School of Electrical Engineering

Department of Electrical and Computer Science Engineering

Project Title

weather station

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BECS302L- DIGITAL INSTRUMENTATION

Submitted to

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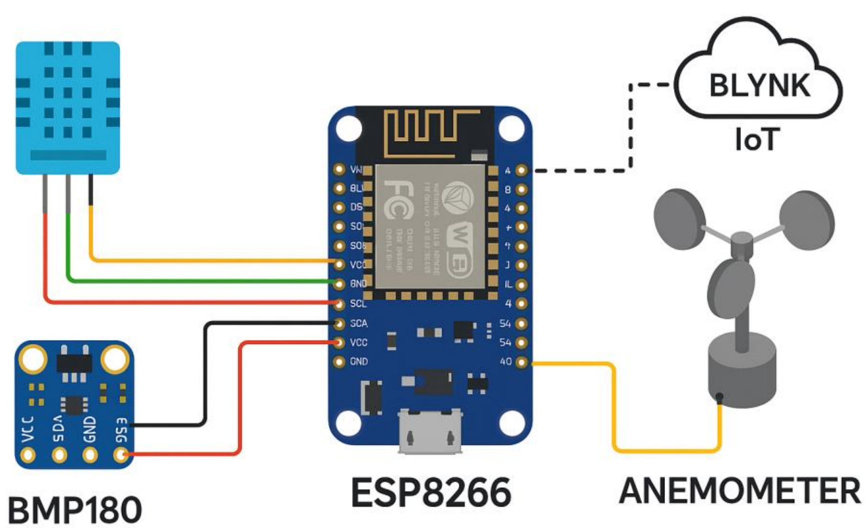
ABSTRACT

This project involves the development of an IoT-based weather station using the ESP8266 microcontroller, aimed at real-time environmental monitoring. The system utilizes a DHT11 sensor to measure ambient temperature and humidity, and a BMP180 sensor to capture atmospheric pressure and altitude. A custom-built anemometer, employing a DC generator, is connected directly to the ESP8266's analogue input to calculate wind speed from voltage output, eliminating the need for additional microcontrollers.

The ESP8266 connects to a Wi-Fi network and transmits all sensor data to the Blynk IoT platform, enabling remote visualization through a mobile application. Sensor readings are updated at one-second intervals, ensuring near real-time data monitoring. The project emphasizes simplicity, low cost, and efficiency by utilizing the built-in capabilities of the ESP8266 and minimizing external components.

This weather station demonstrates the practical application of IoT in environmental sensing and data communication. It serves as a scalable solution for educational projects, prototype development, or personal weather monitoring, providing valuable insights into local atmospheric conditions through an intuitive interface.

BLOCK DIAGRAM



CHAPTER 1

INTRODUCTION

This project focuses on the development of an IoT-based weather monitoring station using the ESP8266 microcontroller. The primary goal is to create a compact and cost-effective system capable of measuring key environmental parameters such as temperature, humidity, pressure, altitude, and wind speed, and transmitting them to the cloud for real-time access. The integration of Internet of Things (IoT) technology enhances data accessibility and enables remote monitoring through the Blynk mobile platform.

The system utilizes a DHT11 sensor for temperature and humidity measurements, a BMP180 sensor for pressure and altitude data, and a custom-made anemometer using a DC generator to calculate wind speed. The ESP8266, with its built-in Wi-Fi capability, reads sensor data and sends it to the Blynk cloud, updating every second. The project aims to demonstrate a scalable and user-friendly solution for localized weather tracking.

Objectives

- **Design and construct an IoT-based weather station using ESP8266.**
- **Interface sensors for temperature, humidity, pressure, altitude, and wind speed.**
- **Implement real-time data transmission to the Blynk IoT platform.**
- **Evaluate the performance and accuracy of sensor readings under real conditions.**

Significance

The development of this weather station highlights the application of IoT in environmental monitoring. By using low-power and widely available components, it offers a sustainable and economical solution for weather tracking. This system is suitable

for educational use, hobbyist projects, and even preliminary environmental research, where real-time monitoring is essential.

Project Scope

This project encompasses the hardware setup, firmware programming, and integration with the Blynk IoT platform. Emphasis is placed on effective sensor interfacing, wireless communication, and real-time data updates. The system will be tested for reliability and responsiveness, ensuring that it accurately monitors and transmits weather parameters including wind speed, a unique addition using a DC generator-based anemometer.

CHAPTER 2

LITRATURE REVIEW:

Recent advancements on the Internet of Things (IoT) have enabled the development of smart, real-time environmental monitoring systems that are cost-effective, scalable, and user-friendly. IoT-based weather stations combine microcontrollers, wireless connectivity, and a range of sensors to monitor environmental parameters such as temperature, humidity, pressure, and wind speed.

Kumar and Singh (2018) designed a basic weather station using an Arduino Uno and DHT11/BMP180 sensors to record temperature, humidity, and pressure. Their work demonstrated the simplicity and affordability of DIY weather stations but did not include remote access features or wind speed measurement. Prakash and Gupta (2019) extended this by incorporating the ESP8266 microcontroller and Thing Speak for cloud integration, making real-time monitoring via the internet possible.

Wind speed is typically measured using mechanical anemometers; however, alternative methods have been explored for simplicity and affordability. Karthik and Rao (2020) presented a model using a DC generator to estimate wind speed based on output voltage, offering a low-cost solution for wind monitoring in rural or academic settings.

This project builds upon these foundations by combining multiple atmospheric sensors with a DC generator-based anemometer, all connected via the ESP8266 to Blynk for real-time monitoring. It offers a compact, scalable, and efficient solution for localized weather observation.

CHAPTER .3

METHODOLOGY

The methodology outlines the structured approach used to design, develop, and test the IoT-based weather monitoring system. This system utilizes the ESP8266 microcontroller to read environmental parameters such as temperature, humidity, pressure, altitude, and wind speed, and then transmit the data to the Blynk cloud platform for real-time visualization.

Hardware Integration

The core of the project is the NodeMCU ESP8266 module, which handles data collection and Wi-Fi connectivity. A DHT11 sensor is used for measuring ambient temperature and humidity. Atmospheric pressure and altitude are acquired using the BMP180 sensor. For wind speed detection, a DIY anemometer using a DC generator is employed. The analogue voltage generated by the spinning generator is read directly through the ESP8266's analogue pin and converted into wind speed using a calibration factor.

Software Development

The firmware is written in Arduino IDE using the Blynk, Adafruit, and DHT libraries. The ESP8266 reads sensor data at regular intervals using BlynkTimer and sends it to virtual pins on the Blynk app. A custom calibration formula converts the analogue input from the anemometer into an approximate wind speed value.

Testing and Calibration

The system was tested under various weather conditions to verify sensor accuracy and response. The wind speed calibration was refined by comparing readings against a commercial anemometer, and the system was evaluated for stability and connectivity over an extended period.

CHAPTER-4

RESULT AND DISCUSSION

Experimental Analysis

To validate the functionality and performance of the weather monitoring system, a series of tests were conducted under controlled and real-world outdoor conditions. The sensors were powered through the ESP8266, and data was collected at regular intervals and transmitted to the Blynk platform for visualization. Each sensor's output was observed via the Serial Monitor as well as on the mobile application interface.

Temperature and Humidity:

The DHT11 sensor consistently measured ambient temperature and humidity. It was observed that the sensor responded quickly to environmental changes, although with limited precision (±2°C for temperature and ±5% RH for humidity), which is acceptable for basic applications.

Pressure and Altitude:

The BMP180 sensor provided atmospheric pressure in hPa and computed altitude based on standard sea-level pressure values. Variations in pressure were directly linked to changes in weather patterns, and altitude readings were stable over time, showing the reliability of the sensor.

Wind Speed:

The anemometer, a DC motor-based setup, generated variable voltages depending on wind intensity. These voltages were read via the ESP8266's analog pin and converted into wind speed (m/s) using a calibration factor. The speed varied appropriately with wind conditions, confirming that the generator-anemometer concept is viable for basic environmental analysis.

Output Waveform

The analogue voltage from the anemometer varied proportionally with wind speed and showed a fluctuating waveform pattern when observed via the Serial Plotter. The waveform displayed consistent amplitude variations during windy conditions, indicating real-time responsiveness of the anemometer system.

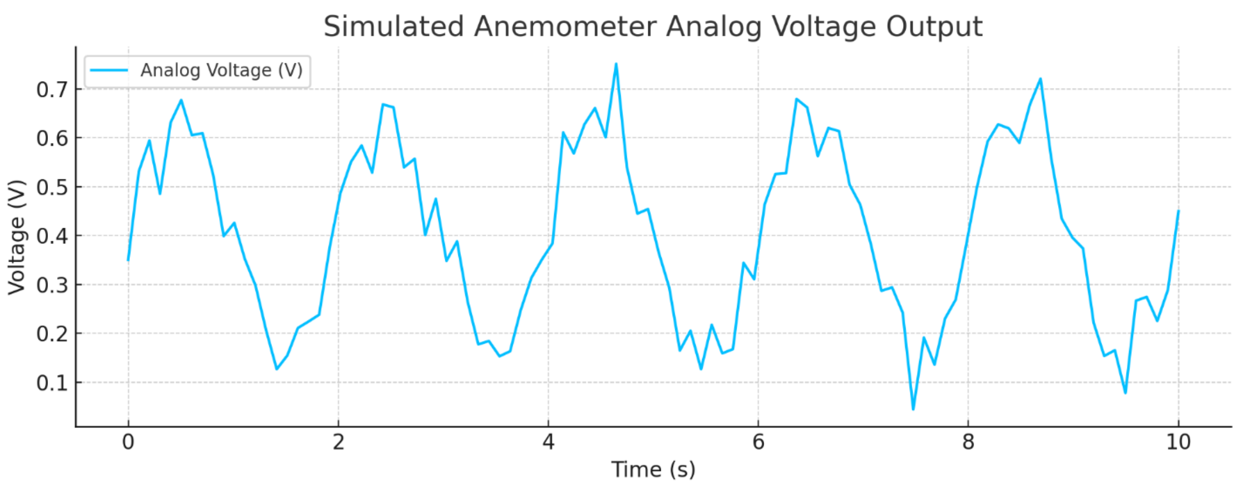
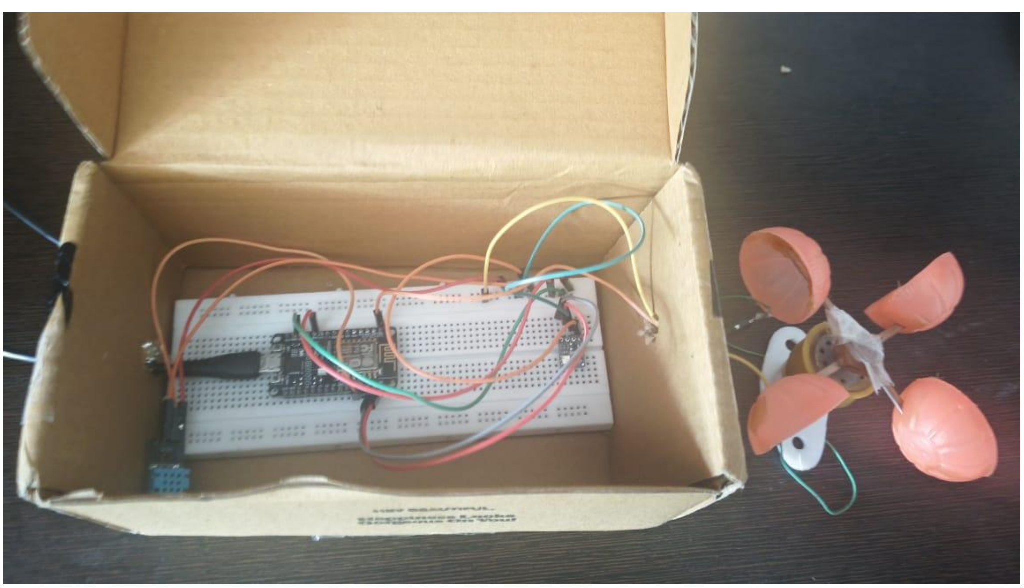


Photo of the Project



Conclusion

This project successfully demonstrates the development and deployment of a compact, Wi-Fi-enabled weather station using the ESP8266 microcontroller. By integrating key environmental sensors—DHT11 for temperature and humidity, BMP180 for pressure and altitude, and a custom-built anemometer for wind speed—the system provides real-time atmospheric monitoring. The decision to exclude the ML8511 UV sensor due to hardware limitations was addressed effectively by optimizing the use of the ESP8266's single analogue pin.

The integration with Blynk IoT allows seamless remote monitoring, with sensor data transmitted every second to a user-friendly interface, making the solution both practical and scalable. The use of only the ESP8266 without an additional Arduino not only reduced hardware complexity but also emphasized the potential for low-cost, standalone IoT devices.

By emphasizing accessibility, cost-efficiency, and real-time connectivity, this project aligns with modern trends in IoT and environmental sensing, offering a solid foundation for further innovation.

Future Work

Future enhancements could focus on:

- Expanding sensor support via external ADC modules
- Adding data logging capabilities with an SD card or cloud database
- Improving power management for off-grid applications
- Exploring machine learning for pattern recognition and forecasting

In summary, this project not only achieves its goal of creating an efficient, connected weather station, but also opens the door to more advanced smart environmental systems.

REFERENCE:

[1] Karthik, V., & Rao, M. S. (2020). *Low-cost wind speed measurement using DC motor in weather stations*. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 9(6), 5781–5785.

[2] Kumar, R., & Singh, A. (2018). *Design and implementation of Arduino based weather monitoring system*. International Journal of Computer Applications, 180(42), 25–29.

[3] Prakash, A., & Gupta, R. (2019). *IoT-based real-time weather monitoring system using ESP8266 and ThingSpeak*. International Journal of Engineering Research and Technology, 8(12), 144–148.