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IOT Based Real Time Weather Monitoring System Using NODEMCU

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Abstract: Real-time weather monitoring systems are essential for collecting and analyzing weather data, providing critical information for a range of applications, including agriculture, transportation, and disaster management. This research paper presents a weather monitoring system using the NodeMCU platform, which enables real-time data collection and transmission over the internet. The system includes various sensors to measure temperature, humidity, air pressure, and wind speed, and direction, with the data collected transmitted to a cloud-based platform for storage and analysis. The NodeMCU's WiFi connectivity allows for remote monitoring and control of the system, providing real-time access to weather data from anywhere in the world. The system's performance is evaluated through experiments conducted in real-world weather conditions, demonstrating its reliability and accuracy. The cost-effectiveness and scalability of the system are also evaluated, demonstrating its affordability and reliability as a solution for weather monitoring. The paper concludes with recommendations for future improvements and applications to the system.
Keywords: NodeMCU, Thingspeak, BMP180, DHT11, Rain Sensor

I. INTRODUCTION

Monitoring weather's condition plays an extensive role in today's ever-changing world. The impact of the state of the environment creates a number of difficulties in a variety of industries, including agriculture, industry, construction, and more. However, the estimated impact primarily affects industry and agriculture.[1]

The emergence of the Internet of Things (IoT) has opened new opportunities for developing weather monitoring systems that can transmit data in real-time. A weather monitoring system is a piece of equipment that uses several sensors to gather information about the weather and environment. There are two different kinds of weather stations: one that has its own sensors, and the other that gets its data from the servers of other weather stations. Weather stations are also called weather centres, personal weather stations, professional weather stations, home weather stations, weather forecaster, and forecasters. The ability to collect and analyze real-time weather data provides valuable information that can be used to make informed decisions and act accordingly.[2]

This paper presents a real-time weather monitoring system using the NodeMCU, which provides an affordable and reliable solution for weather monitoring.

The NodeMCU is a widely used IoT development board that can connect to the internet through WiFi. The system developed in this paper includes various sensors such as thermistor to take temperature readings, a barometer to measure the atmospheric pressure, capacitive humidity sensor to measure humidity, rain sensor to measure rainfall, and more. The collected data is transmitted in real-time to a cloud-based platform for storage and analysis, enabling remote access from anywhere in the world. The system's hardware and software are detailed, providing a guide for replicating and customizing the system.[3]

The system's performance is evaluated through experiments conducted in real-world weather conditions. The results of the study show that the system can provide accurate and timely weather data, making it a valuable tool for various applications. The system's accuracy and reliability are evaluated by comparing the collected data to official weather data sources. The system's ability to operate in various weather conditions is also tested, demonstrating its ability to operate in extreme weather conditions. Findings demonstrate that the system can deliver precise and timely meteorological data, making it a useful tool in monitoring weather conditions.

The study also evaluates the system's cost-effectiveness and scalability. The NodeMCU provides an affordable and reliable solution for weather monitoring, making it accessible to individuals and organizations alike.

The scalability of the system is evaluated by testing the system's ability to handle a large number of nodes, demonstrating its ability to operate on a large scale. The system's remote monitoring and control capabilities are also evaluated, demonstrating its ability to provide real-time access to weather data from anywhere in the world.

The cloud-based platform used for data storage and analysis provides a user-friendly interface for accessing and visualizing weather data. User can collect the measurements by the sensors at any time.

It can even be viewed on mobile handsets or tablet. This means that whenever user want to know what the temperature is, user can have access to information in real time. The system's hardware and software can be customized to meet specific needs, making it suitable for various applications.[4]

The NodeMCU-based real-time weather monitoring system created in this paper offers reasonable and dependable weather monitoring option. The system's accuracy, reliability, cost-effectiveness, scalability, and remote monitoring capabilities make it a valuable tool for various applications. The study demonstrates the feasibility and effectiveness of using the NodeMCU for weather monitoring, providing a foundation for future research and development in this area such as connecting it to the satellite as a global feature of this system. [5][6]

II. LITERATURE SURVEY

A. Cost Effective Automatic Weather Station a Review, Mrs. M. M. Raste, Ms. A. A. Pujari, Vinayak Aappasaheb Pujari, 2016

The proposed system uses the solar power panel. This system is used to monitor temperature, wind speed, wind direction, humidity and rain. The sensed data will be sent to GSM module and through gateway to the personal computer. A server is connected to the database.[7]

B. Real Time Data Transmission for Weather Monitoring System, Ms. Poonam Khermalis, Ms. Sanika Doke, Ms. Varsha Dherange, Prof. Satyashil Nagrale, 2016

Proposed the weather monitoring system using real time data transmission. The proposed system uses VAISALA weather transmitter sensor WXT520 to transmit the data to the control room. It senses the parameters like wind speed, wind direction, precipitation, atmospheric pressure, temperature, relative humidity. This real time data is transmitted wirelessly through GSM over long distance. This system provides flexibility as needs changes.[8]

C. Weather Forecasting using Arduino Based Cube-Sat, R. Bhattacharjee, M. Sau Giri, P. Bhattacharya, 2016

M. Rahaman Laskar et al. presented paper on weather forecasting using Arduino and Cube-Sat.: This proposed system uses temperature and humidity sensor (DHT11), pressure and altitude sensor (BMP180) and accelerometer (ADXL-335). The data processing unit Arduino Uno is used. Cube satellite is used to provide information of weather from anywhere without using network. A gas balloon is used to hold and carry the Cube satellite. This system is simple to construct, portable, cost efficient, low power consuming and reliable. But there are some limitations such as device may not communicate at long distance without powerful transceiver section, at higher altitude record of data with the help of gas balloon may be a problem and components may be damaged by rain or long-time use.[9]

III.PROPOSED SYSTEM

Weather conditions are tracked in the environment, or any particular building and information are transferred to the cloud server. The fact that this system would manually communicate the information about the current environment will be advantageous. One can access the information about the weather from any part of the world.[10]

The main aim is to design and implement a resourceful weather monitoring system through which the necessary parameters are remotely monitored via the Internet and the data collected from the devices are stored in the cloud and the predictable trend is projected on the web browser.[11]

In this study, the groundwork is laid for an effective method of tracking local weather conditions and making the data accessible from anywhere in the world.

The Internet of Things (IoT), which is an efficient and effective method for joining the things to the web and to connect the entire universe of things in a network, is the technological advancement that underpins this. Anything like electronic devices, sensors, and automobile electronics could be present here.

The system functions with tracking and monitoring environmental circumstances such as temperature, relative humidity, pressure and quantity of rainfall with sensors and whenever these scores exceed a selected threshold limit for each.

Conditions of the environment can be tracked by gathering the data from the sensors and deposited in the cloud and analysed there.[5][6]

A. Proposed Architecture of the system

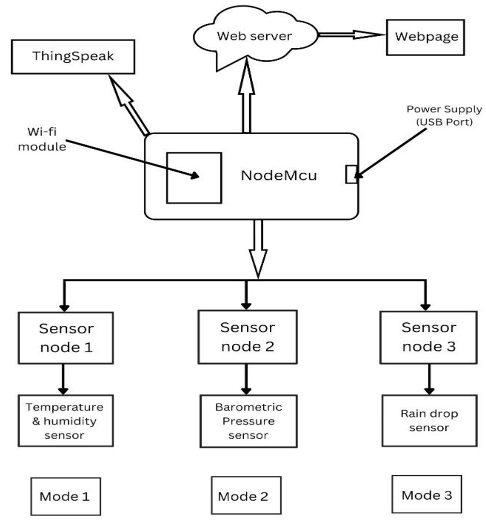

Fig 1.: Architecture of proposed system

The architecture for the suggested concept is shown in figure above. The NodeMCU, a Wi-Fi capable microcontroller, is coupled to a temperature sensor (DHT11), barometric pressure sensor (BMP180), and raindrop sensor. The NodeMCU connects to the internet through an internet router and provides data to ThingSpeak, an IoT platform for data collection and analysis. Using the IP address of the Wi-Fi router, the data is then evaluated and displayed on the data analysis platform and web page.[12]

B. Flowchart

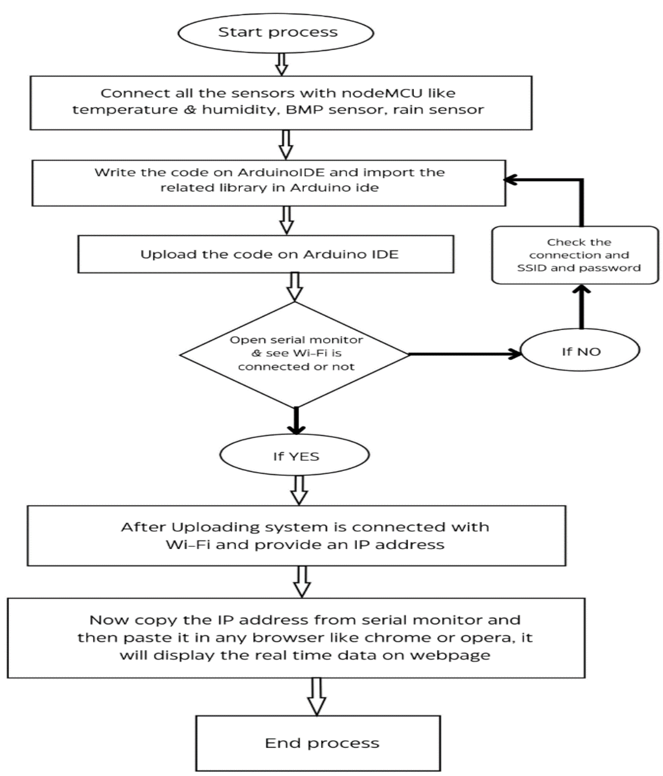

Fig 2.: Flowchart of proposed model

The software code's logical representation has been shown in flowchart form. Above figure shows the flowchart of the logic implemented in the modelled system.

Upon the completion of all connections as depicted in fig. Using a USB cable, the power supply is sent to the NodeMCU. Which is connected with our personal computer. We have written two code modules. The first one uses Arduino sketch to connect to various sensors, and the second one is a java script web page module. After establishing connection to hardware, upload the code which we have written. Before uploading the code, first it needs to be verified. Open the Arduino IDE, enter your code there, click "Verify," then wait for about 1-2 minutes while the verification process is completed, after which you may select to upload the code after it has successfully completed compiling. After that open the serial monitor which display that system is connected with Wi-Fi. Once a hardware connection has been made, HTTP request processing begins, and an IP address is then displayed on the serial monitor. Then, using a web browser such as Chrome, Internet Explorer, Opera, etc., copy the IP address and paste it. Whichever browser you choose will display the matching temperature, humidity, pressure, and rainfall values. These values are obtained from the sensors. In addition to that, these recorded values are sent to the Thingspeak using the internet. Then, we can analyse the values as a visualization on the screen on Thingspeak dashboard.

C. Circuit Diagram

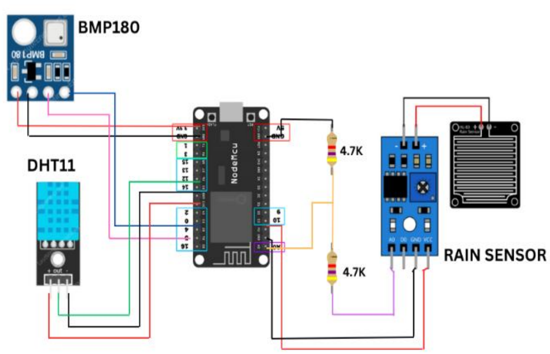

Fig 3.: Pinout of proposed model

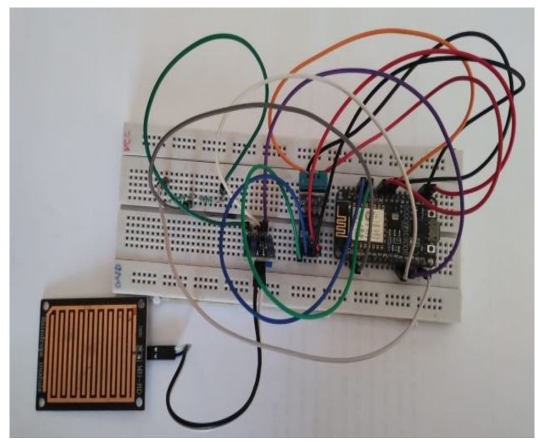

Fig 4.: Circuit diagram of proposed model

From the above Schematic diagram, The DHT11 sensor, BMP 180 sensor, rain sensor, all are connected with the NodeMCU pins, and the power supply is done by USB cable to connect the hardware to the system. The pictures up top show the prototype model. For the connections to work properly, they must all be connected in the same way. The below tables show the pin configuration for each sensor.[13][14]

VCC	3V3
DATA	D5
GND	GND

Table 1.: Pin Configuration between NodeMCU and DHT11

VIN	3V3
GND	GND
SCL	D1
SDA	D2

Table 2.: Pin Configuration between NodeMCU and BMP180

A0	GND(include)

Table 3.: Pin Configuration between NodeMCU and Rain Sensor FC-37

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IV. RESULTS & DISCUSSIONS

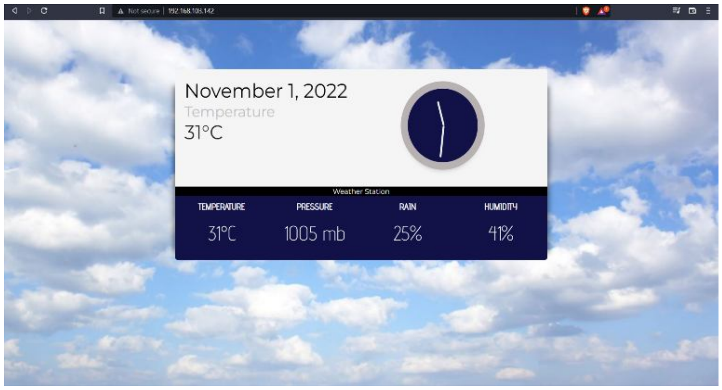

Fig 5.: Final result on webpage

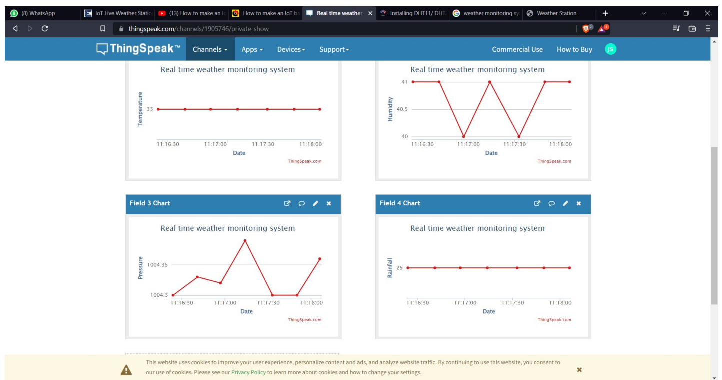

Fig 6.: Thingspeak dashboard

After setting up a hardware device to collect data and send it to an online service (Thingspeak) for analysis and visualization. The process involves establishing a hardware connection, which initiates HTTP request processing, and displaying an IP address on a serial monitor. Once you have the IP address, you can access the collected data using a web browser and see the temperature, humidity, pressure, and rainfall values. The NodeMCU board also connects to Thingspeak cloud, allowing analysis of the data. By sending the recorded values to Thingspeak using the internet, you can analyze them through the Thingspeak dashboard and visualize the data in various ways from various sensors in real-time.

V. CONCLUSION

This paper aim is to measure the various parameters like Temperature, Humidity, Rainfall level, barometric pressure and continuously monitor them. The data can be stored online, which can be used to forecast weather and eventually analyse climate patterns, as well as for other meteorological purposes. The system uses a good combination of analog and digital sensors in wired and wireless modes of operation. Thus, a proof of concept for an Internet of Things device for a real time weather monitoring system has been established.

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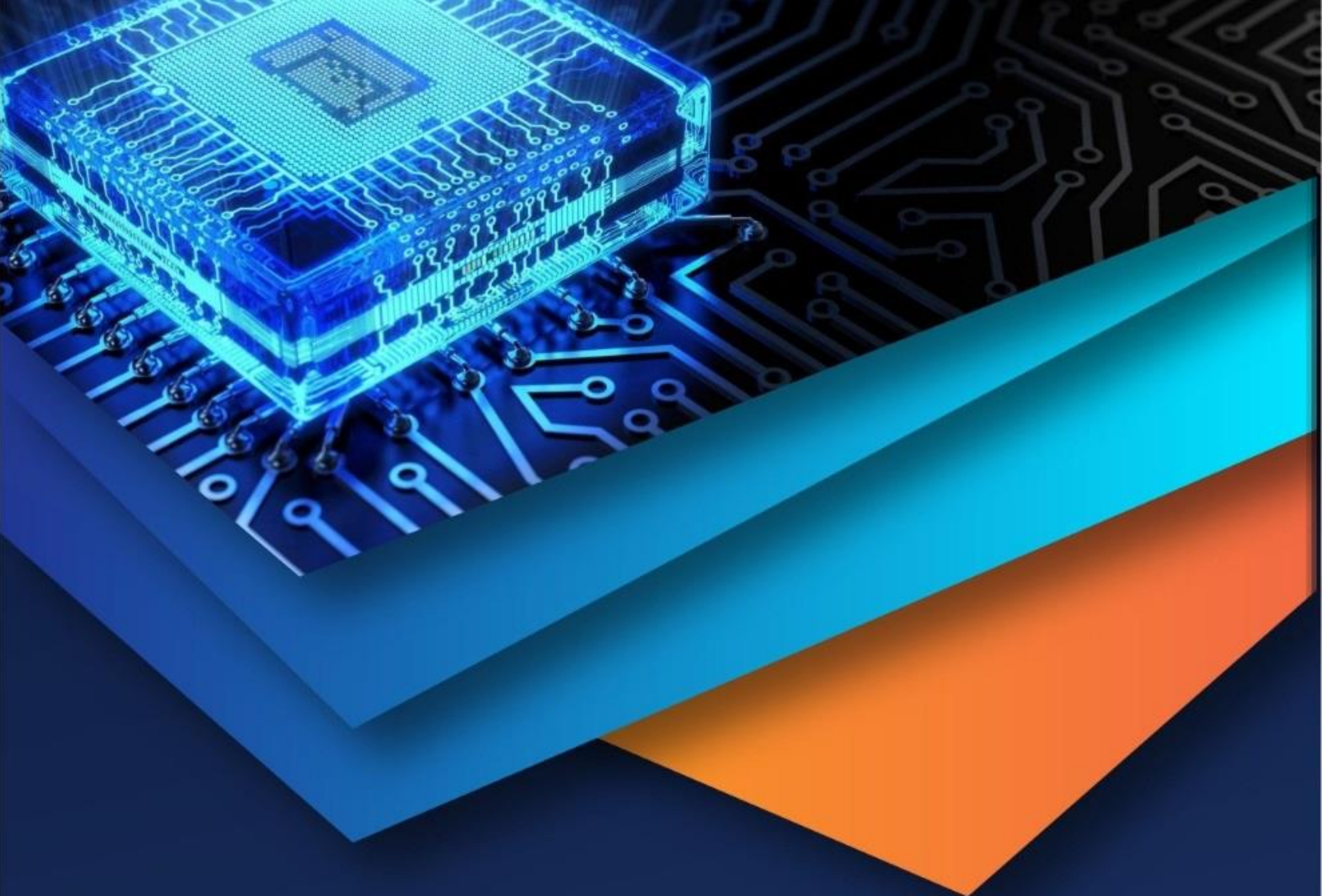

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