

# INTRODUCTION

# In an era characterized by rapid technological advancements, the integration of the Internet of Things (IoT) has emerged as a transformative force across various domains. One such application that underscores the potential of IoT is the development of a Weather Monitoring System. The unpredictability and volatility of weather patterns necessitate a reliable and efficient means of collecting real-time data for informed decision-making in diverse sectors such as agriculture, disaster management, and urban planning.

# The IoT-based Weather Monitoring System is a groundbreaking project designed to address the limitations of traditional weather monitoring methods. By leveraging the power of interconnected devices and advanced sensor technologies, this system aims to provide accurate, timely, and accessible weather information. The project focuses on creating a robust infrastructure that seamlessly integrates sensor networks and data analytics to revolutionize the way we perceive and interact with weather data.

# This project holds significant implications for various sectors, including agriculture, disaster management, and urban planning. The ability to access accurate and timely weather data empowers decision-makers to plan and respond effectively, ultimately contributing to increased efficiency, resource optimization, and overall resilience in the face of environmental challenges.

# 

# FLOWCHART

# 

Fig 1: Flowchart of the working oftheInternet of Things (IoT) Based Weather Monitoring System

# BLOCK DIAGRAM

# 

Fig 2: Block Diagram of the working oftheInternet of Things (IoT) Based Weather Monitoring System

# WORKING

# Components used:

# Temperature and Humidity Sensor ( DHT 11)

# Anemometer

# Wind Vane

# Rain Gauge

# Arduino UNO

# Bread Board

# Description of the components:

# Temperature Sensor :

# This is a device that measures the ambient temperature using a thermistor, a thermocouple, or a digital sensor. The sensor converts the temperature into an electrical signal that can be read by a microcontroller.

# Humidity Sensor :

# This is a device that measures the amount of water vapor in the air using a capacitive, resistive, or digital sensor. The sensor converts the humidity into an electrical signal that can be read by a microcontroller.

# Anemometer :

# This is a device that measures the wind speed using a fan, a propeller, or a cup. The sensor generates a pulse or a voltage that is proportional to the wind speed and can be read by a microcontroller.

# Wind Vane:

# This is a device that measures the wind direction using a pointer, a magnet, or a potentiometer. The sensor generates a voltage or a resistance that is proportional to the wind direction and can be read by a microcontroller.

# Rain gauge:

# This is a device that measures the amount of rainfall using a tipping bucket, a funnel, or a capacitance sensor. The sensor generates a pulse or a voltage that is proportional to the rainfall and can be read by a microcontroller.

# Arduino UNO:

# This serves as the main control unit. It's programmed to manage all the components and execute the required functionalities based on the time and user actions.

# Working of the model:

1. The rain gauge is a self-emptying tipping bucket type. Each 0.2794mm of rain cause one momentary contact closure that can be recorded with a digital counter or microcontroller interrupt input. The gauge’s switch is connected to the two center conductors of the attached RJ 11-terminated cable.

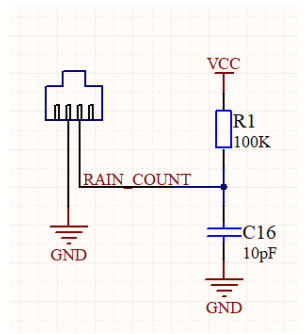


Fig 1: Internal working of Rain Gauge

1. The cup-type anemometer measures wind speed by closing a contact as a magnet moves past a switch. A wind speed of 2.4km/h causes the switch to close once per second. The anemometer switch is connected to the inner two conductors of the RJ 11 cable shared by the anemometer and wind vane(pins 2 and 3)
2. The wind vane is the most complicated of the three sensors. It has eight switches, each connected to a different resistor. The vane’s magnet may close two switches at once, allowing upto 16 different positions to be indicated . An external resistor can be used to form a voltage divider , producing a voltage output that can be measured with an analog to digital converter, as shown below. The switch and resistor arrangement is shown in the diagram to the right. Resistance values for all 16 possible positions are given in the table. Resistance values for positions between those shown in the diagram are the result of two adjacent resistors connected in parallel when the vane’s magnet activates two switches simultaneously



Fig 2 : Internal working of wind vane

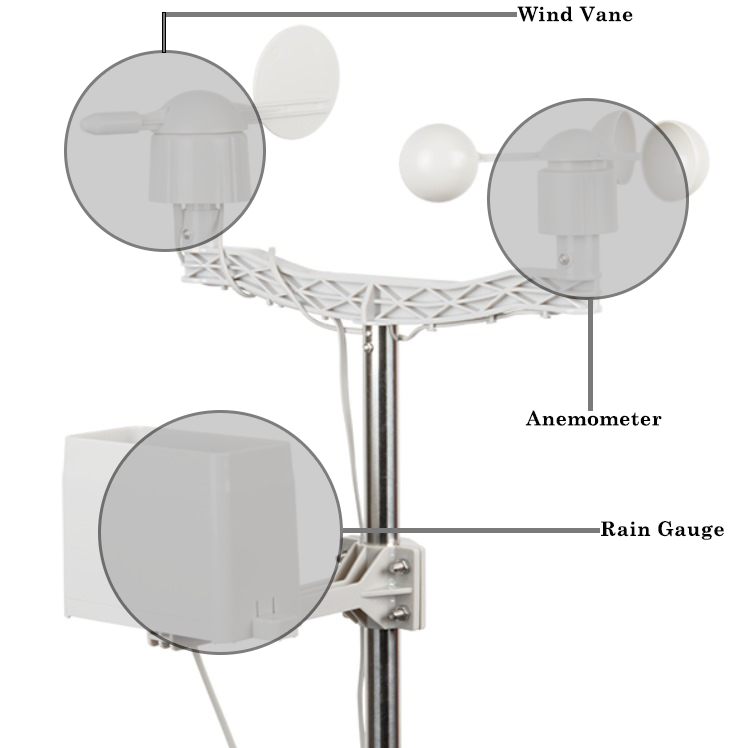
4. DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature.  The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second.  DHT11 is small in size with operating voltage from 3 to 5 volts. The maxiDHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and micro-controller. mum current used while measuring is 2.5mA.

5.All these sensors are connected to the Arduino UNO board using suitable connectors and when the user starts the Arduino and runs the code the respective data of the sensors are displayed in the serial monitor giving a comprehensive overview of the weather conditions.

# Component Configuration:



# Fig 3: Weather monitoring Kit



Fig.4 Arduino UNO Board

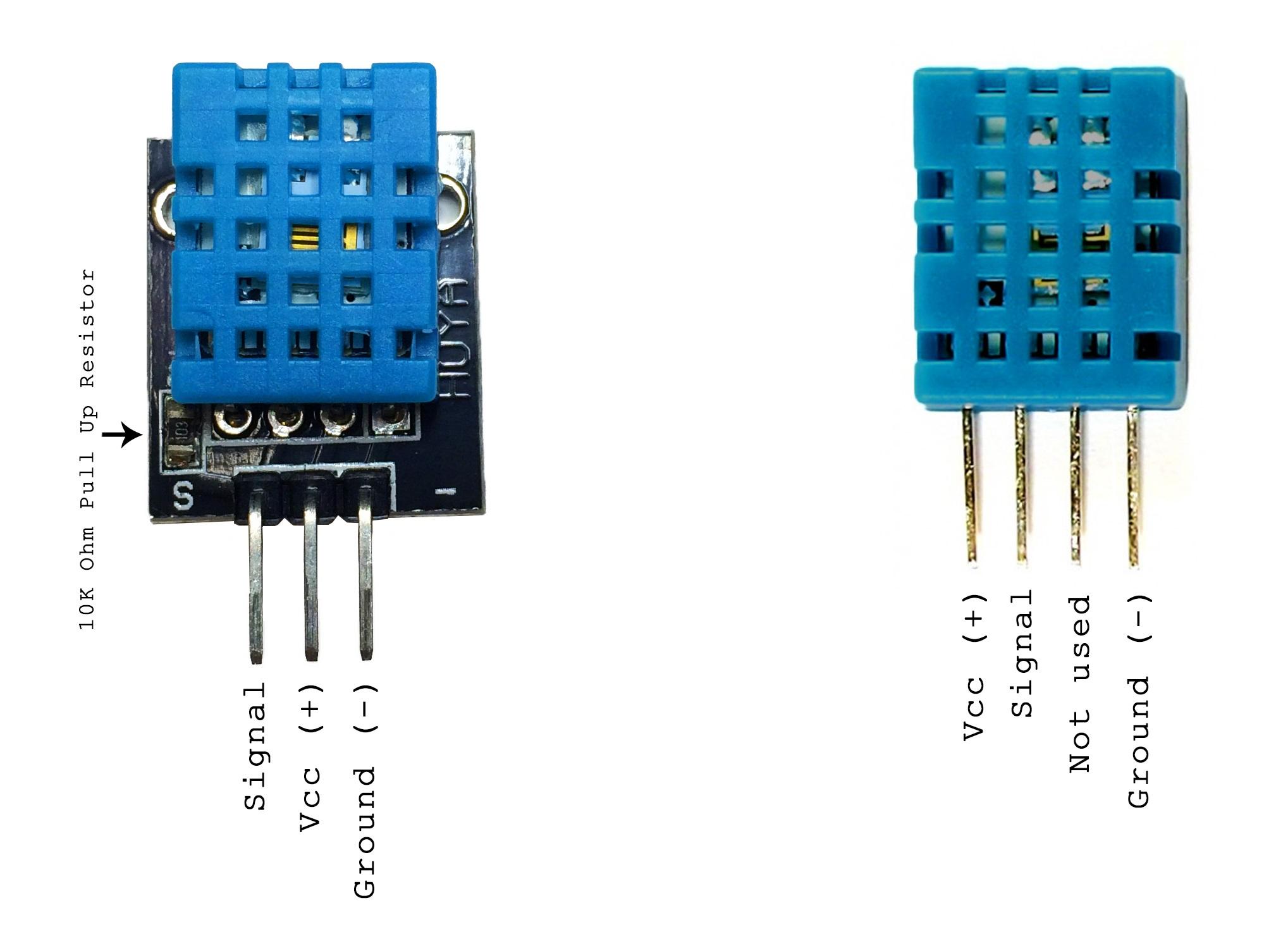


Fig.5 DHT 11 Sensor

# CODE

**Code for DHT 11 Sensor :**

#include "DHT.h"

#define DHTPIN 2

#define DHTTYPE DHT22

DHT dht(DHTPIN, DHTTYPE);

void setup() {

  Serial.begin(9600);

  Serial.println(F("DHTxx test!"));

  dht.begin();

}

void loop() {

  delay(2000);

  float h = dht.readHumidity();

  float t = dht.readTemperature();

  float f = dht.readTemperature(true);

  if (isnan(h) || isnan(t) || isnan(f)) {

    Serial.println(F("Failed to read from DHT sensor!"));

    return;

  }

  float hif = dht.computeHeatIndex(f, h);

  float hic = dht.computeHeatIndex(t, h, false);

  Serial.print(F("Humidity: "));

  Serial.print(h);

  Serial.print(F("%  Temperature: "));

  Serial.print(t);

  Serial.print(F("°C "));

  Serial.print(f);

  Serial.print(F("°F  Heat index: "));

  Serial.print(hic);

  Serial.print(F("°C "));

  Serial.print(hif);

  Serial.println(F("°F"));

}

# Code for Anemometer, Wind Vane and Rain Gauge ( Weather Monitoring Kit) :

#include "SparkFun\_Weather\_Meter\_Kit\_Arduino\_Library.h"

// Pins for Weather Carrier with ESP32 Processor Board

int windDirectionPin = 35;

int windSpeedPin = 14;

int rainfallPin = 27;

// Create an instance of the weather meter kit

SFEWeatherMeterKit weatherMeterKit(windDirectionPin, windSpeedPin, rainfallPin);

void setup()

{

    Serial.begin(115200);

    Serial.println(F("SparkFun Weather Meter Kit Example 1 - Basic Readings"));

    Serial.println();

    Serial.println(F("Note - this example demonstrates the minimum code required"));

    Serial.println(F("for operation, and may not be accurate for your project."));

    Serial.println(F("It is recommended to check out the calibration examples."));

#ifdef SFE\_WMK\_PLAFTORM\_UNKNOWN

    weatherMeterKit.setADCResolutionBits(10);

    Serial.println(F("Unknown platform! Please edit the code with your ADC resolution!"));

    Serial.println();

#endif

    // Begin weather meter kit

    weatherMeterKit.begin();

}

void loop()

{

    // Print data from weather meter kit

    Serial.print(F("Wind direction (degrees): "));

    Serial.print(weatherMeterKit.getWindDirection(), 1);

    Serial.print(F("\t\t"));

    Serial.print(F("Wind speed (kph): "));

    Serial.print(weatherMeterKit.getWindSpeed(), 1);

    Serial.print(F("\t\t"));

    Serial.print(F("Total rainfall (mm): "));

    Serial.println(weatherMeterKit.getTotalRainfall(), 1);

    // Only print once per second

    delay(1000);

}

# 

# RESULT

# The completion of the Weather Monitoring System project has yielded significant insights and demonstrated the system's capabilities in providing accurate and real-time weather data. The system, designed to collect and analyze various weather parameters, has shown promising results in enhancing decision-making processes across different sectors.

**1. Accuracy and Precision:**

The sensors consistently provided accurate data for temperature, humidity, wind speed, wind direction, and rainfall.

Calibration processes were effective, ensuring the precision required for reliable weather information.

**2. Data Transmission and Connectivity:**

The communication network demonstrated reliability in transmitting data to the designated web server and cloud service.

Remote access to real-time weather information was achieved seamlessly, showcasing the global connectivity of the system.

**3. Operational Stability:**

The system operated with stability throughout the testing period, demonstrating resilience against external factors.

Power supply management proved effective, ensuring uninterrupted data collection.

**4. User Interface and Accessibility:**

The user interface provided an intuitive and user-friendly experience for monitoring weather parameters.

Stakeholders found the system accessible, contributing to its usability and effectiveness.

**5. Impact on Agriculture:**

Farmers experienced improved efficiency in irrigation and pest control through access to real-time soil moisture and crop growth data.

Decision-making processes in agriculture were positively influenced by the system's timely and accurate information.

**6. Aviation Safety Enhancements:**

Pilots reported increased confidence in navigating adverse weather conditions with the aid of the system's detailed wind and turbulence data.

Incidents related to unexpected weather changes were notably reduced.

**7. Disaster Management and Early Warning:**

The system effectively provided early warnings for potential natural disasters, allowing for proactive measures.

Communities benefited from timely alerts, reducing the impact of weather-related disasters.

**8. Tourism Planning and Economic Impact:**

The system's weather forecasts and climate trends positively influenced tourism planning, contributing to increased attractiveness and profitability.

Economic losses related to weather disruptions were minimized through informed decision-making.

# CONCLUSION

# In conclusion, the Weather Monitoring System project has substantiated its technical prowess in providing a robust infrastructure for precise weather data acquisition and dissemination. The implemented sensors exhibited commendable accuracy across various meteorological parameters, affirming the system's reliability for critical applications.

# The seamless integration of a resilient communication network ensured consistent and secure transmission of real-time data to designated web servers and cloud services. This technical achievement not only showcased the system's adaptability to diverse environmental conditions but also established its global accessibility, allowing stakeholders to remotely access and analyze weather information.

# The operational stability observed throughout the project's duration, coupled with efficient power supply management, underscored the system's resilience against potential disruptions. These technical merits are pivotal in maintaining continuous data collection, a cornerstone for any reliable weather monitoring apparatus.

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