Iot Based Weather Reporting System Using AI Technique

R. Vijayalakshmi*[1], G. Abinaya*[2], P. Deepika*[3], R. Indira Prabha*[4], S. Priyadharshini*[5]
*[1]*Assistant Professor, Student (UG), Department of Electrical and Electronics Engineering, Nandha Engineering College (Autonomous), Erode, India.*

Abstract: Traditional weather forecasting methods often face limitations in accuracy. Accurate weather forecasts are crucial for implementing proactive safety measures, especially in regions prone to natural disasters. By addressing these needs, the IoT- based weather reporting system with AI integration aims to revolutionize how we collect, analyse, and utilize weather data for the benefit of society and various industries. Weather plays a significant role in transportation safety and logistics. Timely and accurate weather information helps in planning routes, managing traffic, ensuring the safety of commuters, thereby improving overall transportation efficiency. Farmers heavily depend on weather patterns for crop management. This project focuses on developing an IoT-based weather reporting system enhanced with AI techniques. Leveraging Internet of Things (IoT) devices for data collection, the system integrates advanced artificial intelligence algorithms to analyse and predict weather patterns. The AI algorithms process real-time data from various sensors to provide accurate and timely weather reports. This approach aims to enhance the precision of weather forecasting, enabling better preparedness for adverse conditions and facilitating informed decision-making in diverse sectors.

Keywords: Weather monitoring, IoT, Artificial Intelligence, ESP32 camera module, MSP430 microcontroller.

I. INTRODUCTION

The Internet of Things (IoT) has altered the way which connect with the surrounding. It has enabled everyday objects to be connected and communicate with each other, leading to a more efficient and smarter world. IoT has had a significant impact on various industries, such as healthcare, transportation, manufacturing and agriculture, by providing real-time data about processes, systems and environments. This continuous data collection and analysis have led to improved decision-making, increased efficiency, and cost savings. One of the key areas where IoT has made a significant impact is weather monitoring and reporting. Traditional weather monitoring systems rely on manual measurements and weather stations covering limited areas. These systems are often expensive, require manual installation and maintenance, and have a high risk of human error. As a result, they cannot provide timely and accurate weather information that is crucial for various industries and individuals. To overcome these limitations, we propose an IoT-based weather reporting system that leverages artificial intelligence (AI) techniques to enhance the accuracy and efficiency of weather monitoring and reporting. This system uses sensors, microcontrollers, AI technology, and other components to collect and analyse real-time weather data and provide accurate weather forecasts. The proposed system incorporates various sensors such as CO2, O2, wind speed, LM35, humidity, dust, and rain sensors, which are strategically placed in different locations to collect data on different weather parameters. These sensors are connected to an MSP430 microcontroller, which acts as the central processing unit of the system. The microcontroller collects data from the sensors and sends it to the cloud server for further analysis. The data is then analysed using AI techniques, specifically artificial intelligence Internet of Things (AIIOT) technology. This technology combines AI and IoT to analyse large amounts of data and make intelligent decisions based on data patterns and trends. The AIIOT technology used in our system uses machine learning algorithms to analyse the weather data and provide accurate weather forecasts. To ensure the reliability and security of the system, an alarm and ESP32 CAM have been integrated into the system. The alarm is used for warning of severe weather conditions, such as hurricanes, tornadoes, and floods, providing individuals and industries with enough time to take necessary precautions. The ESP32 CAM, a camera module, is used for additional security measures, as it captures images of the weather conditions and sends them to the cloud server for further analysis. The data collected and analysed by the system is displaced on an LCD screen, making it easily to accessible to users. The system's user-friendly interface allows individuals and industries to access real-time weather information and make informed decisions. Our IoT-based weather reporting system offers a cost-effective and efficient solution for monitoring and reporting weather conditions. The system's wireless and automated design eliminates the need for manual measurements and maintenance, reducing the overall cost and labour. Also, the real-time data collection and analysis provide accurate weather information, which is crucial for various industries like agriculture, transportation and disaster management. The system's AI technology not only enhances accuracy but also helps in predicting natural disasters and taking necessary precautions beforehand. This proactive

approach can save lives and prevent potential damages caused by severe weather conditions. In conclusion, our proposed IoT-based weather reporting system offers a comprehensive and intelligent solution for monitoring and reporting weather conditions. By incorporating AI techniques and utilizing a combination of sensors and microcontrollers, the system provides accurate real-time data and helps in predicting natural disasters. The system's reliability, security, and cost-effectiveness make it a valuable asset for various industries and individuals. With continuous advancements in IoT and AI technologies, such innovative systems have the potential to transform the way we monitor and forecast weather, ultimately leading to a safer and more efficient world.

II. LITERATURE SURVEY

The author says that weather prediction has been a challenge as a result of the severity and frequency of increased extreme weather events over the last 30 years [1]. Various weather parameters including temperature, pressure, humidity and rain value are collected by using a variety of sensors. An LDR sensor is also included which provides the value of light intensity. An alert SMS is sent when the weather condition is abnormal [2]. Real-time weather data are collected and displayed on the OLED which are then stored on the cloud and can be accessed through ThinkSpeak website [3]. Machine learning makes it easier by avoiding the physical processes for collecting weather data. It uses the stored past data for the prediction of future weather conditions [4,5,6]. NodeMCU is interfaced with temperature and raindrop sensors and the weather data can be accessed through the ThinkSpeak website [7]. Connecting mobile phone to GSM via wireless network and then to microcontroller provides real-time weather data. GSM sends an alert SMS during extreme weather events [8]. A vehicle with installed mobile weather station in it collects and sends weather data to receivers through both wired and wireless technologies along the path it travels. However, this system only works when the vehicle is in motion [9]. Now-a-days urban areas get severely affected by air contamination and this has evil effects on people, plants and other creatures [10]. Hence it is necessary to sense the presence of O2, CO2 and dust present in atmosphere.

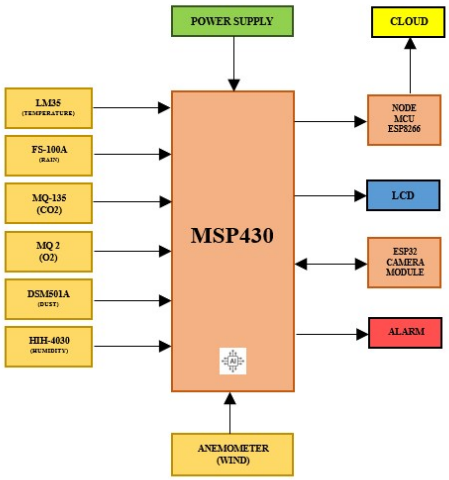

Fig. 1 Block Diagram

III. PROPOSED SYSTEM

The Internet of Things (IoT) has displayed remarkable potential in various fields like healthcare, transportation, agriculture, and more. It enables seamless connectivity and data exchange between physical devices, thereby transforming the way we collect, analyze, and utilize data. The immense benefits of IoT have led to its widespread implementation in different industries and one such area is weather monitoring and reporting. Accurate and timely weather information is crucial for various sectors, including agriculture, transportation, disaster management and more. Traditional weather monitoring systems rely on manual data collection, which is time-consuming and often lacks accuracy. With the advancement of technology, an IoT- based weather reporting systems and provides real-time data analysis, making it an efficient solution for monitoring and predicting weather conditions. In this system, we have proposed an IoT- based weather reporting system that utilizes an artificial intelligence (AI) technique to accurately monitor and report weather conditions. The system incorporates various sensors, a microcontroller and AIIOT technology to collect, analyse and report weather data in real-time. The inclusion of an alarm and ESP32 CAM ensures the system's reliability and security, making it an ideal solution for diverse industries.

Hardware Components Description

MSP430 Microcontroller

The MSP430 microcontroller is the brain of the system. It acts as an internally between the sensors and the AI technology, receiving data from the sensors and sending it to the AI algorithm for analysis. It also provides control over the connected devices, such as the alarm and the camera.

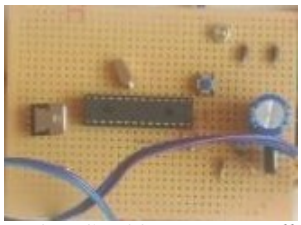

Fig. 2 MSP430 Microcontroller

ESP32-CAM

The ESP32 CAM is a small camera module with built-in Wi-Fi and Bluetooth capabilities. It is used in the system to capture images and transmit them to the display unit where the user can view them. This feature is particularly useful in cases where visual confirmation is required to validate the weather conditions.

Fig. 3 ESP32-CAM

Sensor Unit

The sensor unit is responsible for collecting data related to various weather parameters. It comprises the CO2, O2, wind speed, LM35, humidity, dust and rain sensors connected to the MSP430 microcontroller. *Table 1* gives details of the sensors used.

PARAMETER	SENSOR USED
CO2	MQ-135
O2	MQ2
Wind Speed	Anemometer
Temperature	LM35
Humidity	HIH-4030
Dust	DSM501A
Rain	FS-100A

Table 1 Sensors Used

Display Unit

The 16x2 LCD display shows the output parameters in 2 lines having 16 characters in each. Various sensor outputs including temperature, wind speed, air quality, and humidity are displayed on the LCD. This makes the system more convenient for the users.

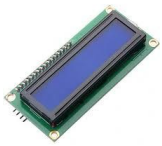

Fig. 4 16x2 LCD

NodeMCU ESP8266

Node MCU is a small powerful board which is of low cost. It connects to the internet and communicates with cloud platforms to transform data. The usage of node MCU can reduce the amount of data transmitted over the network and thus optimize the usage of bandwidth.

Fig. 5 NodeMCU ESP8266

Alarm

To ensure the system's reliability, an alarm is included in the design. It serves as a warning system in case of any drastic changes in the weather conditions. For instance, if the system detects a sudden increase in CO2 levels or wind speed, the alarm will be triggered, alerting the user to take necessary precautions.

Fig. 6 Alarm

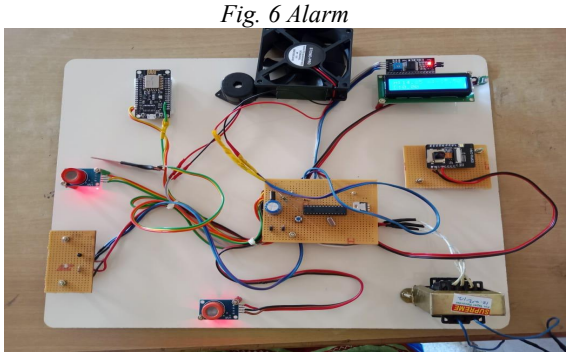

Fig. 7 IoT Based Weather Monitoring Using AI Technique

IV. RESULT AND DISCUSSION

The value of the wind speed sensor is 1 mile per hour, which indicates that the wind is in its normal range. The value of the temperature sensor LM35 is 30. 3°C.The rain sensor shows 8mm/hr. which denotes that it is also in its normal range. The humidity sensor shows 13.68% which denotes the humidity in the atmosphere is very low. The value of CO2 sensor and O2 sensor are 30% and 65% respectively. Dust sensor sensed the presence of dust as 0.39%. LCD displays the values which the units are measured by the sensors. During abnormal conditions, the alarm buzzers are used to inform the extreme weather condition and the values are go beyond the normal range. As well as an image is sent to the telegram bot that shows the picture of current extreme weather. An alert message is also displayed on the ThinkSpeak mobile application.

Fig. 8 Output on LCD

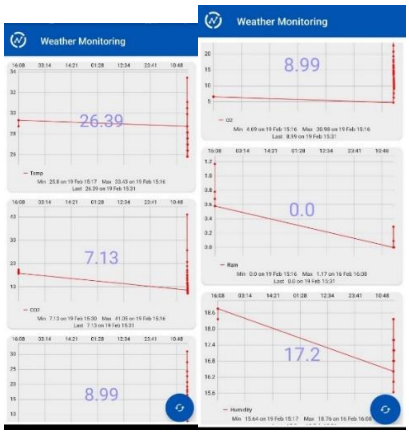

Fig. 9 Outputs on Thinkspeak Website

V.CONCLUSION

This concept which combines Artificial Intelligence and IoT techniques has a great potential which transform the way of gathering and utilizing data. The use of sensors and AI method facilitates the analysis of real-time data for weather forecasting. This data can provide valuable weather information for industries, agricultural fields, etc. The addition of alert and security measure elements made this device a more dependable and user-friendly weather monitoring solution.

REFERENCES

[1] Mary Nsabagwaa, Maximus Byamukamab, Emmanuel Kondelaa, "Towards a robust and affordable Automatic Weather Station".

[2] Ravi Kishore Kodali and Snehashish Mandal "IoT Based Weather Station" 2016 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT) 978-1-5090- 5240-0/16/$31.00, IEEE, (2016).

[3] Ravi Kishore Kodali and Archana Sahu "An IoT based Weather Information Prototype Using WeMos" 2016 2nd International Conference on Contemporary Computing and Informatics (ic3i), 978-1-5090-5256- 1/16/$31.00, IEEE, (2016).

[4] Hasan, N.; Uddin, M.T.; Chowdhury, N.K. Automated weather event analysis with machine learning. In Proceedings of the IEEE 2016 International Conference on Innovations in Science, Engineering and Technology (ICISET), Dhaka, Bangladesh, 28–29 October 2016; pp. 1–5.

[5] Lai, L.L.; Braun, H.; Zhang, Q.P.; Wu, Q.; Ma, Y.N.; Sun, W.C.; Yang, L. Intelligent weather forecast. In Proceedings of the IEEE International Conference on Machine Learning and Cybernetics, Shanghai, China,26–29 August 2004; pp. 4216–4221.

[6] C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of ELECTRICAL ENGINEERING, Vol.63 (6), pp.365-372, Dec.2012.

[7] C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011.

[8] C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011.

[9] C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.

[10] Nagarajan C., Neelakrishnan G., Akila P., Fathima U., Sneha S. "Performance Analysis and Implementation of 89C51 Controller Based Solar Tracking System with Boost Converter" Journal of VLSI Design Tools & Technology. 2022; 12(2): 34–41p.

[11] C. Nagarajan, G.Neelakrishnan, R. Janani, S.Maithili, G. Ramya "Investigation on Fault Analysis for Power Transformers Using Adaptive Differential Relay" Asian Journal of Electrical Science, Vol.11 No.1, pp: 1-8, 2022.

[12] G.Neelakrishnan, K.Anandhakumar, A.Prathap, S.Prakash "Performance Estimation of cascaded h-bridge MLI for HEV using SVPWM" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:750-756

[13] G.Neelakrishnan, S.N.Pruthika, P.T.Shalini, S.Soniya, "Perfromance Investigation of T-Source Inverter fed with Solar Cell" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:744-749

[14] C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007

[15] M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022

[16] M Suganthi, N Ramesh, CT Sivakumar, K Vidhya, "Physiochemical Analysis of Ground Water used for Domestic needs in the Area of Perundurai in Erode District", International Research Journal of Multidisciplinary Technovation, pp: 630-635, 2019

[17] Salman, A.G.; Kanigoro, B.; Heryadi, Y. Weather forecasting using deep learning techniques. In Proceedings of the 2015 IEEE International Conference on Advanced Computer Science and Information Systems (ICACSIS), Depok, Indonesia, 10–11 October 2015; pp. 281–285.

[18] Kavya Ladi, A V S N Manoj, G V N Deepak, "IOT Based Weather Reporting System to Find Dynamic Climatic Parameters", International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS-2017).

[19] P. Susmitha, G. Sowmyabala "Design and Implementation of Weather Monitoring and Controlling System", International Journal of Computer Applications (0975 – 8887) Volume 97– No.3, (July 2014). Cybernetics, Shanghai, China,26–29 August 2004; pp. 4216–4221.

[20] Foina, A.; I-Deeb, A.E. PeWeMoS-Pervasive Weather Monitoring System. In Proceedings of the 2008 3rd International Conference on Pervasive Computing and Applications (ICPCA), Alexandria, Egypt, 6–8 October2008.

[21] R. Vijayalakshmi, V. Aarthi, L. Devika, S. Sandhiya, "Air pollution detection and control using Internet of Things". In proceedings of the 2021 International Research Journal of Modernization in Engineering Technology and Science. Volume:03/Issue:03/March-2021.