Real Time Weather Monitoring System using IoT

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Abstract. The proposed project aims to use IoT technology to build a weather monitoring and reporting system which has the potential to improve the accuracy and reliability of weather data. Weather monitoring systems can collect real-time data on various weather conditions, such as temperature and humidity, using sensors and other IoT devices. This data can then be analysed and used to generate accurate and timely weather reports, which individuals and organizations can use for various purposes, such as agriculture, aviation, and disaster management. The aim of real-time weather monitoring using IoT is to collect, analyse, and disseminate accurate and timely information about the current weather conditions to individuals and organizations through web and mobile dashboards for decision-making purposes.

1 Introduction

IoT is defined as the Internet of Things (IoT). It's entrenched with tool, electronics, and sensors to the web. It controls and exchanges information without interaction of people. Internet of things additionally defines the transfer of information, controlling and having permission to the accessories and intention with the aid of sensors by utilizing the web. The web of things, or IoT, is a network of interconnected computing devices, mechanical and digital machinery, items, animals, or individuals who can swap information across a network without needing human-to-human or human-to-computer interaction. Weather monitoring and reporting systems are essential tools for individuals and organizations to understand and respond to various weather conditions. These systems use sensors and other instruments to collect data on various weather parameters, such as temperature, humidity, air pressure, and precipitation. This data is then analysed and used to generate weather reports, which can be used for a wide range of purposes, such as agriculture, aviation, and disaster management.

Traditionally, weather monitoring and reporting systems have relied on stationary sensors and instruments, such as weather stations and meteorological balloons, to collect weather data. These systems have been effective in providing accurate and timely weather reports, but they have several limitations. For example, the coverage of these systems is often limited to specific geographic locations, and the data collected is often not available in real-time. The recent developments in IoT technology have the potential to overcome these

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limitations and improve the accuracy and reliability of weather monitoring and reporting systems. By using There are several examples of weather monitoring and reporting systems using IoT technology, including: The Smart Citizen Kit (SCK), developed by the Barcelona-based company Open Dot, is a low-cost weather monitoring system that uses IoT technology to collect data on temperature, humidity, air pressure, and other weather parameters. The system consists of a sensor module that can be mounted on a wall or other surface, and a mobile app that allows users to access the data collected by the sensor. The SCK has been used in various projects, including citizen science initiatives and environmental monitoring projects. The Netatmo Weather Station is a consumer-grade weather monitoring system that uses IoT technology to collect data on temperature, humidity, air pressure, and other weather parameters.

2 Existing Methods

Rajinder Kumar M. Math and Dharwadkar proposes an IoT-based real-time local weather station for Precision Agriculture in India [1]. The authors aim to provide farmers with a means of automating their agricultural practices such as irrigation, fertilization, and harvesting, at the right time using this system. The paper describes a low-cost weather station that monitors weather parameters like temperature, humidity, air pressure, rainfall, and soil moisture using an IoT platform. The authors also propose an artificial neural network-based smart weather prediction system that can predict weather conditions in advance to aid farmers in decision making. The study is significant in that it addresses the challenges faced by farmers in India due to unpredictable weather conditions and the high cost of conventional weather monitoring systems.

Levin Varghese, Gerard Deepak and Santhanavijayan proposes an IoT-based climate forecast system that uses a Raspberry Pi 3 Model B, some sensors, and a weather forecast algorithm to predict weather [2]. The system monitors temperature and air pressure to forecast the weather. The paper describes the system's design, implementation, and testing, and presents the results of the system's accuracy in weather forecasting.

A weather monitoring system that utilizes an IoT approach to provide real-time monitoring of temperature and humidity is presented in [3]. The system was implemented using an Arduino UNO microcontroller and a DHT11 sensor to measure temperature and humidity. The study aimed to create an efficient, low-cost system with different models to monitor the environment in real-time and provide alerts. The data collected by the system was statistically analyzed, and the results showed no significant difference between the study groups.

The paper [4] presented a system for monitoring various environmental parameters such as temperature, humidity, air quality index, CO concentrations, rain, and light using custom-designed, energy-efficient sensors. The system utilizes an ESP8266 Wi-Fi module to transmit data to ThingSpeak, which analyzes and presents the collected data in graphical and tabular forms. The system includes a mobile application and web application for data monitoring, storage, and visualization. The implementation of the E-Sense system is cost-efficient, compact, user-friendly, and can work without human intervention.

The paper [5] presented a solution for monitoring weather conditions in real-time using IoT technology and implemented a system that uses multiple sensors to collect weather data, which is then transmitted to a central hub for processing and analysis. The system is based on the Message Queuing Telemetry Transport (MQTT) technology, which enables easy communication between heterogeneous Relational Database Management Systems (RDBMS). The paper also describes the hardware and software components used in the system, as well as the communication protocols and data transmission methods. Overall, the

paper provides a detailed account of an IoT-based weather monitoring system that can be used in various applications such as agriculture, transportation, and disaster management.

3 Proposed Method

3.1 Problem Statement

The problem that the real time weather monitoring system using IoT aims to solve is the lack of accurate and timely weather information. Traditional weather monitoring systems rely on a network of stationary weather stations, which may not provide sufficient coverage and may not be able to provide real-time information. This can lead to inadequate preparation for weather events and potential safety hazards. The IoT-based weather monitoring system aims to overcome these limitations by using a net-work of sensors that are deployed in various locations and can provide real-time data on temperature, humidity, wind speed, and other meteorological parameters. The system will also use predictive algorithms to provide forecasts and alerts for extreme weather events.

3.2 Objectives

The objective of a real-time weather monitoring system using IoT is to collect, analyze, and disseminate weather data in real-time. This system aims to provide accurate and up-to-date weather information to users, enabling them to make informed decisions and take necessary precautions based on the current weather conditions. The system also helps in tracking and predicting weather patterns, providing early warning alerts for potential natural disasters, and im-proving the overall efficiency and effectiveness of weather-related activities.

3.3 Architecture diagram

Figure 1 depicts the architecture of the proposed system. A IoT based weather monitoring system using Blynk IoT would involve the use of sensors and other connected de-vices to collect weather data, and a Blynk IoT platform to transmit and manage the data. Here is a general overview of how such a system might work: Sensors and other connected devices would be installed in the area to be monitored. These could include temperature sensors, humidity sensors, wind speed sensors, and other devices that are able to collect weather data.

The sensors and devices would be connected to the internet, either directly or through a local gateway, and would be configured to send their data to the Blynk IoT platform. The Blynk IoT platform would receive the data from the sensors and devices, and would store it in a database for future use.

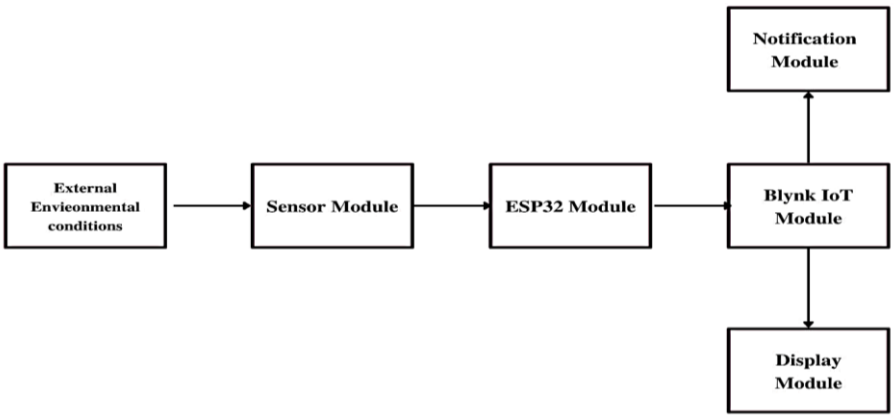

Fig. 1. Architecture diagram.

3.4 Modules-connectivity diagram

These are the modules present in the proposed system

- Sensor module
- ESP32 module
- Blynk IoT module
- Notification module
- Display module (Blynk web and mobile dashboard)

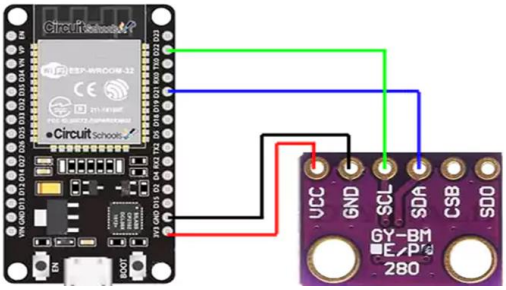

Fig. 2. Connectivity diagram of the proposed system.

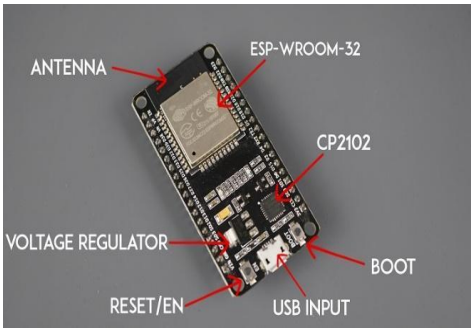

Fig. 3. General Overview of the ESP32 DEVKITC development board.

3.5 Modules and its description

3.5.1 Module 1: BMP280 Module

The BMP280 is a high precision, low power combined digital pressure and temperature sensor. It is based on the BMP180, with a number of additional features and improvements. It is de-signed to be used in a wide range of applications, including weather forecasting, altitude measurement, and indoor navigation. The BMP280 has a pressure measurement range of 300-1100 hPa and a temperature measurement range of -40 to 85°C. It can be used in either I2C or SPI communication mode, and is available in a compact 2.5x3.0mm QFN-16 package.

Fig. 4. BMP280.

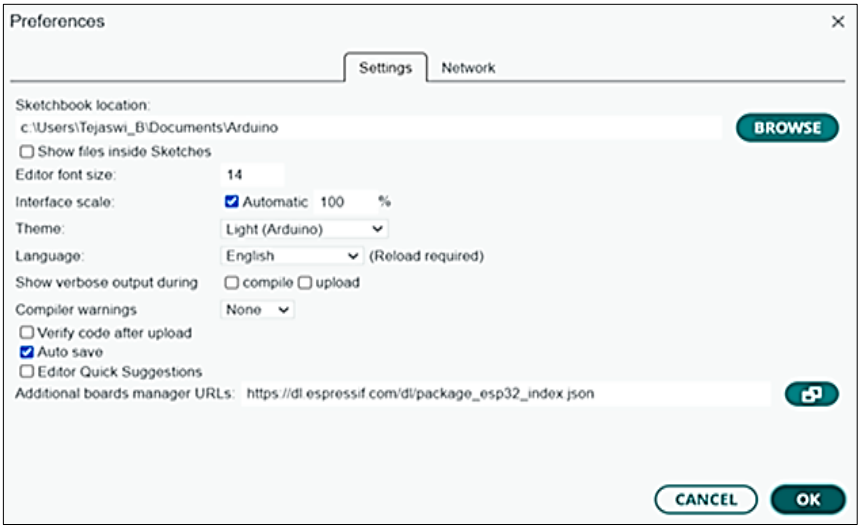

Fig. 5. Arduino setup.

3.5.2 Module 2: ESP32 module

In order to interface with the BMP280 sensor and publish collected data to an IoT server, we need to provide instructions to our ESP32 module. Arduino IDE is a popular integrated development environment used for programming the esp32. The image in figure 6 depicts this de-vice.

Fig. 6. ESP32.

3.5.3 Module 3: Blynk IoT module

Once you have these components, you can follow the instructions provided by Blynk to set up your project. This typically involves creating a new project in your Blynk account, configuring the server and library, and writing a program to run on your device. Once your project is set up, you can use the Blynk platform to manage and control your devices and sensors, and to build custom user interfaces for your IoT applications. The image in fig-7 the DataStream of weather monitoring.

- A Blynk server: Blynk provides a cloud-based server that can be used to manage your IoT projects. You can use the server provided by Blynk, or you can set up your own server on a local network or on a cloud platform such as Amazon Web Services.
- A Blynk library: Blynk provides libraries for a variety of programming languages and platforms, such as Arduino, Raspberry Pi, and Node-RED. You will need to download and install the appropriate library for your project.

3.5.4 Module 4: Notification module

Blynk is an IoT platform that allows users to build custom applications for controlling and managing connected devices and sensors. One of the key features of Blynk is the ability to send notifications in response to certain events or triggers.To use notifications in a Blynk project, you will need to do the following:

- Set up a Blynk account and create a new project.
- Add a notification widget to your project's user interface. This widget can be configured to display different types of notifications, such as text messages, emails, or push notifications.
- Write a program for your device that sends notifications to the Blynk server. This program can be triggered by certain events or conditions, such as a sensor reading reaching a certain threshold or a button being pressed.
- Configure the notification widget to receive notifications from your device. This involves specifying the type of notifications you want to receive, as well as the settings for sending the notifications.

Fig. 7. Blynk IoT Firmware Configuration.

3.5.5 Module 5: Display module

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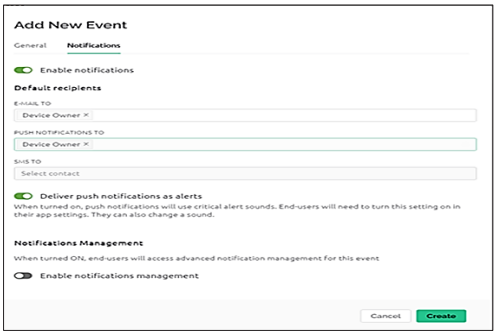

Fig. 8. Adding user details to Blynk alerts.

5 Results and Discussions

5.1 Description about Dataset

A dataset for an IoT-based weather monitoring system would likely include a range of different data types and formats, depending on the specific sensors and devices used in the system. Some examples of data that might be included in such a dataset are as follows:

- Time-stamped measurements of weather parameters such as temperature, humidity, wind speed, and atmospheric pressure. These measurements would typically be taken at regular intervals, such as every minute or every hour.
- Location data, such as latitude and longitude coordinates, to indicate where the weather measurements were taken. This data could be used to map the weather observations onto a geographic map.

- Sensor metadata, such as the type and model of the sensors used, their calibration information, and their accuracy and precision. This data could be used to assess the quality and reliability of the weather measurements.
- Annotated data, such as labels or tags indicating the type of weather or atmospheric conditions observed at a particular time and location. This data could be used to train machine learning algorithms to classify different weather types.

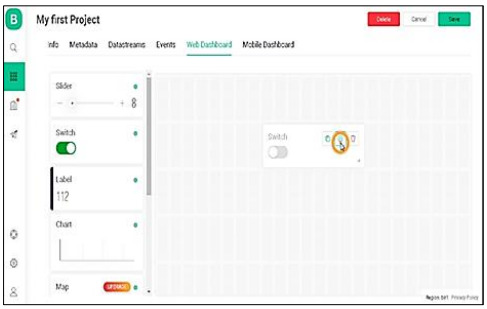

Fig. 9. Web dash board setup.

5.2 Experimental results

The proposed system displays the Real-time visualisation of weather parameters of the temperature, Pressure and altitude of a geographical location in which the system is being used. The temperature is having an maximum of 85 degree centigrade. The web dashboard and the mobile dashboard can be accessed from any part of the world, and the display the values of temperature, pressure and altitude of the current geographical location of the place. Figure 11 shows the connection of the Bmp280.

Input:

- External weather conditions detected by the BMP280 sensor.

Output:

- Displaying the result on the web and the mobile dashboard.
- Alert message is received from the module to the usé.

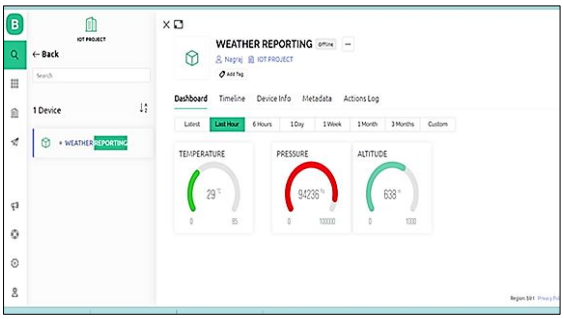

Fig. 10. Observations generated by the system, with weather conditions detected by BMP280

5.3 Significance of Proposed Method with Advantages

An IoT-based weather monitoring system is significant because it provides a way to collect, analyse, and visualise real-time weather data. This can be useful for a variety of purposes, such as:

- Personal use: Individuals can use an IoT-based weather monitoring system to monitor the weather conditions in their local area, and to plan their activities accordingly. For example, a person could use the system to check the current temperature and wind speed before going for a run, or to see if there is a chance of precipitation before heading out to the park.

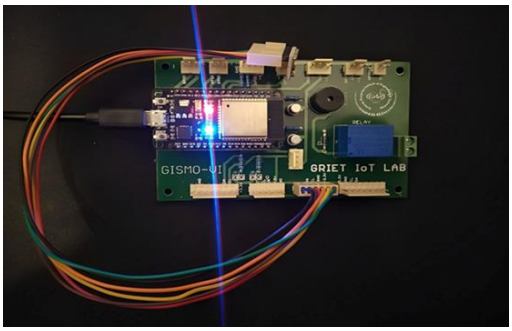

Fig. 11 Overview of the Real-time prototype model.

- Business use: Businesses can use an IoT-based weather monitoring system to monitor the weather conditions at their locations, and to make decisions based on this information. For example, a retail store could use the system to monitor the temperature and humidity inside the store, and to adjust the heating and cooling accordingly.
- Public safety: Governments and public safety organisations can use an IoT-based weather monitoring system to monitor weather conditions in their region, and to issue alerts and warnings when necessary. For example, a weather monitoring system could be used to detect the formation of a tornado, and to issue an alert to the public to take shelter.
- Goods in transit: An IoT-based weather monitoring system could be used to monitor the weather conditions for goods in transit. This could be useful for ensuring that the goods are not damaged or degraded by adverse weather conditions during transport.

6 Conclusion

An IoT-based weather monitoring system is a network of sensors, devices, and other technologies that are used to collect and analyse data about the weather. This system can be used to monitor a variety of weather-related parameters, such as temperature, humidity, atmospheric pressure, and wind speed. The collected data is then sent to a central hub, where it can be processed and analysed to provide real-time information about the weather. This information can be used for a variety of purposes, including forecasting future weather patterns, alerting people to potential weather hazards, and optimising energy usage. Overall, an IoT-based weather monitoring system can provide valuable insights and information that can help people better understand and prepare for the weather.

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