Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 4, April : 2024

IOT BASED SMART WEATHER MONITORING SYSTEM

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ABSTRACT

The proposed paper 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. The system is an advanced solution for monitoring the weather conditions at a particular place and make the information visible anywhere in the world. Weather monitoring systems can collect real-time data on various weather conditions, such as temperature, pressure at sea level, altitude, real time altitude, smoke level and gas level 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.

Keywords- Internet of Things (IoT) Embedded Computing System; Arduino Software, ESP8266, Smart Environment.

I. 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, pressure at sea level, altitude, real altitude, smoke level and gas level. 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

Industrial Engineering Journal
ISSN: 0970-2555
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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
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, pressure at sea level, altitude, real time altitude, smoke level and gas level 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.

II. OBJECTIVES

1. The objective of a real-time weather monitoring system using IoT is to collect, analyze and disseminate weather data in real-time.
2. 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.
3. 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.

III. LITERATURE SURVEY

A literature survey on IoT-based smart weather monitoring systems reveals a growing interest and significant advancements in this field. This survey encompasses various research papers, academic articles, and technical reports that explore different aspects of IoT-based weather monitoring systems, including sensors, communication protocols, data analysis techniques, and applications.

One key aspect of IoT-based weather monitoring systems is the utilization of sensor technologies for data collection. Researchers have explored a wide range of sensors to measure parameters such as temperature, humidity, pressure, rainfall, wind speed, and direction. For example, studies have investigated the use of low-cost sensors, such as DHT11 and BMP180, as well as more advanced sensors with higher accuracy and precision.

Several studies have highlighted the importance of real-time monitoring and decision support in IoT-based weather monitoring systems. By integrating weather data with geographical information systems (GIS) and other relevant data sources, such as crop yields, water levels, and infrastructure status, these systems can provide valuable insights for various applications, including agriculture, disaster management, transportation, and urban planning.

Overall, the literature survey highlights the interdisciplinary nature of IoT-based smart weather monitoring systems, drawing insights from fields such as meteorology, sensor networks, communication systems, data science, and environmental engineering. By leveraging IoT technologies, these systems offer unprecedented capabilities for real-time monitoring, analysis, and decision-making, paving the way for more resilient and sustainable communities in the face of changing weather patterns and climate extremes.

IV. EXISTING METHODS

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.

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. The system was implemented using an Arduino NANO 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 analysed , and the results showed no significant difference between the study groups. The paper 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 Thing Speak, which analyses 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 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. Overall, it 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.

V PROPOSED METHOD

5.1 BLOCK DIAGRAM

The implemented system consists of a microcontroller (ESP8266) and Arduino Nano as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller. The sensors can be operated by the microcontroller to retrieve the data from them and it processes the analysis with the sensor data and updates it to the internet through Wi-Fi module connected with it.

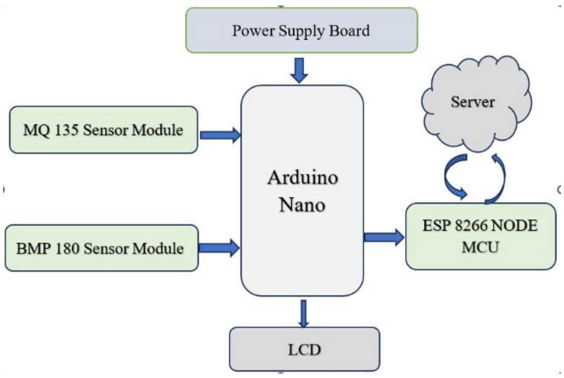

Fig. 1 Block Diagram of the Project

5.2. Schematic Diagram

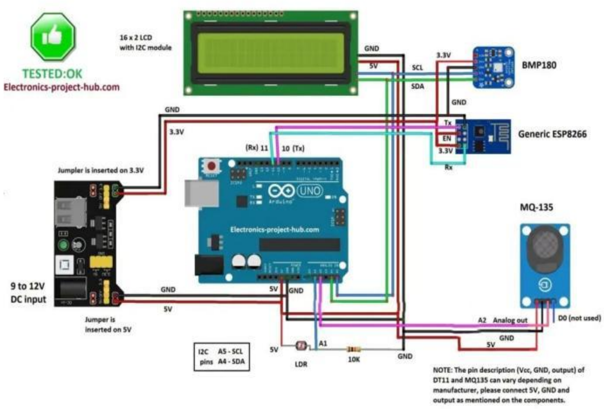

Fig 2 Schematic Diagram

5.3 WORKING PRINCIPLE

The working principle of the IoT-based smart weather monitoring system integrating Node MCU, BMP180 sensor, MQ-135 sensor, LCD, power supply board, and Thing Speak involves several steps:

1. Node MCU Configuration: The Node MCU is programmed to connect to the internet via Wi-Fi using its integrated Wi-Fi module. This allows the Node MCU to communicate with the Thing Speak platform for uploading sensor data.

2. Sensor Integration: The BMP180 sensor is utilized to measure temperature, barometric pressure, real altitude and altitude. The MQ-135 sensor is employed to detect gas levels and smoke levels in the environment. Both sensors are connected to the Node MCU via digital or analog pins.

3. Data Acquisition: The Node MCU reads sensor data at regular intervals (e.g., every few seconds) using appropriate libraries and communication protocols. The BMP180 sensor provides temperature, pressure, and altitude data, while the MQ-135 sensor offers gas and smoke level readings.

4. LCD Display: The Node MCU displays the real-time sensor data on an LCD screen connected to its GPIO pins. The LCD provides a visual interface for viewing temperature, pressure, altitude, gas level, and smoke level readings.

5. Data Transmission to Thing Speak: The Node MCU sends the collected sensor data to the Thing Speak platform via HTTP or MQTT protocols. Thing Speak provides cloud-based storage and visualization tools for analysing and monitoring sensor data in real-time.

6. Node MCU Code: The Node MCU firmware is programmed using Arduino

IDE or similar development environments. The code includes sensor initialization, data acquisition, LCD display management, Wi-Fi connectivity setup, and Thing Speak data upload functionality.

7. Viewing Results: Users can access the collected sensor data and visualizations on the Thing Speak platform through a web browser or mobile application. Thing Speak provides for monitoring weather conditions and air quality in real-time.

Overall, the IoT-based smart weather monitoring system offers a convenient and efficient solution for measuring temperature, pressure, altitude, gas levels, and smoke levels, and transmitting the data to a cloud platform for analysis and visualization. It enables users to monitor environmental conditions remotely and take appropriate actions based on the collected sensor data.

VI RESULTS & DISCUSSION

The implemented system consists of a microcontroller(ESP8266) as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller Arduino Nano. The sensors can be operated by the microcontroller to retrieve the data from them and it processes the analysis with the sensor data and updates it to the internet through Wi-Fi module connected with it. Here we used ESP8266 Wi-Fi module which is having TCP/IP protocol stack integrated on chip. So that it can provide any microcontroller to get connected with Wi-Fi network. ESP8266 is a preprogrammed SOC and any microcontroller has to communicate with it through UART interface.

The MQ-135 sensor's resistance changes as it comes into contact with different gases. This resistance can be converted into a voltage or current signal, which can then be processed by a microcontroller or other electronic devices. The output signal from the sensor is typically processed by a microcontroller. This processing may involve amplification, filtering, and conversion to a digital format for further analysis or display. It displays the information regarding the Smoke level and the Gas levels in the weather.

Pressure Sensing**:** The BMP180 sensor uses a piezoresistive pressure sensor to measure atmospheric pressure. This sensor consists of a silicon diaphragm with piezoresistors. When the pressure changes, the diaphragm flexes, causing the resistance of the piezo resistors to change. This change in resistance is then converted into a digital pressure reading.

Temperature Sensing**:** The BMP180 also includes an integrated temperature sensor. This sensor measures the temperature of the environment using a built-in thermistor. The resistance of the thermistor changes with temperature, and this change is converted into a digital temperature reading.

Altitude Calculation**:** Altitude can be calculated using the measured pressure. As altitude increases, atmospheric pressure decreases. By comparing the measured pressure to a standard pressure at sea level, the BMP180 can estimate the altitude. This estimation is based on the barometric formula, which describes the relationship between pressure and altitude in the Earth's atmosphere.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 4, April : 2024

Data Processing: Once the temperature, pressure, and altitude data are obtained from the sensor, they can be processed and used in various applications and is displayed on the corresponding apparatus. The retrieved data is then sent to the Arduino nano which is the heart of the system. The information thus acquired from the sensors is then sent to the LCD for display.

As a result the parameters detected in the weather will be displayed on the LCD connected. The measured parameters can also be viewed in the registered mobile number in the Things Speak Server. The Things Speak Server contains an ID and the password which is pre-registered at the time of writing the code for Arduino Nano. The information from the server can be monitored from anywhere.

<u>OUTPUTS ON LCD:</u>

6.1.1 Displaying Gas Level :

Fig 6.1.1 Gas Level

6.1.2 Displaying Real Altitude:

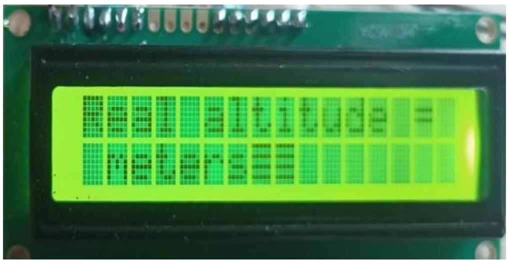

Fig 6.1.2 Real Altitude

6.1.3 Displaying Smoke Level:

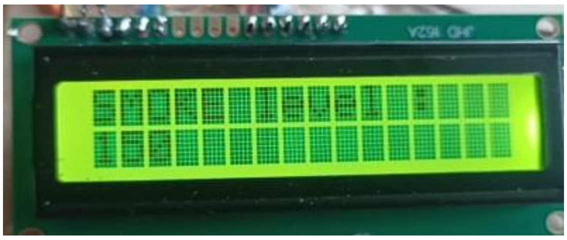

Fig 6.1.3 Smoke Level

6.1.4 Displaying Temperature:

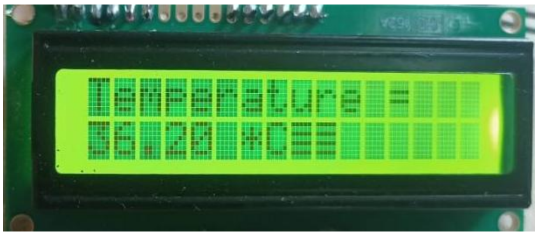

Fig 6.1.4 Temperature

6.1.5 Displaying Pressure at Sea Level :

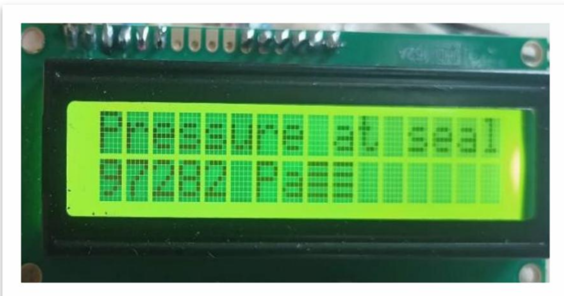

Fig 6.1.5 Pressure at Sea Level

6.1.6 Displaying Altitude

Industrial Engineering Journal
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Fig 6.1.6 Altitud

6.2 OUTPUT ON THINGS SPEAK

6.2.1 Instance – 1


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Fig 6.2.1 Case-1

6.2.2 Instance – 2

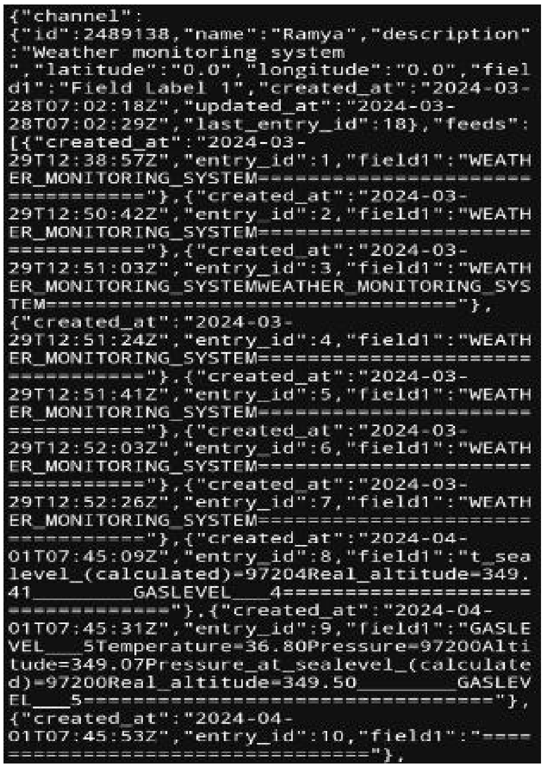
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Fig 6.2.2 Case - 2

6.2.3 Instance - 3


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Fig 6.2.3 Case - 3

6.2.4 Instance – 4

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ISSN: 0970-2555
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Fig 6.2.4 Case – 4

VII. CONCLUSION

In conclusion, IoT-based smart weather monitoring systems represent a significant advancement in the field of environmental monitoring. By integrating sensors, communication technologies, and data analysis techniques, these systems offer real-time insights into weather conditions, enabling better decision-making and resource allocation across various sectors. The adoption of IoT in weather monitoring has the potential to enhance early warning systems, improve agricultural productivity, support disaster management efforts, and contribute to building more resilient communities in the face of climate change. However, challenges such as sensor accuracy, data privacy, network reliability, and interoperability remain to be addressed. Overall, continued research and innovation in this area will further enhance the effectiveness and impact of IoT-based smart weather monitoring systems in mitigating the impacts of extreme weather events and fostering sustainable development.

FUTURE SCOPE

The future scope of IoT-based smart weather monitoring systems is promising, with potential advancements in sensor technology, communication protocols, data analytics, and applications. As sensor technology continues to evolve, we can expect the development of more compact, cost-effective, and accurate sensors capable of measuring a wide range of weather parameters with higher precision. Moreover, the integration of emerging communication protocols such as 5G and satellite networks will enable seamless connectivity and real-time data transmission over larger geographical areas. In terms of data analytics, advancements in machine learning and artificial intelligence will enhance the predictive capabilities of weather forecasting models, enabling more accurate and timely predictions of weather patterns and extreme events. Furthermore, the future applications of IoT-based weather monitoring systems are vast, ranging from precision agriculture and disaster management to smart cities and renewable energy optimization. Overall, the future of IoT-based smart weather monitoring systems holds great promise for improving situational awareness, enhancing decision-making, and building more resilient and sustainable communities in the face of changing weather conditions and climate challenges.

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