IOT BASED ATMOSPHERE MONITORING SYSTEM

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***Abstract*—This project presents an advanced air monitoring system based on the Node MCU platform designed to measure and report various environmental parameters. The system integrates multiple sensors including air quality, temperature, humidity, pressure, and rain sensors. The integration of the Wi-Fi module facilitates seamless data transfer from time to time to the central database, allowing remote access to weather data from a website or mobile application. User-friendly regular weather analysis. Air quality sensors detect pollutants and specific contaminants to provide information on air quality. Temperature and humidity sensors monitor atmospheric conditions, which are important for applications from agricultural planning to weather forecasting. Pressure sensors collect information about the atmosphere that is important for weather forecasting. Rain gauges can also measure rainfall, providing important information for water research and water management. Upload to cloud-based storage. This information is then processed and accessed through user-friendly interfaces on web browsers and mobile devices. Users can view current weather and historical data to support decisions based on accurate and timely information. The use of Internet of Things (IoT) technology increases the accuracy and reliability of weather data collection by improving the ability to provide continuous monitoring and instant updates. Temperature and humidity sensors, rain sensors, air quality sensors, pressure sensors, and light sensors.**

***Index Terms*—Internet of Things, Wi-Fi, temperature humidity sensor, Rainfall sensor, Air Quality sensor, Pressure sensor, Light sensor.**

I. Introduction

Our project introduces a new weather monitoring system based on the Node MCU platform, designed to monitor and re- port various aspects of the environment. The system integrates a variety of sensors, including air quality, temperature, humid- ity, barometric pressure, and rain sensors, all connected to the Node MCU. By integrating the Wi-Fi module, it can connect to a central location and transfer data instantly, allowing remote access to weather data on websites or mobile applications. The system effectively handles a variety of sensors and mod- ules[7]. Air quality sensors detect pollutants and contaminants, providing a better view of the environment. Temperature and humidity sensors monitor atmospheric conditions, which are important for applications such as agricultural planning and weather forecasting[6]. Barometers provide information about air pressure, which is important for predicting the weather, while rain gauges measure the amount of precipitation, providing important information for hydrology and science. A Wi-Fi module connected to the Node MCU allows data to be stored in a cloud-based database[2]. This information is processed and provided through a user-friendly interface accessible from web browsers and mobile devices[1]. Users can view current weather and historical data to make decisions based on accurate and timely information. The use of IoT technology increases the accuracy and reliability of weather data collection by im- proving the system's ability to provide continuous monitoring and instant updates[3]. The platform and various sensors provide detailed and timely information. Integration of Wi-Fi modulesallows users to easily access this information from the central database via web and mobile applications[9]. The system is designed to be efficient and effective, making it the perfect solution for a variety of applications, from farm planning to daily weather forecasts, helping to improve environmental awareness and decision-making.

PROPOSED SYSTEM

The weather monitoring concept aims to solve the limita- tions of existing systems by combining air quality, tempera- ture, humidity, pressure, and rain sensors[1]. This system uses the Arduino UNO platform and strives to provide more detailed and accurate information about the environment. Integration of Wi-Fi modules enables real-time data transmission, allowing weather data to be easily accessed via web or mobile appli- cations[8].

II. Requirements

A. Software Requirements

Various software and platforms are required to develop and deploy a weather monitoring system using the Node MCU[5].

These components enable seamless workflows, from sensor data collection to real-time data transfer and user interaction. Key features include:

Arduino IDE: Provides an intuitive way to create Ar- duino sketches and includes various libraries for connect- ing sensors and modules. Temperature and Humidity Sensor (DHT11/DHT22): Used for measuring temperature and hu- midity. Wi-Fi Library: Used for Wi-Fi modules if integrating with ESP8266 or ESP32. ThingSpeak: An IoT analytics plat- form for collecting, visualizing, and analyzing real-time data in the cloud. Web Development Tools: HTML/CSS/JavaScript: Used to create web user interfaces for displaying weather data by time and history[8]. React Native or Flutter: Used to develop cross-platform applications that allow users to access cloud data on smartphones and tablets. IoT Platform: Arduino IoT Cloud: Enables connection, control, and monitoring of IoT devices, making it easier for data to be viewed and interacted with equipment[4].

B. Hardware Requirements

Hardware Requirements 1. Arduino UNO Compatibility:

Sensors: Ensure that the sensors used are compatible with the Node MCU and designed to work with a variety of systems and small devices. Most sensors have a straightforward inter- face that is generally compatible with Node MCU, depending on the specific model. 2. Power Supply:

A stable power supply is essential for the Node MCU and all connected sensors. This can be achieved through: USB Connection: Connect the Node MCU to a computer via USB. Dedicated Power Source: Use a 9V battery or DC adapter to provide consistent power. 3. Wi-Fi Module:

Ensure that the Wi-Fi module used is compatible with the Node MCU and provides stable connectivity for data transmission. 4. Sensor Suitability:

Verify that sensors are suitable for outdoor use if the system will be deployed in external environments[9]. This ensures dura- bility and reliable performance in various weather conditions.

5. Ease of Integration:

The Node MCU is designed for straightforward assembly and data collection. Ensure that the setup does not involve sig- nificant calculations that could impact performance or stability.

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PLANNING AND DESIGN

1. Define requirements: Specify the type of data you want to collect, such as air quality index, temperature, humidity, pressure, and precipitation. System Architecture: Prepare con- nection configuration with Arduino Uno and demonstrate data transfer over WiFi.

Power considerations: Determine the power requirements of the Node MCU and connected sensors[6].

Connect sensors: Connect each sensor to the Node MCU using the appropriate jumpers and connectors according to the specifications[5].

WiFi module configuration: According to the model require- ments, use UART communication or SPI interface to connect the WiFi module (such as ESP8266 or ESP32) to Arduino Uno.

Arduino IDE Installation: Install the Arduino IDE on your computer and configure it to program the Node MCU[5].

C. Hardware components

Node MCU board, Air quality sensor such as MQ series sensor, Temperature and humidity sensor such as DHT series sensor, Pressure sensing Sensors such as BMP series sen- sors, Rainfall sensors, Wireless modules such as ESP8266 or ESP32.

D. Software components

Arduino IDE for coding and loading programs, Arduino function Formula library specific for each sensor, WiFi module library like ESP8266WiFi for ESP826

E. Steps

Initialize sensors: Set up each sensor in the Arduino sketch, specifying its pin connections and sensor configuration. Use the WiFi module library to create a WiFi connection and set network credentials in the setup() function. Error handling: Use error handling for proper operation of sensor failure or WiFi interference.

F. Some Common Mistakes

power management (If you are running on battery power, maximize power efficiency to extend battery life.)

COMPONENTS

Fig. 1. I2C Adapter

The I2C LCD adapter is a device with microcontroller PCF8574 chip. Using this adapter, anyone can control a 16x2 LCD with only two cables (SDA, SCL)[6].

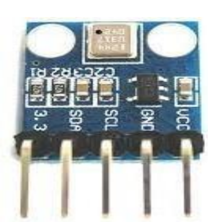

Fig. 2. BMP 180 sensor

BMP180 Air Pressure/Temperature/Altitude Sensor - 5V is the best low cost sensor to measure air pressure and

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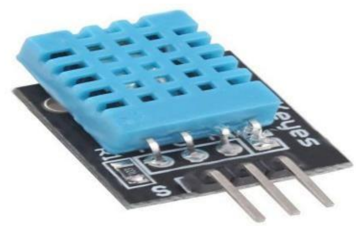

Fig. 3. DHT 11

temperature. Since pressure changes with altitude, we can use this sensor as an indicator[9].

DHT11 is a simple, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the ambient air and send a digital signal to the data pin (no need for an analog input pin). It is very easy to use, but you need to be careful when retrieving the information.

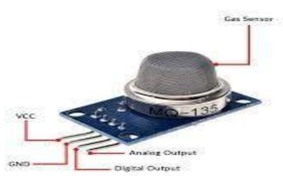

Fig. 4. Air Quality sensor

MQ135 air quality sensor is a kind of MQ gas sensor used to detect, measure and monitor various kinds of gases in the air.

Fig. 5. Wifi module

ESP8266 is a versatile IoT SoC with a 32-bit microcon- troller running at 80 MHz, integrated Wi-Fi (b/g/n), and up to 16 MB flash memory[10]. It supports GPIO, I2C, SPI and UART interfaces and can be run from Arduino IDE or native SDK. Ideal for low-cost wireless IoT applications in many industries.

RESULT

The IoT-based atmospheric monitoring system designed with NodeMCU effectively measures and records various environmental parameters such as temperature, humidity, and air quality. The NodeMCU, integrated with a range of sensors, collects real-time data, which is then transmitted to a cloud

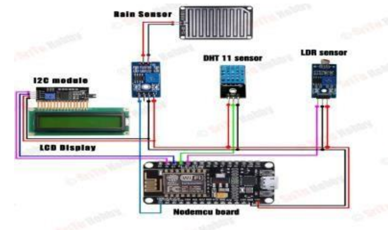

Fig. 6. Circuit Diagram

server for storage and analysis. This setup allows for continu- ous monitoring and easy access to historical data, facilitating trend analysis and early detection of harmful environmental changes.

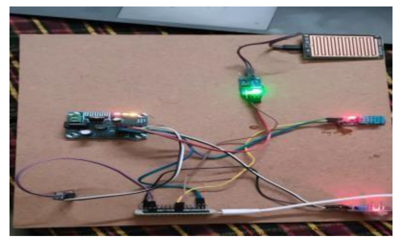

Fig. 7. atmosphere monitoring system

The system was tested in various environments to en- sure accuracy and reliability. During the testing phase, the NodeMCU proved to be a robust and efficient controller, handling multiple sensors simultaneously without significant latency[8]. The temperature and humidity sensors provided con- sistent readings within the expected range, while the air quality sensor effectively detected changes in particulate matter and gas concentrations.

One of the key advantages observed was the system's capa- bility to operate autonomously once deployed, requiring mini- mal human intervention. The wireless connectivity provided by the NodeMCU enabled seamless data transmission, making the system highly scalable for larger deployments across different geographic locations. Moreover, the integration with cloud services allowed for real-time data visualization through a user-friendly interface, making it accessible to non-technical users[9].

Fig. 8. OUTPUT

Overall, It offers valuable insights into atmospheric con- ditions, which can be utilized by environmental agencies, researchers, and even the general public to make informed decisions about air quality and related health risks

CONCLUSION

This study demonstrates the efficiency and compatibility of this system compared to other systems[2]. He effectively reduced the staff and made the project now a huge success. The system will effectively capture weather conditions in real time, benefiting farmers, businesses and citizens whose lives are affected by weather conditions. In agriculture, this information can be used to improve plant growth and allow farmers to modify the environment accordingly[1]. These demonstrations have great potential to improve agriculture worldwide[8]. For example, farmers can access the temperature, humidity, wind direction and other factors necessary to grow crops or plants that require a specific environment.

FUTURE SCOPE

The existing system can be improved by connecting addi- tional sensors such as soil moisture sensors and MQ3 sensors to collect specific data in the field. The humidity level of the facility or field automatically controls the pump. These sensors will provide information on the level of fuel toxicity in the environment and improve the understanding and management of the local climate[7].

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