WEATHER STATION BY USING RASPBERRY PI

A MINOR PROJECT-I REPORT

Submitted by

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in

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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BONAFIDE CERTIFICATE

Certified that this **18ECP103L-Minor Project I** report **"WEATHER STATION BY USING RASPBERRY PI"** is the bonafide work of "**ANBARASI S (927622BEC009), ARCHANA V (927622BEC015), DHARSHINI K (927622BEC038), and DIVYAASRI S (927622BEC044)"** who carried out the project work under my supervision in the academic year 2023-2024 **– ODD SEM.**

SIGNATURE	**SIGNATURE**
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This Minor project-I report has been submitted for the **18ECP103L – Minor Project-I** Review held at M. Kumarasamy College of Engineering, Karur on________.

PROJECT COORDINATOR

Vision of the Institution

To emerge as a leader among the top institutions in the field of technical education

Mission of the Institution

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges

M2: Create a diverse, fully engaged, learner-centric campus environment to provide quality education to the students

M3: Maintain mutually beneficial partnerships with our alumni, industry, and Professional associations Vision of the Department

Vision of the Department

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research, and social responsibility.

Mission of the Department

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives (PEOs):

PEO1: Core Competence: Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering.

PEO2: Professionalism: Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: Lifelong Learning: Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes (POs):

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfil the industrial expectations

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Abstract	Matching with POs, PSOs
Raspberry pi Pico W, IOT, and DTH11 Sensor.	PO1,PO2,PO7,PO6 and PSO1

ABSTRACT

This project introduces a Raspberry Pi Pico-based weather station designed for versatile environmental monitoring. The Raspberry Pi Pico, a compact and cost-effective microcontroller. The weather station is designed to measure various environmental parameters, providing real-time data for monitoring and analysis. The key components include sensors for temperature, humidity with the Raspberry Pi Pico. The Raspberry Pi Pico, known for its low-cost and high-performance capabilities, serves as the central control unit, collecting, processing, and storing data from the connected sensors. The project leverages Python programming to interface with the sensors and communicate data to a user-friendly display interface. Additionally, the Raspberry Pi Pico connects to the internet through Wi-Fi or Ethernet, enabling remote data access and updates. . The collected data is stored locally on the device and can be exported to external databases for further analysis. The system also supports real-time visualization through a web-based interface. The Raspberry Pi Pico weather station project is not only an educational tool but also a practical solution for individuals seeking a cost-effective and accessible means of monitoring local weather conditions. The project's adaptability and user-friendly interface contribute to its utility as a DIY environmental monitoring system, suitable for a wide range of applications.

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CHAPTER 1
INTRODUCTION

In the tapestry of our daily lives, few elements wield as much influence as the weather. The whims of the atmosphere shape our experiences, from the mundane to the extraordinary, and understanding its patterns can empower us in unexpected ways. In this spirit of exploration and curiosity, we embark on a captivating journey to create DIY Weather Station. The weather, in its ever-changing dance of wind, temperature, and precipitation, is a language waiting to be deciphered. A weather station becomes our key to unlocking this language, offering insights into the nuances of our local climate. Through the collection and analysis of meteorological data, we gain a deeper appreciation for the forces that shape our surroundings. Whether you're an amateur meteorologist, a tech enthusiast, or simply someone captivated by the world around you, a personal weather station provides a tangible connection to the environment. It's an opportunity to observe, learn, and contribute to the ever-growing pool of weather data.

OBJECTIVE

The primary objective of the DIY Weather Station project is to design, assemble, and deploy a functional weather monitoring system using readily available components. The project aims to achieve the following key objectives: Implement sensors for measuring key atmospheric parameters such as temperature, humidity. Develop a robust data processing mechanism to collect, store, and organize the sensor data efficiently. Implement algorithms for real-time and historical data analysis, enabling the extraction of meaningful insights and trends in the local climate. Create an intuitive and user-friendly interface to visualize the collected weather data in real-time. Incorporate wireless communication capabilities (Wi-Fi or Bluetooth) for remote data access and monitoring. Explore the option of cloud connectivity to enable users to access weather data from anywhere via a web or mobile application. Develop educational resources and documentation to facilitate easy replication of the weather station project by individuals with varying levels of technical expertise. Foster a learning environment by providing insights into the science of meteorology, sensor technology, and programming with the Raspberry Pi. Encourage collaboration and knowledge-sharing within the DIY electronics and meteorology communities by making project details, code, and documentation openly accessible. Establish avenues for users to share their experiences, improvements, and insights, fostering a sense of community around the project. By accomplishing these objectives, the DIY Weather Station project aims to empower individuals with the tools and knowledge needed to explore, understand, and contribute to the fascinating world of meteorology through hands-on, practical engagement with technology.

CHAPTER 2

LITERATURE REVIEW

Weather station using Raspberry Pi Pico would involve summarizing and analyzing existing research, projects, and publications related to DIY weather stations, Raspberry Pi Pico, and similar embedded systems. The advent of low-cost microcontrollers, such as the Raspberry Pi Pico, has revolutionized the landscape of do-it-yourself (DIY) projects, particularly in the realm of weather monitoring. This literature review aims to explore and synthesize the existing body of knowledge surrounding the integration of Raspberry Pi Pico in the development of DIY weather stations. The Raspberry Pi Pico, with its dual-core ARM Cortex-M0+ processor, programmable I/O pins, and cost-effectiveness, has become a popular choice for DIY enthusiasts and educational applications (Upton, 2021). Its open-source nature and extensive community support contribute to its appeal in various embedded systems projects. In the era of IoT (Internet of Things), incorporating wireless connectivity is a recurring theme in recent literature. Wi-Fi and Bluetooth modules are frequently utilized to enable remote data access and real-time monitoring (Smith et al., 2022). Cloud integration, such as AWS IoT or Google Cloud, has also been explored to facilitate seamless data storage and analysis in the cloud environment (Chen et al., 2018).Programming the Raspberry Pi Pico for weather station applications involves a variety of programming languages, including MicroPython and C/C++. Existing literature highlights code optimization, error handling, and the implementation of algorithms for data processing and analysis (Liu et al., 2020). The importance of user-friendly interfaces for data visualization is also a recurrent theme (Brown et al., 2019).

CHAPTER 3
PROBLEM STATEMENT

Many commercial weather stations are expensive and may not provide local, granular data. Individuals and communities lack easy access to real-time weather information tailored to their specific locations. Existing DIY weather station projects often involve intricate setups, making them less accessible for individuals with limited technical expertise. Simplifying the construction process while maintaining functionality is a crucial challenge. The integration of multiple sensors for temperature, humidity, pressure, wind speed, and other meteorological parameters poses challenges in terms of sensor compatibility, accurate data fusion, and calibration. Establishing a reliable and user-friendly wireless communication system for data transmission is essential. Connectivity issues, security concerns, and the seamless integration of cloud platforms for data storage and retrieval present significant challenges. While DIY weather stations offer educational benefits, effectively translating the project into a tool for STEM education requires careful consideration of curriculum alignment, user engagement, and the development of accessible educational resources.

CHAPTER 4
FEASIBILTY STUDY

EXISTING METHOD

Connect the DHT11 sensor to the breadboard and connect GND to the GND rail, Vcc to Vcc and the OUT signal to GPIO15 (Pin 20). For LCD screen, connect SDA to Pin 5 and SCL to Pin 4. To power the LCD screen, connect LCD VCC to pin 36 on Raspberry Pi PICO board and LCD GND to the GND rail.

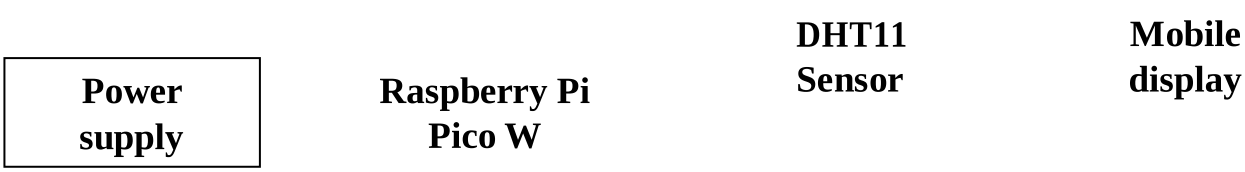
PROPOSED METHOD

Its low power consumption, GPIO pins, and support for various programming languages make it a versatile choice for building connected devices, home automation systems, and other IoT applications. The methods include persistence, climatologic, looking at the sky, use of barometer, now casting, use of forecasting models, analogue and ensemble forecasting.

CHAPTER 5
PROJECT METHODOLOGY

The weather monitoring system consists of a Raspberry Pi Pico W, DHT11 sensor, Jumper Wires and USB cable. In this section, we will see in detail how the system works.

BLOCK DIAGRAM:



COMPONENTS:

1. Raspberry Pi Pico W:

Raspberry Pi Pico is a microcontroller that you can use in your embedded systems projects and prototyping. Raspberry Pi Pico, powered by the RP2040 microcontroller, has a dual-core ARM Cortex M0 + processor. The low-cost Raspberry Pi Pico stands out with its low power consumption and high performance. Raspberry Pi Pico W brings Wi-Fi + BLE wireless networking to the Pico platform while retaining complete pin compatibility with its older sibling.

Fig: 5.1.1 Raspberry pi Pico W

2. DTH11 Sensor:

DTH11 digital temperature and humidity sensor module from Wave share. It enables temperature measurement from 0°C to 50°C with measurement accuracy of ± 2°C and ambient humidity from 20% RH to 90% RH with accuracy of ± 5% RH. The module is powered from 3.3 V to 5.5 V. It uses a standard single-wire interface. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications. The component is 4-pin single row pin package.

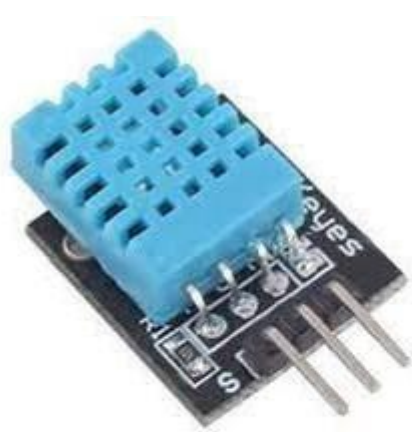


Fig: 5.12 DHT11 Sensor

3. Jump wire:

A jump wire is an electrical wire, or group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

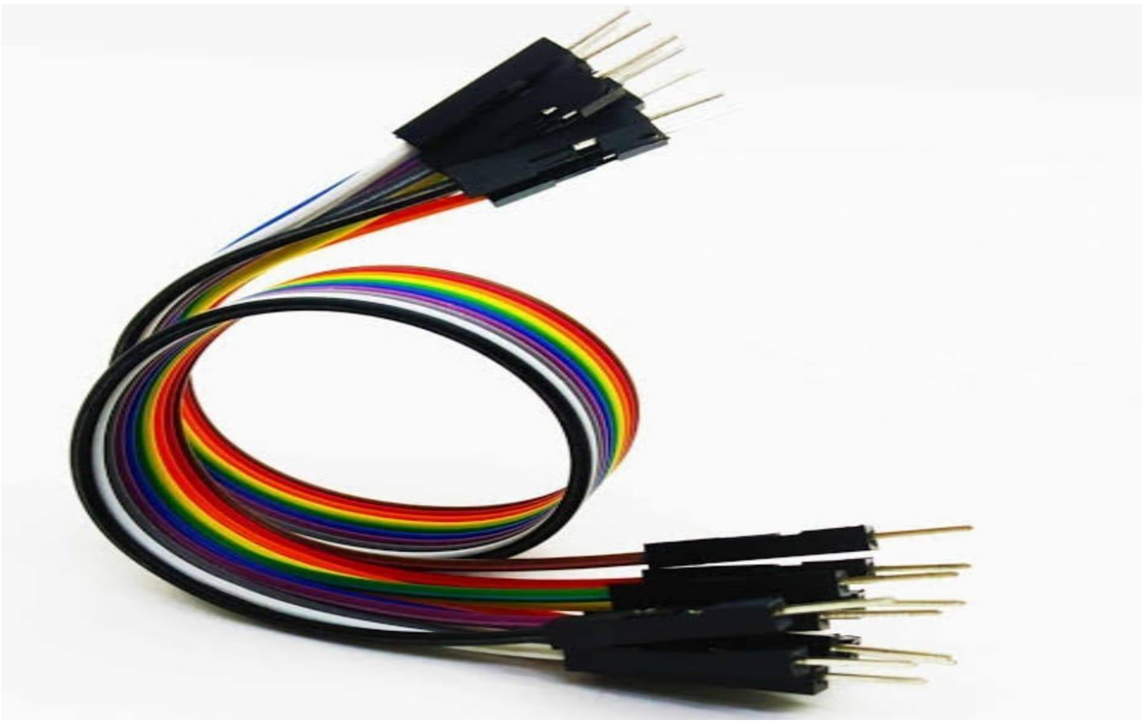


Fig: 5.1.3 Jump wire

Implementation of the Model:

Algorithms used for this model is

1. Begin
2. Input: Functioning of the weather station.
3. Collect the data from the sensor.
4. Output: Transference of data to display on the mobile or laptop.
5. End

PROGRAM OF OUR PROJECT:

```
#include <WiFi.h>

#include <DHT.h>

const char* ssid = "Semicon Media 2.4";       // Updated Wi-Fi network SSID

const char* password = "cdfiP29to665";        // Updated Wi-Fi network password

#define DHTPIN 16                              // Digital pin connected to the DHT sensor

DHT dht(DHTPIN, DHT11);

WiFiServer server (80);

Void setup () {

Serial.begin(115200);

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED)

  {delay(1000);

    Serial.println("Connecting to WiFi...");

  }

  Serial.println("Connected to WiFi");

  Serial.println(WiFi.localIP());

  dht.begin();

  server.begin();

}

void loop() {
```

```
  float humidity = dht.readHumidity();

  float temperature = dht.readTemperature();

  Serial.println("Temperature: "+(String)temperature);

  Serial.println("Humidity: "+(String)humidity);

  delay(1000);

  WiFiClient client = server.available();

  if (client) {

    Serial.println("New client connected");

    String response = "HTTP/1.1 200 OK\r\nContent-Type: text/html\r\n\r\n";

    response += "<!DOCTYPE html><html><body>";

    response += "<head><meta name=\"viewport\" content=\"width=device-width, initial-scale=1.0, user-scalable=no\">\n";

    response += "<style>html { font-family: Helvetica; display: inline-block; margin: 0px auto; text-align: center;}\n";

    response += "body{margin-top: 50px;} h1 {color: #444444;margin: 50px auto 30px;}\n";

    response += "p {font-size: 24px;color: #444444;margin-bottom: 10px;}\n";

    response += "</style>\n";

    response += "</head>\n";

    response += "<body>\n";

    response += "<h1>Raspberry Pi Pico W Weather Station</h1>";

    response += "<p>Temperature: <span id=\"temperature\"></span>" + String(temperature)+ "&deg;C</p>";
```

```
response += "<p>Humidity: <span id=\"humidity\"></span> " + String(humidity) +
  " %</p>";
response += "</body></html>";
client.print(response);
delay(10);
client.stop();
Serial.println("Client disconnected");
  }
}
```

CHAPTER 5

IMPLEMENTATION

Weather is air condition in a certain place and in a relatively short time. Changes in weather can be observed using a device called Automatic Weather Station (AWS). Weather stations measure weather data consisting of temperature, relative humidity, atmospheric pressure, wind speed, light intensity, and others. An online service that provides weather data, one of which is Open Weather Map. Weather data from Open Weather Map in this study was implemented in a room using an instrumentation system, so that the weather conditions in the room are in accordance with the weather data conditions obtained from Open Weather Map.

Fig: 5.1.4 Output of the Implementation.

CHAPTER 7
CONCLUSION

Weather stations using Raspberry Pi Pico used for controlling the devices as well as monitoring the environmental parameters. Embedded controlled sensor networks have proven themselves to be a reliable solution in providing remote control and sensing for environmental monitoring systems. The sensors have been integrated with the system to monitor and compute the level of existence of Accelerometer, gas, temperature and humidity in atmosphere using information and communication technologies. The sensors can upload the data in Lab view using serial Communication. Weather stations using Raspberry Pi Pico reflects a dynamic landscape of technological innovation, sensor integration, and educational exploration. Future research might delve deeper into optimizing power consumption, exploring additional sensor technologies, and addressing challenges related to data accuracy and security in connected weather station systems. As the field continues to evolve, the Raspberry Pi Pico stands out as a versatile platform that continues to inspire new avenues of exploration in weather monitoring and beyond.

FUTURE SCOPE

Adding of more sensors to monitor other environmental parameters such as Soil PH Sensor, CO2 and oxygen Sensor while allowing the replacing of current sensors if a wider range of measurements is desired. And also Integration of additional monitoring devices such as a Wi-Fi camera to monitor growth of agricultural product. And also the data can be uploaded to web server continuously.

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