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IOT Based Weather Monitoring Data Acquisition System

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Abstract

An IoT-based weather monitoring system that collects and stores weather data allowing easier access and recording. It is also incorporated with the ability to predict future weather data based on previous recordings. Keeping track of weather conditions is one of the most concentrated areas in our current society. Weather monitoring systems are built to collect these data from a wide range of areas. And there exist satellite systems which do similar work over a wider range of area. The goal of this project is to develop weather monitoring system that can gather these same data over a given area over time. The system is made of hardware built with ESP8266 (NodeMCU) and a website. The hardware device and the server transfer data using the industry-standard HTTP connection protocol. There exist various sensors like temperature sensors, humidity sensors, rain sensors and pressure sensor which are suitable for the full functioning of the system. These sensors collect and transmit data to a server via a Wi-Fi module to be stored and can be accessed on the webpage. These data are then analyzed and used in predicting future data.

Keywords: IoT, Weather Monitoring, Real-time data collection, predictive analysis, low-cost solution

1. INTRODUCTION

Over the past few years, high-speed internet has revolutionized global connectivity, linking people across the world. This advancement has also enabled machines and devices to communicate via the Internet of Things (IoT). IoT connects physical objects embedded with sensors and software to share data over networks.

Smart devices that can recognize and react to changes in energy usage at the local and global levels are being created using IoT. In order to provide information on the weather at a particular location, Weather stations gather climatological information about the current weather in a particular area and forecast the local weather. However, the weather varies every day. Recording recent weather updates are necessary to get an accurate result. Before, people were cooped up in their homes, preoccupied with household chores or working in offices, and unaware of the economic and environmental boundaries and changes taking place outside of those structures. They were unaware of the outside climate's estimated

moisture content, the temperature outside, whether it was rainy or not, or whether it was normal or extremely high or low. This gadget can offer a useful resolution in these circumstances. Human life is significantly impacted by the weather. Collecting different weather components has many advantages for humans. To make it simple to check climate parameters, the study installed a framework for climate monitoring.

Numerous sensors, such as humidity, temperature, and others, are included in this framework. Climate parameters are preserved by clouds. As a result, anyone who has been verified can use the internet to access climate data from any location. The information is passed to verified people in the event of a disaster, such as a meaningful downpour, fire, temperature, unbearable wind, or soaker, which is very helpful in returning to the previous state. Several variables, such as air temperature, air pressure, moisture, and rainfall, affect a location's weather. By considering these elements, we can easily comprehend how the external environment is impacted (Shahadat et al., 2020). Weather monitoring holds great importance in society as it plays a crucial role in various areas. It enables the collection of information about weather changes, which is essential for agricultural field weather conditions, industrial conditions monitoring, and event planning (Al-Furati, Al-Assfor and Abdul Zahra, 2023; Sutar, 2020). The Internet of Things is defined as an open and extensive network of intelligent objects with the ability to self-organize, share information, data, and resources, and act and react in response to situations and changes in the environment (Madakam et al., 2015). Most common domains are now being impacted by the application of the Internet of Things. IoT systems have been developed to manage, control, and keep an eye on routine human behaviours, environmental conditions or animal behaviours (Mabrouki et al., 2021). For many years, people have tried to understand their surroundings. As a result, people have created a wide range of tools to measure different parameters. To measure temperature, atmospheric pressure, and solar radiation, respectively, humans created thermometers, barometers, and pyrometers. Conversely, using traditional tools necessitates taking direct readings from instruments. On the other hand, thanks to the development of IoT, humans cannow remotely measure industry. Weather monitoring allows us to keep an eye on factors like temperature, humidity, atmospheric pressure, light rain, wind speed, and wind direction. To keep the industrial and agricultural sectors in balance, all weather variables must be present. Several different human activities are impacted by the weather. Although they have some similarities, people often confuse weather and climate.

2. SYSTEM ARCHITECTURE

This paper involves the creation of an IOT-based weather station that collects weather data over time. It detects weather conditions, stores them in a cloud system, and predicts future weather conditions. The work split into two parts: an Arduino-based IoT weather station and a web application. The IoT weather monitoring system is made up of a NodeMCU ESP8266 development board, jumper wires, a DHT11 temperature/humidity sensor, a rain sensor, and a battery power source. Thingspeak is the IoT platform for displaying sensor data which is the platform being considered in this project. The method is split into two parts, hardware engineering and software development, as was previously mentioned. The hardware development process includes both the steps of creating circuits and creating prototypes. Also included in the software are circuit simulation, schematic diagrams, data acquisition, and IoT coding.

The data is then wirelessly transferred to the Thingspeak IoT platform over the ESP98266 Wi-Fi network. The system's controller, the ESP8266, gathers all of the data collected by the sensors that are connected to it. (Kamble et al., 2017). Figure 1 shows the block diagram of the entire system design.
The system is able to display the weather by analysing the current conditions using sensor value data. Three types of sensors—temperature, humidity, rain, and pressure is used to track the weather parameters. A microcontroller called NodeMCU is in charge of managing all the data, and an Esp8266 serve as the client, getting sensor data from NodeMCU and displaying it online. IoT technology is generally suggested to be used as a medium of communication for this project as was mentioned in the preceding section. After the microcontroller ESP8266 is set up all of the sensors and has started reading data from them, the system process starts.

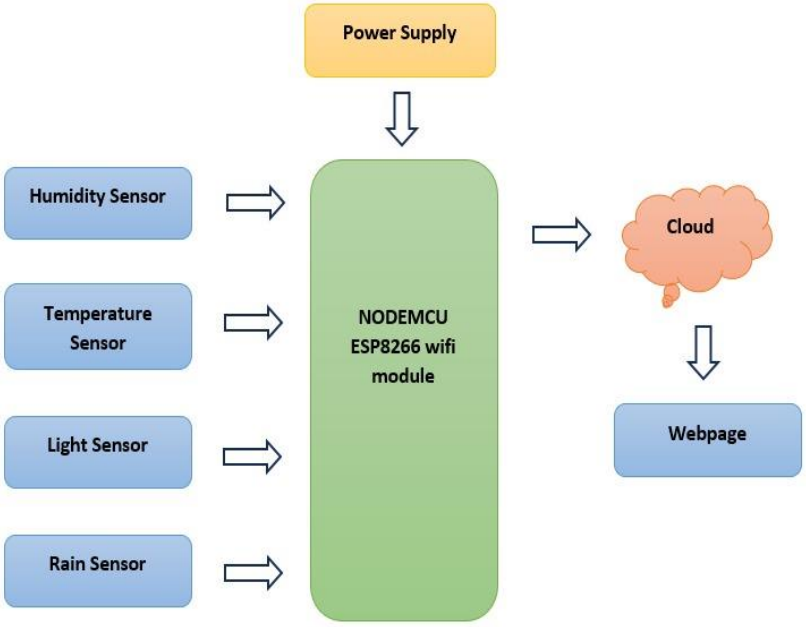

Fig 1: Block diagram of weather data acquisition system

This block diagram represents method is split into two parts, hardware engineering and software development, as was previously mentioned. The hardware development process includes both the steps of creating circuits and creating prototypes. Also included in the software are circuit simulation, schematic diagrams, data acquisition, and IoT coding. The system is able to display the weather by analysing the current conditions using sensor value data. Three types of sensors—temperature, humidity, rain, and pressure is used to track the weather parameters. A microcontroller called NodeMCU is in charge of managing all the data, and an Esp8266 serve as the client, getting sensor data from

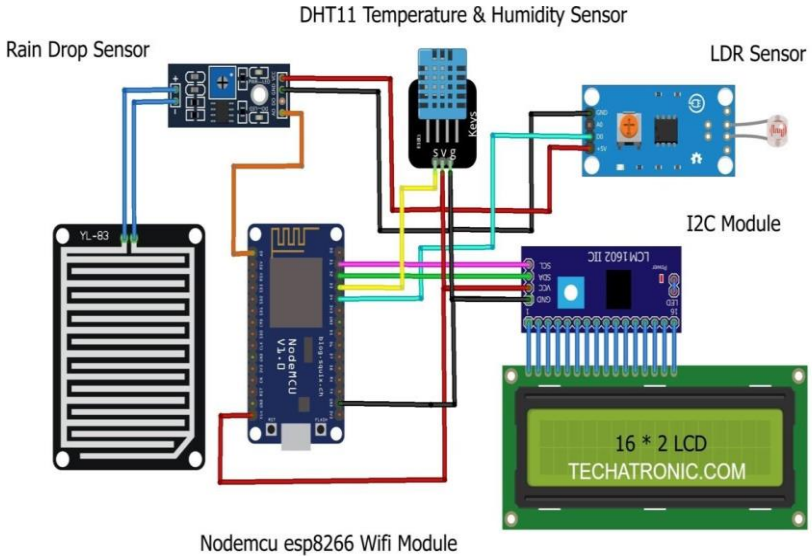

Fig 2: Circuit connection of hardware system

NodeMCU and displaying it online. IoT technology is generally suggested to be used as a medium of communication for this project as was mentioned in the preceding section. Reddy et al. proposed an inexpensive weather monitoring system based on internet-of-things technology in 2018. For sensing the air quality, the proposed system made use of several electronic sensors, including those that could detect hydrocarbons, Sulphur dioxide, nitrogen oxides, and others. The system activated the warning alarm if it received dangerous gas values. Additionally, it can send a Short Message Service (SMS) message to the end user. Finally, it was linked to a distance database created to keep track of previous measurements. Following that, Kumari et al. proposed an IoT-based, Android-based system for monitoring the environment. The system's capabilities include measuring some of the soil, water, and air factors that are used to assess the environment. The system has some sensors connected to a Raspberry Pi card because of these factors. After receiving the measured parameters, the card uses a wireless network to send its values to a remote database.

3. SYSTEM IMPLEMENTATION AND RESULTS

The components used in any system have a significant impact on its design and implementation. A system's design can be significantly impacted by poor component selection. When choosing components, keep the following things in mind: i. The necessary performance and capacity. ii. The initial capital and continuous costs. iii. Utilization and reliability. The components selected for the proposed model are;

i. NodeMCU ESP8266 development board.
ii. DHT11 humidity/temperature sensor.
iii. Rain Water sensor., light sensor.
iv. Jumper wires.
v. Power source.

Fig 3: DHT11 sensor

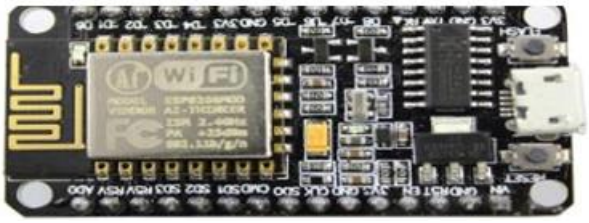

Fig 4: NodeMCU with ESP8266

Fig 5: Rain sensor

IoT-based Weather Monitoring and Reporting System project is used to get live weather conditions. It will monitor temperature, humidity, moisture, and rain level. Suppose Scientists/ nature analysts want to monitor changes in a particular environment like a volcano or a rainforest. And these people are from different places in the world. In this case, SMS based weather monitoring system has some limitations since it sends SMS to a few numbers. And time for sending SMS increases as the number of mobile numbers increases. To know the information about the weather of a particular place then they have to visit that particular sites where everyone can see it. Nivedan.V (2019), proposed that this project predominantly combines the two-study fields- based control systems and data gathering techniques to create an extensive database system depending on the employed attributes to generate the presented data. The main things here have been chosen based on the sensors used vividly to build the system to design a productive weather monitoring project. The recommended sensors are used here to measure and gather the Temperature and Humidity data.

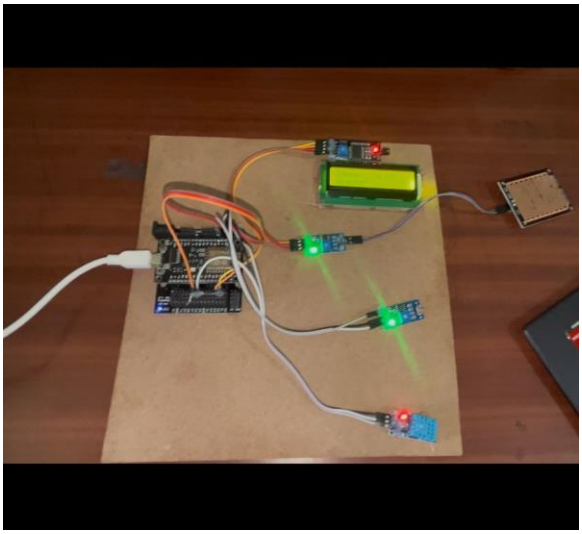

Fig 6: Weather monitoring data acquisition system

1. Real-Time Monitoring: Provides up-to-date weather data, enabling timely actions and informed decision-making.
2. Remote Accessibility: Weather data can be accessed from anywhere using internet-connected devices, enhancing convenience.
3. High Accuracy and Efficiency: IoT sensors deliver precise and reliable weather data with minimal human error.
4. Cost-Effectiveness: Reduces manual intervention, operational costs, and resource waste through automation.
5. Early Warning System: Sends alerts for extreme weather conditions, aiding disaster preparedness and response.
6. Scalability: Additional sensors can be added to monitor more parameters, allowing the system to grow with needs.
7. Data Storage and Analytics: Enables long-term storage of weather data on the cloud for trend analysis and forecasting.
8. Energy Efficiency: Modern IoT devices consume minimal energy, making them suitable for long-term remote deployments.
9. Customization: Can be tailored to specific requirements, such as agriculture, urban planning, or industrial applications.

4. CONCLUSION

This work which entails designing and installing an online weather monitoring system, was planned with weather conditions, component and research availability of materials, efficiency, compatibility and mobility, and durability in mind. The project's performance following the test was in line with design parameters. The operation is also dependent on how effectively the soldering is done and how well the components are positioned. If substandard soldering lead is used, the circuit may produce a dry joint too soon, causing the project to fail Packaging, component quality, handling, and usage are all factors that could affect performance. For future research, the project work can be improved upon. The following

areas were highlighted for this purpose. The whole circuitry can be reduced by using integrated circuits with a larger scale of integration. A larger-scale integrated circuit can be used so that other means of authentication could be used to cut across to the less privileged in the society (e.g, visually impaired individuals)). Moreover, it is recommended that students be enlightened on new areas of technology that are yet to be addressed to solve the various problems man faces in his day-to-day activities.

REFERENCES

1. Ahmed, E. M. E., Abdalla, K. H. B., & khider Eltahir, I. (2018). Farm automation based on IoT. International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE) (pp. 1-4). IEEE
2. AI FOR BUSINESS.(n.d.)https://www.intelgorithm.com/
3. Al Amin, M. S., Islam, M. R., & Khalid, M. S. (2019). IoT based smart farming: A review. IEEE Access, 7, 73765 73777.
4. Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of Things:A survey on enabling technologies, protocols, and applications. IEEE Communications Surveys & Tutorials, 17(4), 2347-2376.
5. Al-Turjman, F., Alshamrani, S., & Alsolami, F. (2019). An IoT-Based Weather Monitoring System: Design, Implementation and Evaluation. Sensors, 19(8), 1842.
6. Bhagat A., Thakare A., and Choudhary K. (2019). IoT Based Weather Monitoring and Reporting System Project. International Journal of Trend in Scientific Research And Development, 3(3):365-367.
7. Chaudhari, A. (2018). Internet of Things and Regulations. Internet of Things, for Things, and by Things,181 – 196.
8. Vardhini, P. H. (2017). Efficient irrigation system powered by solar panel setup with tracking mechanism. International Journal of Emerging Technologies and Innovative Research, 4(3), 238-241.
9. P. A. H. Vardhini, R. Pavan Kumar, T. Singh, H. V. R. Puliyala and S. Chamarthy, "Efficient IoT based Smart Home Assistance System with Electrical Control Unit," 2022 International Mobile and Embedded Technology Conference (MECON), Noida, India, 2022, pp. 475-479, doi: 10.1109/MECON53876.2022.9752276.
10. Girija, C., Grace, S. A., Harshhalatha, H., & Pushpalatha, H. P. (2018). Internet of Things (IOT) based weather monitoring system. Int. J. Eng. Res. Technol. (IJERT). ISSN, 2278-0181.
11. Han, S., Yu, X., Huang, Y., Hu, Y., & Wang, Y. (2020). Design of an IoT-based air quality monitoring system. Journal of Ambient Intelligence and Humanized Computing, 11(8), 3565- 3577.
12. H Vardhini and Raju G. Janardhana, "Design of Internet of Things Based Smart and Efficient Water Distribution System for Urban and Agriculture Areas", Journal of Computational and Theoretical Nanoscience, vol. 17, no. 9–10, pp. 4688-91, Jul 2020.
13. Vardhini, P. H., & Hanku, V. Energy efficient implementation of IoT based home irrigation system using Raspberry Pi. In 1st international conference on advanced technologies in engineering management & sciences (pp. 218-223).
14. Li, X., Lu, L., & Fu, C. (2020). IoT sensors for industry 4.0: A review. IEEE Internet of Things Journal, 7(7), 5584 5602.
15. P. A. H. Vardhini, V. K. R. Yasa and G. J. Raju, "Raspberry Pi Vehicle Gateway System with Image

Processing based Authorization Detection using IoT," 2021 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Bangalore, India, 2021, pp. 1-5, doi: 10.1109/CONECCT52877.2021.9622528.

16. Lobos, G. A., Peralta, N. R., & Acuña, G. E. (2018). IoT-based precision agriculture: A review of smart farming technologies and applications. Computers and Electronics in Agriculture, 143, 283-297.
17. D. N. Lakshmi Koustubha, B. Shri S and P. Upender, "Brake Smart: Harnessing IoT and Ultrasonic Technology for Collision-Free Driving," 2025 IEEE International Students' Conference on Electrical, Electronics and Computer Science (SCEECS), Bhopal, India, 2025, pp. 1-6, doi: 10.1109/SCEECS64059.2025.10940068.
18. Nivedan V. (2019). Weather Monitoring System using IoT with Arduino Ethernet Shield. International Journal for Research in Applied Science and Engineering Technology, 7(1), 218 – 221.
19. Vardhini, P. H., Koteswaramma, N., & Babu, K. M. C. (2019). IoT based raspberry pi crop vandalism prevention system. International Journal of Innovative Technology and Exploring Engineering, 9(1), 3188-3192.
20. Patel, K. K., & Patel, S. M. (2016). Internet of things-IOT: definition, characteristics, architecture, enabling technologies, application & future challenges, international journal of engineering science and computing, 6(5).
21. Vardhini, D., Babu, K. C., & Rani, D. (2019). Raspberry Pi based automated and efficient irrigation system with add-on field security. International Journal of Advanced Science and Technology, 28(19), 192-196.
22. Mabrouki J., M. Azrour, D. Dhiba, Y. Farhaoui and S. E. Hajjaji (2021) “IoT-based data logger for weather monitoring using Arduino-based wireless sensor networks with remote graphical application and alerts, “in Big Data Mining and Analytics, vol. 4(1), pp. 25-32.
23. Vardhini, P. H., Babu, Y. M. M., & Veni, A. K. (2019). Industry Parameters Monitoring and Controlling system based on Embedded Web server. International Journal of Emerging Technologies and Innovative Research, 6(2), 80-84.]
24. V. Sreelatha Reddy, S. Harivardhagini and G. Sreelakshmi, "IoT and Cloud Based Sustainable Smart Irrigation System", E3S Web Conf., vol. 472, no. 2024.
25. Vardhini, P. H., & Babu, K. M. C. (2022, February). Iot based autonomous robot design implementation for military applications. In 2022 IEEE Delhi Section Conference (DELCON) (pp. 1-5). IEEE.
26. P. A. H. Vardhini, V. K. R. Yasa and G. J. Raju, "Raspberry Pi Vehicle Gateway System with Image Processing based Authorization Detection using IoT," 2021 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Bangalore, India, 2021, pp. 1-5, doi: 10.1109/CONECCT52877.2021.9622528.
27. Saude, Natasha et. al, "Iot based smart baby cradle system using raspberry pi b+." 2020 International Conference on Smart Innovations in Design, Environment, Management, Planning and Computing (ICSIDEMPC). IEEE, 2020.
28. Rajeshwari, T., and PA Harsha Vardhini. "Smart Crop Cultivation with Disease Monitoring and Control System." International Journal of Recent Technology and Engineering 8.4 (2019): 7537-7540.
29. Kumar, R. Sravanth, et al. "Artificial intelligence based human attention detection through brain

computer interface for health care monitoring." 2021 IEEE International Conference on Biomedical Engineering, Computer and Information Technology for Health (BECITHCON). IEEE, 2021.
30. Upender, Patri. "Soil moisture estimation with PALSAR data near Roorkee region." 2015 National Conference on Recent Advances in Electronics & Computer Engineering (RAECE). IEEE, 2015.
31. T. Rajeshwari, P. A. Harsha Vardhini, K. Manoj Kumar Reddy, K. K. Priya and K. Sreeja, "Smart Agriculture Implementation using IoT and Leaf Disease Detection using Logistic Regression," 2021 4th International Conference on Recent Developments in Control, Automation & Power Engineering (RDCAPE), Noida, India, 2021, pp. 619-623, doi: 10.1109/RDCAPE52977.2021.9633608.
32. Deepthi, S., et al. "IOT Enabled Forest Fire Detection and Management." International Journal of Engineering Research & Technology (IJERT) 8.11 (2020): 196-199.
33. Nayana, P. N., et al. "Design of a Portable Real-Time Health Monitoring Model using IOT and Thing Speak."
34. Sricharan, Bachu, et al. "RFID based ATM security system using IOT." 2022 International Conference on Intelligent Controller and Computing for Smart Power (ICICCSP). IEEE, 2022.
35. Pydi, Balamurali, et al. "An improved low-carbon intelligent agriculture system with energy optimization principles using wireless IoT environment." Transactions on Emerging Telecommunications Technologies 35.3 (2024): e4948.
36. R. Bolimera, M. Rachana, S. Kaveri, K. R. Kiran, C. Venkanna and G. V. Krishna, "IoT Based Fire and Motion Detection System," 2025 IEEE International Students' Conference on Electrical, Electronics and Computer Science (SCEECS), Bhopal, India, 2025, pp. 1-5, doi: 10.1109/SCEECS64059.2025.10940974.