ENGINEERING IN ADVANCED RESEARCH SCIENCE AND TECHNOLOGY

ISSN 2386-7876
Vol.01, Issue.03
March-2026
Pages: 401-408

A WIRELESS FRAMEWORK FOR ENVIRONMENTAL MONITORING AND INSTANT RESPONSE ALERT

[1] **S.Raghava Rao**, [2] **Ankam Naga Srivalli**, [3] **Perabathula Satya Lavanya**, [4] **Molleti Meghana**, [5] **Adinipeta Manikanta**, [6] **Vittanala Eswari**

[1]M.Tech(Ph.d),Associate professor, Dept of E.C.E, BVCITS, Batlapalem, Amalapuram, AP

[2,3,4,5,6]B. Tech, Dept of E.C.E, BVCITS, Batlapalem, Amalapuram, AP

Abstract This paper proposes an advanced wireless framework for real-time environmental monitoring integrated with an instant response alert system. The system leverages IoT-based sensor nodes to monitor parameters such as temperature, humidity, air quality, and hazardous gases. Data is transmitted via ESP32 modules to cloud platforms for processing and visualization. Threshold-based intelligent alert mechanisms are implemented to notify users instantly through mobile applications, SMS, and email. The proposed system is scalable, cost-effective, and highly efficient for applications in smart cities, industries, and agriculture.

Keywords: Environmental Monitoring, IoT, ESP32, Wireless Sensor Networks, Instant Alert System, Smart Cities, Cloud Computing

Introduction: Environmental pollution and climate change have increased the demand for real-time monitoring systems. Conventional systems are inefficient due to delayed responses. This work introduces a wireless IoT-based solution that ensures continuous monitoring and immediate alerts. The system enhances safety and minimizes environmental risks. Natural disasters such as floods, earthquakes, and landslides cause major destruction to life and property. Many remote areas lack reliable communication systems to alert residents on time. This project introduces a wireless alert system that provides instant disaster notifications using GSM and IoT technology. The aim is to create a responsive system that operates even during power cuts and network failures. It collects data through environmental sensors and transmits it wirelessly for real-time monitoring. Such systems can help authorities take early action, ensuring community preparedness and minimizing the risks associated with natural disasters effectively.

Literature Survey: Various environmental monitoring systems have been developed using IoT and WSN technologies. Zigbee-based systems offer low power consumption but limited range. GSM-based systems provide wide coverage but incur higher costs. Recent advancements using ESP32 and Wi-Fi enable cost-effective and high-speed communication. However, many systems lack real-time alert mechanisms and scalability. This paper improves upon existing solutions by integrating cloud-based analytics and instant notifications. UP NOAH plays a major role in strengthening disaster resilience in the Philippines by creating detailed multi-hazard and risk maps. These maps covering floods, landslides, storm surges, and other threats provide communities and agencies with crucial information for planning and early preparedness. The system combines scientific data and real-time monitoring to support safer and more informed decision-making during natural disasters. The NOAH Initiative also uses an online WebGIS platform to display real-time hazard data on interactive maps. Through this system, users can access information such as rainfall intensity, weather forecasts, and flood modelling results directly from a web interface. This improves the speed and accuracy of disaster response, allowing both the public and local government units to view updated conditions and act accordingly. Wireless Sensor Networks (WSN) are widely used in real-time monitoring applications across many fields. These networks enable continuous data collection for disaster detection, environmental sensing, healthcare monitoring, agriculture automation, and industrial systems. They provide fast, reliable updates on physical conditions, although challenges such as energy consumption and long-term reliability still exist. Overall, WSN technology is essential for systems that require constant and immediate information.

System Architecture: The system architecture consists of sensor nodes, ESP32 communication module, cloud server, and user interface. Sensors collect environmental data and send it to ESP32. ESP32 transmits data to the cloud where analysis is performed. Alerts are generated and sent to users via mobile applications.

Block Diagram:

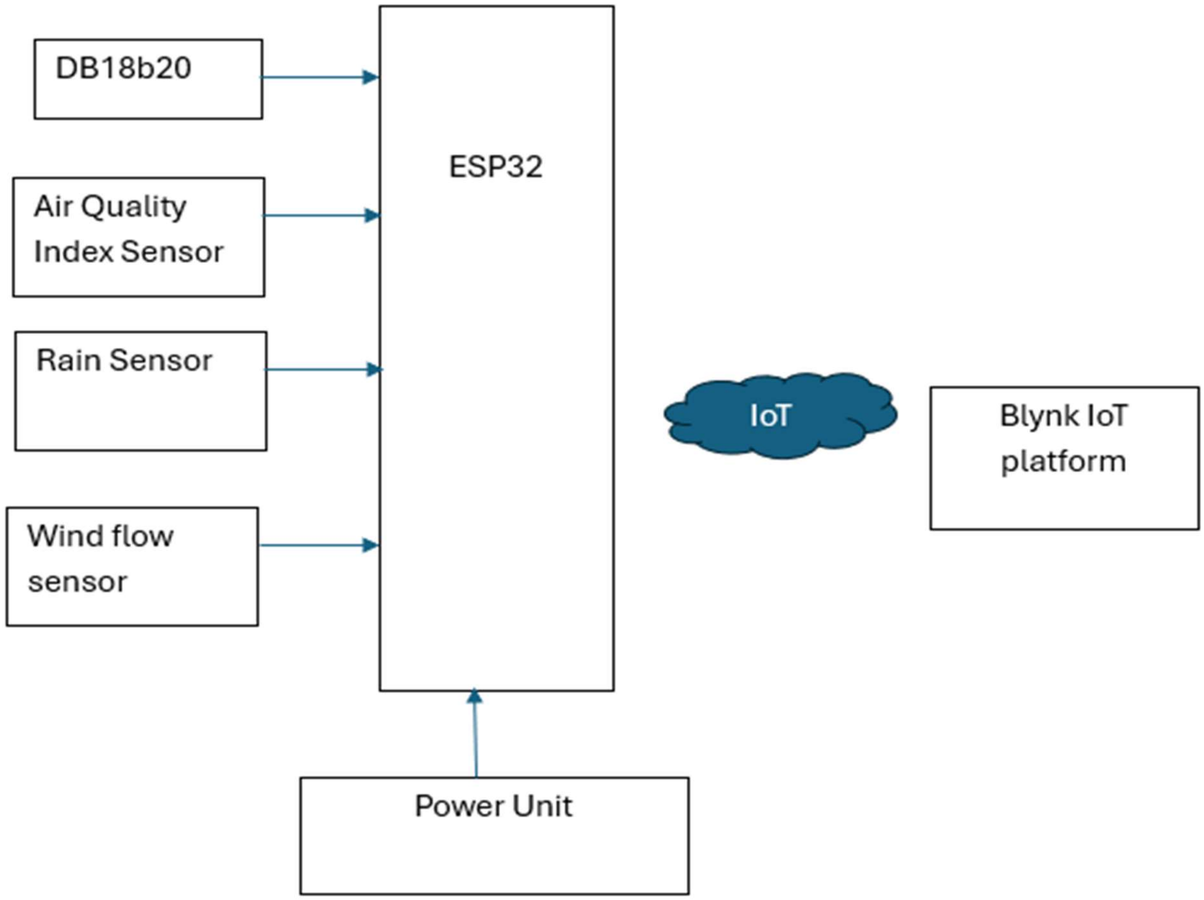

Fig1: Proposed Block diagram

The system includes multiple sensor nodes connected to ESP32. Data flows from sensors to ESP32, then to cloud servers. Users access data through mobile apps and receive alerts in real time.

The system operates in four phases:
1. Data Acquisition
2. Data Transmission
3. Data Processing
4. Alert Generation

Sensors continuously capture data, which is transmitted to the cloud. If thresholds are exceeded, alerts are generated instantly.

DS18B20 TEMPERATURE SENSOR:

The digital temperature sensor like DS18B20 follows single wire protocol and it can be used to measure temperature in the range of -67oF to +257oF or -55oC to +125oC with +-5% accuracy. The range of received data from the 1-wire can range from 9-bit to 12-bit. Because, this sensor follows the single wire protocol, and the controlling of this can be done through an only pin of Microcontroller. This is an advanced level protocol, where each sensor can be set with a 64-bit serial code which aids to control numerous sensors using a single pin of the microcontroller.

Fig2:DS18B20 Temperature Sensor

AQI SENSOR: This is an air quality index (AQI) sensor independently developed by our company. It can detect multiple factors, including temperature, humidity, PM2.5, PM10, air pressure, light, TVOC, CO_2, formaldehyde, O_3, CO, CH_4, O_2, SO_2, NO_2, H_2, H_2S, and NH_3, covering virtually every indicator of air quality. This multifunctional AQI sensor integrates multiple measurement elements and can monitor up to 14 simultaneously.

Fig3: AIQ sensor

RAIN SENSOR:

This rain sensor is made up of two main parts.

The Sensor Pad

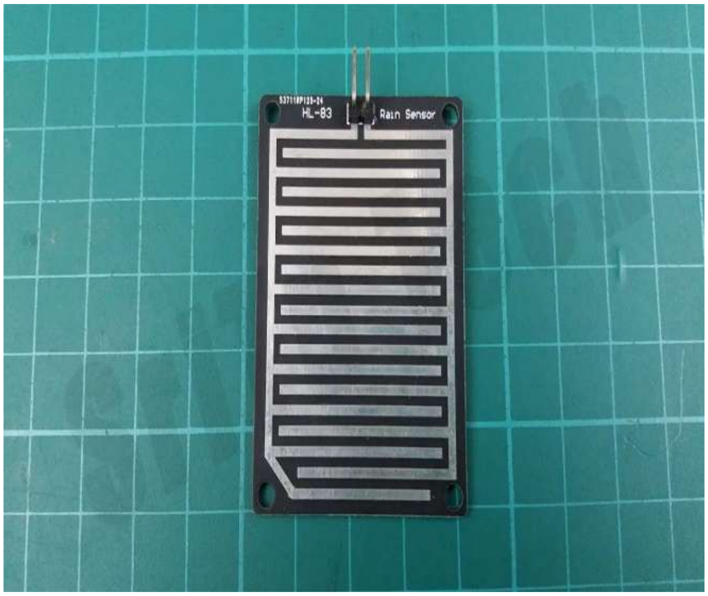

Fig4: Rain sensor pad

It is made up of exposed copper particles on both sides. It acts as a variable resistor. This resistance value varies according to the amount of water falling on it. That resistance value is inversely proportional to the amount of water. Good conductivity occurs when more water flows over the sensor surface.

FLOW RATE SENSOR

Flow measurement is the quantification of bulk fluid movement. Flow can be measured in a variety of ways. The common types of flow meters that find industrial application can belisted as below:

a. Obstruction type (differential pressure or variable area)

b. Inferential (turbine type)

c. Electromagnetic

d. Positive-displacement flow meters, which accumulate a fixed volume of fluid and then countthe number of times the volume is filled to measure flow.

e. Fluid dynamic (vortex shedding)

f. Anemometer

g. Ultrasonic

h. Mass flow meter (Coriolis)

Flow rate is measured by the simple velocity measurement through a conductor (such as a pipe, aqueduct, or other fixed-volume structure) and then multiplying the fluid speed versus time through the fixed-volume conductor to provide a volume quantity.

YF-S201 HALL EFFECT WATER FLOW METER /SENSOR

This sensor sits in line with your water line and contains a pinwheel sensor to measure how much liquid has moved through it. There's an integrated magnetic Hall Effect sensor that outputs an electrical pulse with every revolution. The Hall Effect sensor is sealed from thewater pipe and allows the sensor to stay safe and dry.

Fig5 Flow Sensor

The sensor comes with three wires: red (5-24VDC power), black (ground) and yellow (Hall Effect pulse output). By counting the pulses from the output of the sensor, you can easily calculate water flow. Each pulse is approximately 2.25 milliliters. Note this isn't a precision sensor, and the pulse rate does vary a bit depending on the flow rate, fluid pressure and sensor orientation. It will need careful calibration if better than 10% precision is required. However, it's great for basic measurement tasks.

RESULTS AND DISCUSSION

The system was tested in different environmental conditions. It successfully detected abnormal values and generated alerts within seconds. The response time and accuracy were significantly improved compared to traditional systems.

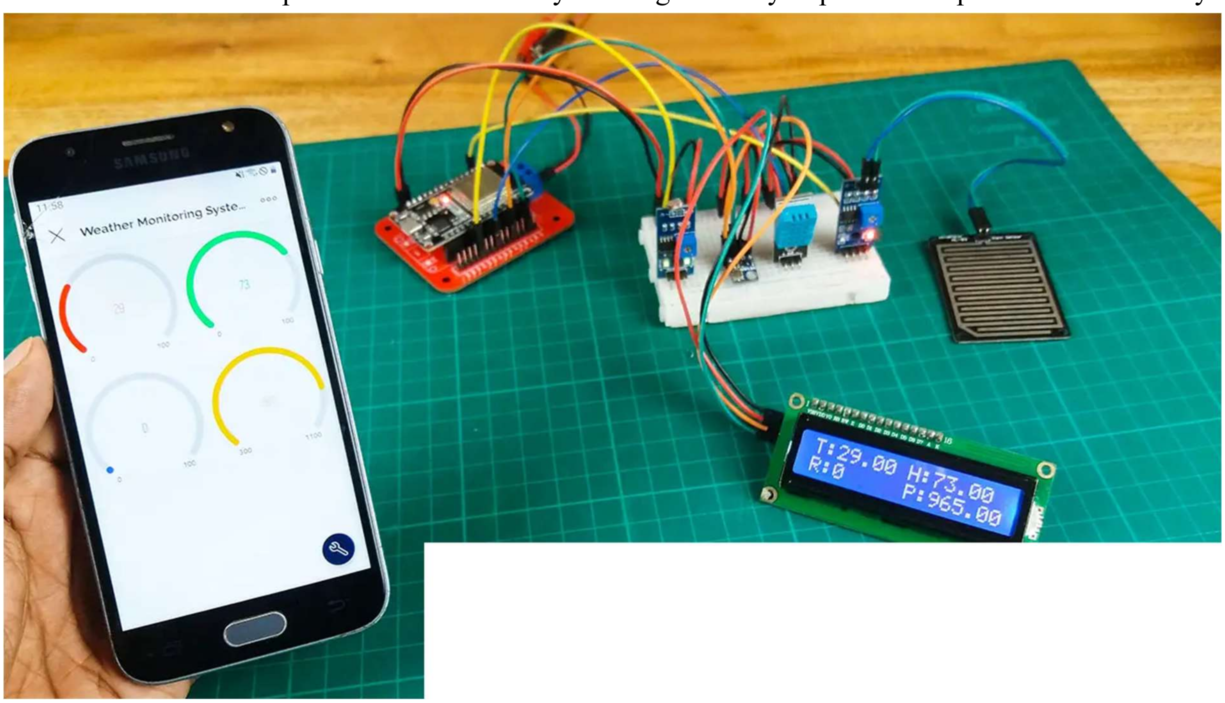

Fig6: Hardware prototype

ADVANTAGES

- Real-time monitoring
- Instant alerts
- Low cost
- Scalable architecture
- Remote access

APPLICATIONS

- Smart Cities
- Industrial Monitoring
- Agriculture
- Air Quality Monitoring
- Disaster Management

CONCLUSION

The proposed wireless framework for environmental monitoring and instant response alert provides an efficient, scalable, and real-time solution for tracking environmental parameters such as temperature, humidity, air quality, and gas levels. By integrating wireless sensor networks with IoT-based communication technologies, the system ensures continuous monitoring and timely data transmission to users or authorities. The implementation demonstrates that the system is capable of detecting abnormal environmental conditions and generating instant alerts, thereby enabling rapid response to potential hazards. This significantly reduces the risk of environmental damage, health issues, and industrial accidents. The framework is cost-effective, energy-efficient, and easy to deploy in both urban and remote areas. Overall, the system enhances environmental awareness and supports proactive decision-making, making it a valuable tool for smart cities, industrial safety, and ecological conservation.

FUTURE SCOPE:

The proposed system can be further enhanced in several ways to improve its performance, intelligence, and applicability:

Integration with Artificial Intelligence (AI):

Machine learning algorithms can be incorporated to predict environmental trends, detect anomalies more accurately, and provide early warnings before critical conditions arise.

Expansion of Sensor Network:

Additional sensors can be included to monitor more parameters such as noise levels, radiation, and soil quality, making the system more comprehensive.

Cloud and Big Data Analytics:

Integration with cloud platforms can enable large-scale data storage and advanced analytics for long-term environmental assessment and policy planning.

REFERENCES

[1] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions," *Future Generation Computer Systems*, vol. 29, no. 7, pp. 1645–1660, 2013.

[2] A. Lanzolla and M. Spadavecchia, "Wireless sensor networks for environmental monitoring," *Sensors*, vol. 21, no. 4, p. 1172, 2021.

[3] P. Baronti, P. Pillai, V. Chook, S. Chessa, A. Gotta, and Y. F. Hu, "Wireless sensor networks: A survey on the state of the art," *Computer Communications*, vol. 30, no. 7, pp. 1655–1695, 2007.

[4] M. E. Jalil et al., "Wireless sensor network applications for environmental monitoring system," *Procedia Engineering*, vol. 41, pp. 1204–1210, 2012.

[5] B. Mamalis and S. Gerakidis, "A combined environmental monitoring framework based on WSN clustering and VANET edge computation offloading," 2024.

[6] T. Luo and S. G. Nagarajan, "Distributed anomaly detection using autoencoder neural networks in WSN for IoT," 2018.

[7] T. M. Behera et al., "Residual energy-based cluster-head selection in WSNs for IoT application," 2019.

[8] "Design and implementation of a low-power wireless sensor network for environmental monitoring," *IEEE Conference*, 2010.

[9] "Environment monitoring system based on architecture of IoT by wireless sensor network," *IEEE Conference*, 2019.

[10] "Wireless sensors network for environmental radiation monitoring using IoT," *IEEE Conference*, 2020.

[11] "Wireless sensor networks for environmental management in IoT: Air and water quality using decision tree algorithm," *IEEE Conference*, 2023.

[12] "Wireless smart sensor networks: Systems, trends and its impact in environmental monitoring," *IEEE Conference*, 2009.

[13] "Energy-efficient wireless sensor network for real-time environmental monitoring," *Springer Discover Electronics*, 2025.

[14] IEEE Standard 1451, "Smart transducer interface for sensors and actuators," IEEE, 2007.

[15] M. Bahrepour, N. Meratnia, and P. J. M. Havinga, "Event detection in wireless sensor networks," *IEEE Conference on Intelligent Sensors*, 2011.