IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, December 2024

Temperature and Humidity Monitoring using NodeMCU

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Abstract: *The paper thus proposes an advanced system that monitors the temperature at various points of location in a data centre and makes this temperature data visible over the internet through cloud-based dashboard and sends SMS and email alerts to predefined recipients when temperature rises above safe operating zone and reaches certain high values. Most of our daily life activities depend on environmental conditions. Traditionally, such parameters are monitored inefficiently with a wired moni toring system, which incurs greater cost of implementation and maintenance. Moreover, the device to detect temperature in terms of a thermometer is not at all appropriate for online measurement because it requires more time to give a response in terms of measurement. The said technology facilitates remote, efficient monitoring of temperature as well as humidity. This system captures real-time data about temperature and humidity in rooms, which ensures safety, protection of equipment, and quality control. The two main parts of this system include a nodeMCU microcontroller equipped with ESP8266 Wi-Fi capability to easily send data to the Arduino IoT Cloud. In this system, DHT11 is applied in determining environmental conditions.*

Keywords: NodeMCU microcontroller,DHT11 sensor, ESP8266 Wi-Fi, Jumper wires, USB cable, LCD display

I. INTRODUCTION

Temperature and humidity are two elements that reflect the climate change of the worlds' today. The drastic changes of these parameters to the environment affect the life cycles of plants and animals. Temperature and humidity can assist the farmers to make a decision making for accurate agricultural production yield and monitoring the condition of fish farms [1 4]. Large scale buildings such skyscrapers, hotel and shopping malls have heating, ventilation and air-condition (HVAC). The changes of temperature and humidity on HVAC are two main factors that affect the environment conditions in the large scale building and increase the energy consumptions [5, 6]. The buildings that have the automatic HVAC systems can increase people's comfort and at the same it can reduce energy consumption.One of the major needs for human being is somewhere to stay. Therefore it must be built wisely to supply healthy, pleasant, and safe for keeping a place in comfort. The scopes of an intelligent building are included in [2–6] with indoor environment monitoring, lighting, power management, buildings security, cooling, heating, ventilation, natural day lighting, fire safety and early fire detection system, and build ing health management. Among all the listed domains, this study focused on the ventilation system .This project aims to achieve several key objectives. Firstly, to design a temperature and humidity monitoring system that allows users to access real-time reports from any location. Secondly, to develop a system that provides users with timely notifications when temperature or humidity exceeds acceptable limits. Lastly, to assess the performance of the developed system, ensuring that it is able to minimize material downtime due to environmental factors affecting critical materials in storage. To meet the stated objectives, the project focuses on detecting temperature and humidity readings through dedicated sensors

II. METHODOLOGY

The core parts of these systems would be investigated, in cluding NodeMCU's specifications, common temperature and humidity sensors (for example, DHT11, DHT22, BME280), and efficiency. This will also involve sensor calibration techniques in relation to the effects on the measurement accuracy due to environmental factors. On top of these, the paper will evaluate and assess the power consumption within NodeMCU in these types of systems, provide

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recommendations on cutting energy use, especially applications which are battery operated and the methods of wireless communication: Wi-Fi, HTTP, Fig. 1. IOT based temperature and humidity measurement system using ESP8266 NodeMCU board like ThingSpeak or Adafruit IO for visualization and storage,will also be discussed. Performance evaluation will include sensor accuracy, power consumption, and the reliability of the monitoring system to address real-world applications in smart homes, agriculture, and industrial monitoring. Case studies will illustrate how systems based on NodeMCU are imple mented in various domains and show their advantages and challenges such as sensor calibration issues and connectivity concerns. The review will also compare NodeMCU-based systems with other platforms such as Arduino or Raspberry Pi, evaluating factors like cost, scalability, and ease of use. Lastly, it will discuss the advancement trends and technologies that emerge on temperature and humidity measurements into the future like inclusion of machine learning and AI toward the predictive analytics, and how edge computing affects broad based issues of IoT for environment.

Recommendations for Improved Design Area for Future Work.

The following paper will deal with the typical temperature and humidity monitoring system in its design and MQTT protocols. The paper will then go on to review the standard system design, which would include circuit design, sensor integration, and software development, particularly using the Arduino IDE to program the NodeMCU. Hardware requirements: Cloud integration, where data is sent to platforms

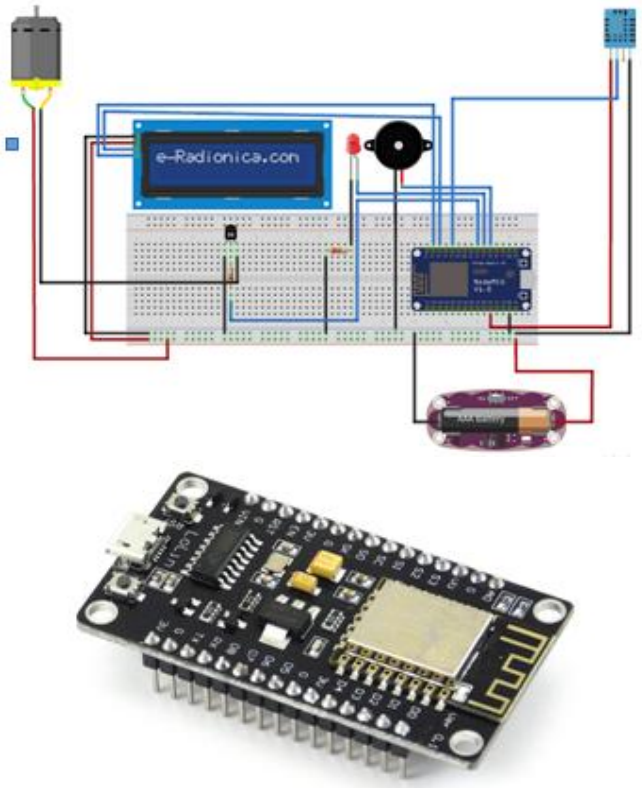

Fig. 2. NodeMCU

architecture. This will include the hardware design, wiring of NodeMCU with sensors, and other essential components like relays. This also considers the power supply requirements. This will be fol lowed by discussing software and programming, covering how the Arduino IDE writes and uploads code to interpret sensor data, process it, and send it to cloud-based platforms. The main focus on the software will be on simplicity, efficiency, and reliability. On the cloud-based platforms, besides data logging and visualization, user interfaces and mobile apps for real-time monitoring also

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will be discussed. The paper will discuss the NodeMCU-based monitoring systems through performance evaluation in terms of accuracy, reliability, and the power those powered by solar cells. This will be in the form of case studies related to agriculture, smart home, HVAC, and industrial monitoring. These examples are going to represent real-world implementation issues with these systems, plus challenges related to their actual deployment, like sensor drift, interference from wireless communication, and other scalabil ity issues. The work will compare NodeMCU-based systems with Arduino and Raspberry Pi types of microcontrollers. Relative merits and demerits of the platforms will be assessed on paper. Costs, scalability, ease of implementation, and per formance of each of these systems in the applications under consideration, such as temperature and humidity monitoring, will be compared. Finally, it will compare the commercial off-the-shelf systems with NodeMCU-based DIY systems by comparing trade-offs between flexibility, customization, and cost.

III. LITERATURE SURVEY

Cao-hoang et al [1] in their paper they proposed on Environment monitoring system for agricultural application based on wireless sensor network .This encompasses agricultural applications of a wireless sensor network. A fraction of this comprises environmental monitoring. Utilization This is one example of how a wireless sensor network is used together with temperature and humidity sensors in an integration system to obtain data for an agricultural application.

Firdaus et al [2] in their paper they proposed on real-time monitoring temperature and humidity system . . In return, the system provides solutions to so many applications like temperature monitor, industrial control, as well as home automation systems. This technology type in microcontrollers and an embedded system can be utilized smart homes, industries, agriculture, etc. It allows the automatic collection of data, its analysis, and can be used to provide accurate control over the environment.

Anuar et al [3] in their paper they proposed on Temperature and Humidity Monitoring System . This uses NodeMCU as an option that replaces traditional, and in comparison more expensive environmental monitoring of homes, schools, or small-scale industries in low-cost effi cient solutions to temperature and humidity monitoring. The project was made possible by using this resource which has the NodeMCU .

Baghyalakshmi [4] in their paper they proposed on Wireless Sensor Network for Temperature and Humidity Monitoring in a Nuclear Facility.Monitoring temperature and humidity in this study is significant in ensuring safety in nuclear facilities. The authors make use of wireless sensor networks that allow them to monitor these parameters in real time and with good accuracy. Such networks play a significant role in terms of ensuring that environmental conditions in nuclear facilities are safe, thus preventing possible dangers from temperature and humidity differences.

Resul et al[5] in their paper they proposed on Temperature and Humidity Control of the Tunnels in the Dam Using Wireless Sensor Networks . Then, it is visualized using platforms such as ThingSpeak, Google Firebase, or InfluxDB. These integrations help to visualize historical data, which can be helpful for research and industrial applications-for example, climate studies and HVAC systems.

Madhuri [6] in their paper they proposed on Review Paper on Internet of Things based Remotely Monitoring of Temperature and Humidity. Several research papers discuss mobile or web applications to connect to NodeMCU in real time to display temperatures and humidity levels. In such an application, the condition of the environment may be monitored from another remote location. Such locations can be a smart home, greenhouse, and a server room.

Singireddy et al [7] in their paper they proposed on IOT Based Remote Monitoring of Weather Parameters for Solar, Wind Applications . IoT has also been used in healthcare, with systems that allow remote temperature monitoring of patients, improving medical care. These systems demonstrate diverse applications of IoT in agriculture, civil en gineering, and healthcare, highlighting the growing importance in realtime monitoring and decision-making.

Abdulrazzak et al[8] in their paper they proposed on Humidity and temperature monitoring. Though this usage of NodeMCU on temperature and humidity monitoring has a good basis, other research studies found some few flaws like sensor accuracy, in the case of DHT11; and range of Wi-Fi signals and data latency on the cloud-based system. There are also challenges on the power consumption and hardware in most projects, especially the calibration of the sensors.

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IV. CONCLUSION

This paper discusses the privacy issues in blockchain ap plications and presumes various privacy-preserving methods. The most significant method used is Smart Contracts with data privacy preservation. In the study, different comparisons done on privacy-preserving methods and their limitations. This will, in the future, focus on the evaluation of secure and scalable blockchain platforms, designing architectures for blockchain that is going to address issues of privacy and anonymity, and investigating the combination of private and public blockchain architectures. An emebedded platform was used implementing real-time monitoring of temperature and humidity while relating floor elevation of the place to values of temperature and humidity in and out of buildings.

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