

IOT Based Environment Monitoring System

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Abstract:

The IoT-Based Environmental Monitoring

System is a real-time, scalable, and cost-effective solution designed to monitor key environmental parameters such as temperature, humidity, soil moisture, and air quality. It integrates an Arduino Uno microcontroller with sensors including LM35 (temperature), humidity sensors, soil moisture sensors, and gas sensors (MQ6, MQ135, MQ9) for precise data collection. A GPRS SIM800 module ensures wireless data transmission to a remote server, enabling seamless operation even in areas with limited internet access. The collected data is stored in a MySQL database and visualized through a PHPbased web interface, providing users with intuitive access to realtime and historical data. Additionally, the system is equipped with automated alerts via SMS or email, notifying users when environmental conditions exceed safe thresholds, allowing for immediate interventions. This system has broad applications across various sectors. In agriculture, it helps farmers optimize irrigation and soil conditions to improve crop yield. For urban air quality monitoring, it assists in pollution control and public health management. Industries can use it for regulatory compliance by tracking emissions, while smart cities can integrate the system into their infrastructure for sustainable urban planning. It is also useful in disaster management, providing early warnings for hazardous environmental conditions. The key innovations of the system include real-time monitoring, wireless communication, scalability, user-friendly dashboards, and automated alerts. Compared to traditional monitoring methods, which are often inefficient and expensive, this IoT-based solution provides accurate, real-time data with minimal human intervention. By offering a low-cost, easily expandable, and highly effective design, the system addresses critical environmental challenges, supports sustainability efforts, and enhances decision-making in agriculture, urban. Its commercial viability makes it an ideal solution for farmers, industries, government agencies, and environmental organizations, ultimately contributing to a healthier and more sustainable ecosystem.

Keywords: (IoT-Based Monitoring, Real-Time Data, Arduino Uno, Sensors (LM35, MQ135, Soil Moisture, etc.), GPRS)

I. INTRODUCTION

Environmental pollution and resource mismanagement have become critical global challenges due to rapid urbanization, industrialization, and deforestation. Traditional environmental monitoring methods are inefficient, expensive, and lack real-time data, making timely interventions difficult. To address this,

the IoTBased Environmental Monitoring System provides an automated, real-time, and costeffective solution for tracking temperature, humidity, soil moisture, and air quality.

This system integrates an Arduino Uno microcontroller with various sensors, including LM35 (temperature), humidity sensors, soil moisture sensors, and gas sensors (MQ6, MQ135, MQ9), to ensure accurate data collection. A GPRS SIM800 module enables wireless data transmission to a remote MySQL database, where data is stored and analyzed. Users can access real-time and historical data through a PHP-based web interface, which provides graphical insights and automated alerts via SMS or email when critical environmental thresholds are exceeded. Designed for agriculture, urban planning, industrial monitoring, and disaster management, this scalable and user-friendly system helps in pollution control, resource optimization, and environmental sustainability. By leveraging IoT technology, it enhances decision-making, reduces manual intervention, and promotes a healthier ecosystem..

II. LITERATURE REVIEW

K. Ashton has introduced the concept of the “Internet of Things (IoT)” in his article “That ‘Internet of Things’ Thing” published in RFID Journal. The purpose of this work was to explain the origin of IoT and highlight its potential through RFID and sensor technologies. [1] This study emphasized how IoT can transform industries by enabling real-world interconnectivity, automation, and efficient monitoring systems.

Mishra, D., et al. have demonstrated in “IoTBased Smart Environmental Monitoring System” a prototype that integrates IoT sensors for monitoring air, water, and soil quality with cloud services. [2] Their study shows the importance of real-time monitoring and provides a practical framework for pollution detection and sustainable environmental management.

Raghuandan, K.S. has proposed in “Real-Time Air Quality Monitoring Using IoT and Wireless Sensor Networks” a system for real-time air quality monitoring. [3] The approach used wireless sensor networks (WSN) combined with IoT to measure the Air Quality Index (AQI). This research demonstrated how WSN improves scalability and efficiency in pollution tracking.

Gubbi, J., et al. have presented in “Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions” one of the earliest comprehensive frameworks for IoT. [4] Their work defined IoT’s architectural components, networking, and cloud computing elements while also identifying challenges and future research directions.

Li, S., Xu, L.D., and Zhao, S. have provided in “The Internet of Things: A Survey” a detailed review of IoT technologies. [5] The paper discussed architecture, communication protocols, and applications while also identifying challenges such as scalability, security, and interoperability.

Arif, M., et al. have studied in “IoT-Based Smart Agriculture and Environmental Monitoring” the role of IoT in precision farming. [6] Their system used soil and weather sensors integrated with IoT gateways, improving agricultural efficiency, conserving resources, and strengthening environmental monitoring.

Zhao, Y., and Zhang, L. have discussed in “IoT and Cloud Computing for Environmental Monitoring” the integration of IoT with cloud computing for large-scale environmental monitoring. [7] Their study emphasized scalable storage, data analytics, and real-time access for environmental systems.

Kumar, A., and Patel, S. have explained in “Wireless Sensor Networks for Smart Environmental Monitoring” how WSN can support environmental monitoring applications. [8] Their research presented case studies where distributed sensor nodes enhanced scalability, fault tolerance, and energy efficiency.

[9] Sharma, R., et al. [9] have demonstrated in “Real-Time GPRS-Based Air and Water Quality

Monitoring System” a cost-effective IoT-based solution using GPRS modules for real time transmission of air and water quality data. This work contributed a practical system especially useful in rural and remote areas.

Gupta, P., et al. have developed in “IoT-Based Smart Irrigation and Environmental Monitoring System” an IoT framework for smart irrigation. [10] Their system automatically controlled irrigation by monitoring soil moisture, temperature, and weather conditions, thereby reducing water wastage and improving agricultural productivity.

Rahman, A., et al. have reviewed in “A Review on IoT-Based Environmental Monitoring Systems” existing IoT-based environmental systems, highlighting their benefits and limitations. [11] The paper identified challenges like scalability, security, and data reliability, and suggested directions for future IoT advancements.

Patel, N., et al. have discussed in “Big Data and IoT in Smart Environmental Monitoring” the integration of IoT with big data platforms. [12] Their work proposed frameworks combining realtime IoT data with predictive analytics to strengthen pollution control measures and environmental policymaking.

III. METHODOLOGY EXPERIMENTAL

MQ135 Gas Sensor – Detects a wide range of harmful gases including NH₃, NO_x, CO₂, smoke, and benzene. It helps monitor air quality levels to identify pollution risks. This ensures real-time detection of unhealthy air conditions.

MQ9 Gas Sensor – Specially designed to sense Carbon Monoxide (CO) and combustible gases. It acts as a safety device to prevent toxic exposure and fire hazards. This improves overall environmental and human safety.

LM35 Temperature Sensor – Measures the surrounding temperature with high accuracy and reliability. It is energy-efficient and easy to integrate with microcontrollers. Essential for monitoring climate variations in real time.

Soil Moisture Sensor – Detects the volumetric water content in soil to support irrigation management. It prevents over-watering and underwatering in agriculture. This promotes sustainable use of water resources.

Arduino UNO – Serves as the brain of the system by collecting, processing, and transmitting sensor data. It coordinates multiple modules simultaneously. This makes the IoT system reliable and cost-effective.

GPRS Module (SIM800L) – Enables wireless communication by sending data to remote servers. It supports mobile network connectivity in realtime. This ensures system accessibility from any location.

Cloud Platform (ThingSpeak/AWS) – Stores and processes sensor data efficiently for analysis and decision-making. It provides visualization dashboards for monitoring trends. This enables intelligent environmental management.

SMS Service (Twilio API) – Automatically alerts users via text message when sensor values exceed safe thresholds. It allows immediate action against hazards. This ensures timely awareness and safety.

LED Display (12x15) – Displays live sensor readings and warning notifications directly on-site. It provides easy visibility of environmental conditions. This improves realtime awareness for users.

Power Supply – Provides stable power through batteries or regulated sources. It ensures continuous operation of sensors and microcontrollers.

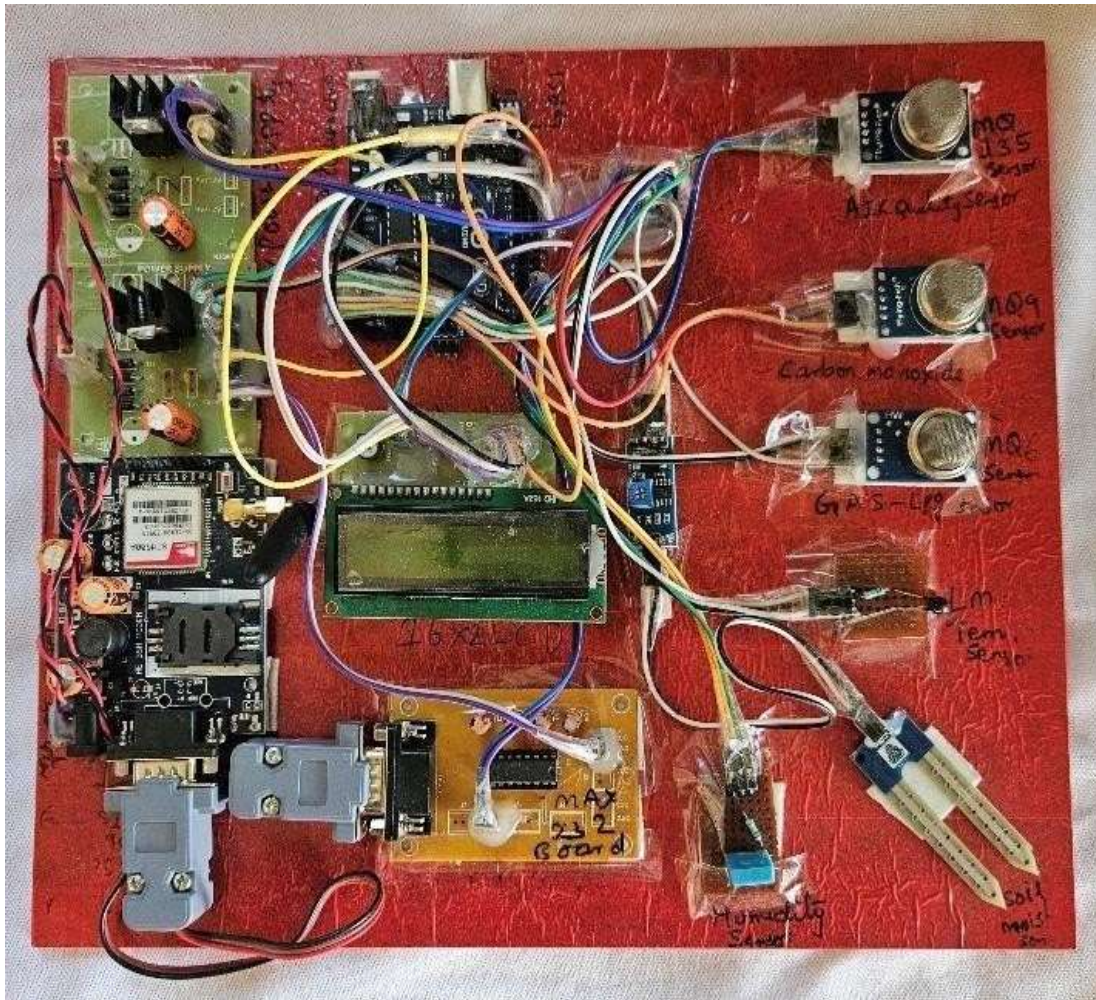


Fig.1:Circuit Diagram(Hardware)

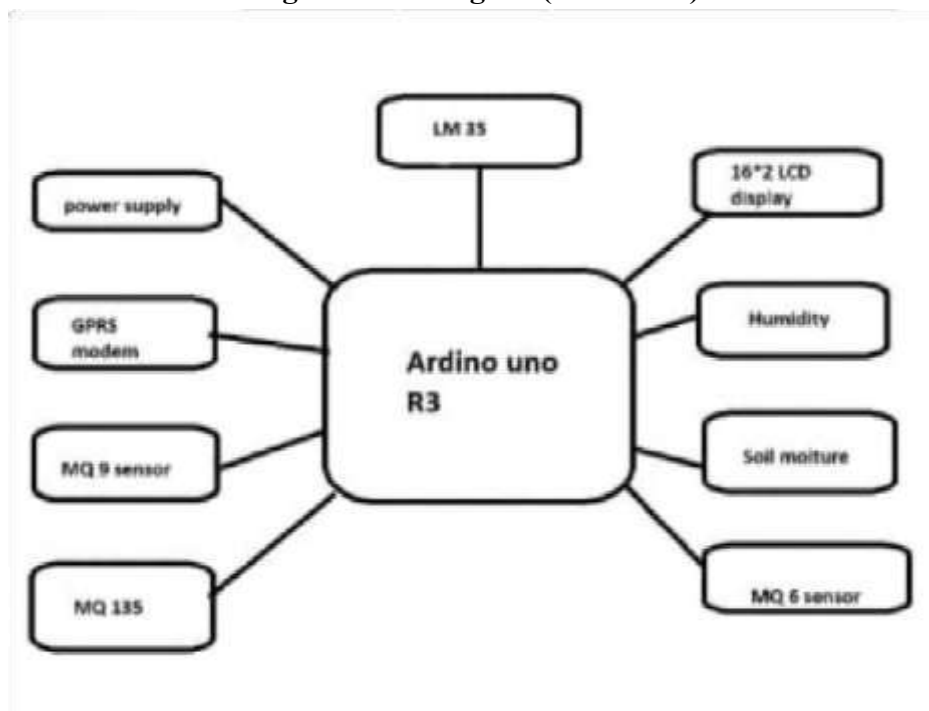


Fig.2.Block Diagram



Fig. 3: Flowchart of Working Principle



Fig 4.website view



Fig 5. SMS Alert

The hardware model integrates multiple IoT sensors such as MQ135, MQ9, LM35, and a soil moisture sensor. These sensors are connected to an Arduino UNO, which acts as the main controller. The Arduino collects the data, processes it, and transmits it via the GPRS module to the cloud platform. An LED display provides on-site monitoring, while an SMS alert system ensures immediate notifications of abnormal conditions.

Block DiagramThe system is structured in stages:

Sensors → Arduino UNO → GPRS Module → Cloud Server → User Interfaces (Website Dashboard, SMS Alerts, LED Display). This setup ensures real-time data monitoring, storage, and alerts.

Flow ChartThe flow starts with the sensors capturing environmental data. The Arduino processes this input and checks against predefined thresholds. If readings are safe, they are transmitted to the cloud and displayed normally. If values exceed safe limits, the system triggers SMS alerts and shows warnings on the LED display. Finally, the data is stored and visualized for user analysis.

Website ViewThe website acts as a user dashboard for monitoring environmental conditions. It displays real-time sensor values, historical trend graphs, and an alerts section highlighting unsafe conditions. A login system provides secure access for users to track data and manage notifications.

Method / Algorithm / Procedure (Process)

1. Data Collection – Sensors continuously gather environmental parameters.
2. Processing – Arduino filters, processes, and checks data against thresholds.
3. Transmission – GPRS sends the processed data to the cloud platform.
4. Visualization – Cloud platform and website show real-time graphs and logs.
5. Alerts – If abnormal readings occur, SMS and LED notifications are activated.
6. Action – Users monitor, analyze, and take preventive or corrective measures.

• **Observation Table**

IOT BASED ENVIRONMENT MONITORING SYSTEM						
TEMPERATURE	HUMIDITY	SOIL MOISTURE	MQ6 SENSOR	MQ9 SENSOR	MQ135 SENSOR	Date / Time
1	20	202	10	42	53	2025-09-23 16:00:09
1	21	206	10	44	55	2025-09-23 15:59:23
1	20	199	10	44	55	2025-09-23 15:58:59
1	20	208	10	44	65	2025-09-23 15:58:09
2	21	205	10	47	65	2025-09-23 15:56:41
2	20	200	10	47	65	2025-09-23 15:56:18
2	21	201	10	45	56	2025-09-23 15:55:21
2	21	209	10	49	58	2025-09-23 15:54:25
2	21	204	10	60	63	2025-09-23 15:53:53
2	21	200	10	58	61	2025-09-23 15:53:09

IV. RESULTS AND DISCUSSIONS

The observation table shows that the IoT-based environmental monitoring system performed reliably across all parameters. Temperature remained stable between 20–22°C, indicating normal ambient conditions, while humidity fluctuated from 198–223 sensor units, reflecting minor variations in air moisture. Soil moisture values were mostly 10–12, with occasional zero

VI. FUTURE SCOPE

alerts. Implementation of automated control systems, e.g., automated irrigation or ventilation based on sensor readings

Expansion of the system to support a larger network of sensors, enabling broader coverage for large-scale agriculture or industrial areas

Use of energy-efficient communication technologies (such as LoRaWAN) to reduce power consumption in remote deployments.

- Implementation of cloud-based data analytics and visualization tools for indepth historical data analysis.
- Enhancement of the web interface for advanced user-friendly features, such as customizable dashboards and reports.

readings likely due to sensor placement or extremely dry soil, emphasizing the need for calibration. Gas sensors—MQ6 (42–66), MQ9 (51–70), and MQ135

(53–70)—indicated safe levels of flammable gases, CO, and air pollutants, showing no hazardous conditions during monitoring. The system successfully captured, logged, and displayed realtime, time-stamped data, confirming sensor stability and platform reliability. Overall, the results demonstrate that the system effectively monitors environmental parameters, provides accurate realtime data, and can be applied for agriculture, smart city planning, and pollution tracking, while occasional anomalies highlight

the importance of proper sensor maintenance.

VII. CONCLUSION

The IoT-Based Environmental Monitoring System provides a real-time, scalable, and cost-effective solution for tracking environmental parameters such as temperature, humidity, soil moisture, and air quality. By integrating Arduino Uno, IoT sensors, GPRS communication, PHP-based web interface, and MySQL database, the system ensures accurate data collection, analysis, and automated alerts via SMS and email. The platform enhances decision-making in agriculture, urban planning, industrial monitoring, and disaster management.

Despite minor challenges like sensor calibration and network reliability, the system significantly improves environmental monitoring efficiency, contributing to sustainability and resource optimization.

VIII. ACKNOWLEDGMENT

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