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Smart Environment and Safety Monitoring System using Arduino

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***Abstract*— The Smart Environment and Safety Monitoring System is an Arduino-based project aimed at enhancing safety and monitoring in industrial and hazardous environments by detecting critical environmental parameters in real time. The system incorporates sensors to monitor temperature fluctuations, gas leaks, fire hazards, structural tilt or vibrations, and water level anomalies. Data from these sensors is processed by an Arduino Uno microcontroller, which displays alerts on an LCD screen and sends SMS notifications via a GSM module for immediate action. Prior to hardware implementation, the system was simulated using Proteus software, enabling efficient debugging, validation of sensor thresholds, and verification of logic in a virtual environment. This simulation phase ensured the reliability and accuracy of the circuit design and programming, significantly reducing troubleshooting efforts during deployment. The system is programmed using the Arduino programming language, a simplified version of C/C++, to facilitate seamless interaction with sensors and modules. The code processes both analog and digital data, manages the display, and sends commands to the GSM module for alert notifications. This project highlights the effective integration of embedded systems, simulation tools, and wireless communication to deliver a cost-effective, reliable, and practical solution for environmental and safety monitoring. It is particularly suited for applications in industries, public utilities, and hazardous environments such as manholes, factories, and construction sites.**

***Keywords* — Arduino uno R3, GSM Module, Fire Sensor, Gas sensor, tilt Sensor, Temperature Sensor, Water level Sensor, LCD Display, 5V Power Supply**

INTRODUCTION

Environmental monitoring and safety systems have become increasingly important due to the rising risks associated with gas leaks, fire hazards, temperature variations, and water level fluctuations. Traditional monitoring methods often rely on manual detection, which may lead to delays in responding to potential threats. To address these challenges, smart automated systems utilizing sensor technology and microcontrollers offer a reliable alternative. The Smart Environmental & Safety Monitoring System using Arduino is designed as an intelligent solution that integrates multiple sensors to detect environmental risks and provide real-time alerts. By leveraging Arduino as the core processing unit and GSM communication for instant notifications, the system enables quick action, minimizing dangers caused by undetected hazards. The system incorporates gas, fire, temperature, water level, and tilt sensors, ensuring that a wide range of environmental and safety threats can be effectively monitored. Each sensor is strategically placed and programmed to analyze real-time data, triggering alerts when predefined thresholds are crossed. For instance, the gas sensor detects harmful gases, the fire sensor responds to smoke or flames, and the temperature sensor ensures monitoring of extreme heat levels. To enhance its practical usability, the GSM module transmits warnings via SMS, alerting users remotely about potential threats, allowing for proactive safety measures. This feature is particularly useful for applications in industries, residential buildings, and agricultural fields, where continuous monitoring is essential to prevent accidents. Before implementing the hardware, Proteus software was used to simulate and validate the functionality of individual sensors. This software-based simulation helped ensure accurate circuit design, optimized sensor responses, and facilitated troubleshooting before the physical assembly. Testing sensors one by one such as individually evaluating the gas sensor, fire sensor, and temperature sensor in the Proteus environment ensured that each component functioned correctly before integrating them into the full system. This approach helped streamline hardware implementation, minimizing errors and improving overall efficiency.

I. LITERATURE REVIEW

The Review of Literature provides a critical appraisal of previous research and developments in the domain of environmental and safety monitoring systems. This chapter emphasizes the contributions made by researchers in designing sensor-driven safety systems, integrating Arduino microcontrollers, and exploring methods of automated hazard detection. The scope and focus of the review are aligned with the objectives of this project, which aims to build a Smart Environmental & Safety Monitoring System using Arduino. Several researchers have studied the application of gas sensors, fire detectors, temperature monitors, water level sensors, and tilt sensors in safety monitoring. These sensors are commonly used for detecting environmental threats, with sensors like MQ-2 for gas detection being highly effective for identifying hazardous gases in industrial and residential environments. Similarly, flame sensors and temperature modules such as LM35 are extensively used in fire prevention systems. Studies also highlight the critical role of tilt sensors, which are employed for identifying changes in orientation or instability, making them valuable in monitoring equipment safety and structural stability. The integration of these sensors with microcontrollers such as Arduino has 2 been a significant focus of research. Arduino's flexibility, low cost, and ease of programming make it a preferred choice for embedded systems in safety monitoring. Researchers have demonstrated how Arduino can efficiently process real-time sensor data and

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transmit alerts under unsafe conditions. The inclusion of GSM modules for communication enables systems to send automated SMS alerts, which ensures timely responses to environmental risks. This feature is particularly useful in applications where remote monitoring is required, such as in industries, homes, and agricultural fields. In addition, software simulation tools like Proteus have been widely employed for the prevalidation of systems before hardware implementation. Proteus allows developers to test individual sensor functionality in a virtual environment, reducing errors and optimizing circuit designs. For example, testing gas sensors, flame detectors, LM35 temperature sensors, water level, and tilt sensors individually in Proteus has proven effective for ensuring accuracy before integrating all components into a hardware setup. This step minimizes debugging issues and improves the overall reliability of the system. While sensor-based systems have made significant contributions to safety automation, researchers acknowledge challenges such as sensor accuracy, environmental interference, cost constraints, and power consumption. Efforts are underway to enhance sensor calibration methods and system efficiency to address these limitations. Future advancements may involve the integration of AI-driven analytics for predictive monitoring, ensuring better hazard detection and mitigation. In summary, the review highlights the contributions of various researchers in the field of environmental and safety monitoring systems, providing a foundation for the design and development of the proposed system. By combining insights from previous studies with advancements in sensor technology, Arduino integration, and GSM-based communication, this project aims to deliver a cost- effective, scalable, and efficient solution for ensuring environmental safety

II. CIRCUIT ARCHITECTURE

The Smart Environmental and Safety Monitoring System using Arduino is implemented using a variety of sensors and an Arduino microcontroller to monitor hazardous environmental conditions in real time. The system is capable of detecting gas leaks, fire, high temperature, water overflow, and equipment tilt. By providing instant alerts through a GSM module and displaying sensor data on an LCD, it ensures quick response and enhances safety in industrial, residential, and public environments.

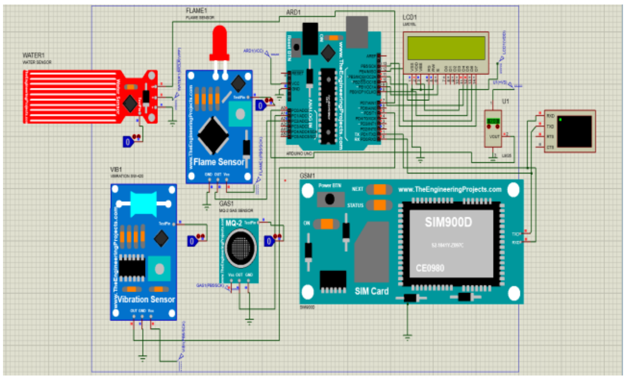

Figure 1

The Smart Environmental & Safety Monitoring System using Arduino is a robust setup that integrates multiple sensors and modules to monitor and detect hazardous conditions in real time. The system is powered by a regulated 5V supply to ensure stable operation across all components, including the Arduino microcontroller, sensors, GSM module, and LCD display. The sensors, including a gas sensor, flame sensor, temperature sensor, water level sensor, and tilt sensor, continuously collect data to monitor environmental parameters such as gas concentration, fire, temperature, water levels, and structural tilts. This data is processed by the Arduino, which compares it against predefined safety thresholds. When a hazardous condition is detected, the system instantly displays alert messages and sensor readings on the 16x2 LCD display, providing clear and real-time feedback to the user. Simultaneously, the GSM module sends SMS alerts to a predefined phone number, ensuring remote notification of potential dangers. This system is particularly useful in industrial, residential, and agricultural settings, offering a cost-effective and scalable solution for safety monitoring and proactive hazard detection.

A. Hardware Components

The system is built using Arduino Uno, which processes data from various sensors and communicates alerts via a GSM module. The key components include:

- Flame Sensor: Detects fire hazards and triggers emergency alerts.
- MQ-2 Gas Sensor: Monitors toxic gas levels and generates warnings. 4
- LM35 Temperature Sensor: Measures temperature fluctuations and issues alerts for abnormal readings.
- Tilt Sensor: Identifies structural movements or vibrations.
- Water Level Sensor: Detects excessive water accumulation, preventing flooding risks.
- GSM Module: Sends SMS notifications to predefined mobile numbers. • LCD Display: Shows sensor readings for immediate on-site feedback Units

B. Hardware Implementation

The Smart Environment and Safety Monitoring System is built using essential hardware components connected to an Arduino Uno microcontroller, which acts as the core of the system. Here's how the hardware is implemented:

1. Arduino Uno: This microcontroller processes data from all sensors and manages the system's operations. It receives input signals, performs calculations based on predefined thresholds, and sends commands to output devices.

2. Sensors:

- Flame Sensor: Detects fire and sends an analog or digital signal to the Arduino.
- MQ-2 Gas Sensor: Identifies the presence of toxic gases by measuring gas concentration levels.
- LM35 Temperature Sensor: Continuously monitors temperature and sends readings to the microcontroller.
- Tilt Sensor: Detects vibrations or abnormal structural movements and sends signals to Arduino.
- Water Level Sensor: Tracks water level changes and signals the microcontroller when it exceeds safety limits.

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3. LCD Display (16x2): Connected to the Arduino, it displays real-time sensor readings and alerts, providing immediate feedback to users.

4. GSM Module: Sends SMS alerts to predefined mobile numbers. The Arduino communicates with the GSM module using AT commands to issue alerts remotely.

5. Power Supply: The system operates on a stable 5V DC power supply, ensuring consistent functionality. A voltage regulator is used to stabilize power input to the Arduino and other components.

6. Connections:

- Sensors are connected to the Arduino's analog and digital input pins to transfer data.
- The LCD is connected to Arduino's digital pins for displaying outputs.
- The GSM module is interfaced with Arduino through UART (serial communication) for sending SMS alerts.

7. Circuit Design:

- The entire system was first simulated using Proteus software. This helped debug and validate the circuit design before physical implementation.
- After the simulation phase, the components were assembled on a breadboard or PCB (Printed Circuit Board) for testing functionality and ensuring reliability.

C Software Implementation

The system is programmed using Arduino IDE, where predefined threshold values are set for each sensor. The LCD display and GSM module are integrated using embedded C/C++ programming. Software simulation is a technique used to model and analyze the Behavior of a system in a virtual environment before implementing it in physical hardware. It plays a crucial role in embedded systems by allowing designers to test, validate, and refine their projects efficiently. In the Smart Environmental & Safety Monitoring System, software simulation enables thorough evaluation of component interactions, system logic, and real-time responses without requiring physical connections. Simulation tools such as Proteus are widely used for visualizing circuit designs, verifying sensor behaviors, and debugging programming logic. Through software simulation, essential functions such as data collection, sensor response evaluation, and communication between modules can be systematically tested. This process ensures that the system operates as expected, identifies potential errors, and allows necessary modifications before moving to the hardware implementation stage.

Key aspects of software simulation include:

- System Verification: Ensures that programmed logic aligns with expected operations.
- Sensor Behavior Analysis: Simulates environmental changes to assess sensor accuracy.
- Communication Testing: Verifies interactions between components like the GSM module and LCD display.
- Error Detection and Debugging: Identifies and resolves code-related issues efficiently.

Software simulation is a critical step in embedded system design, contributing to project accuracy, reliability, and optimized functionality. By leveraging Proteus, developers can refine their designs, reduce hardware dependency, and ensure seamless system integration

D PROEUS:

Proteus is a powerful simulation and circuit design tool widely used for embedded system development and testing. It provides a virtual environment where electronic circuits, including microcontrollers like the Arduino Uno R3, can be designed, simulated, and analyzed before implementing them in real hardware. Proteus offers a range of features that enable users to visualize circuit operation, debug programming logic, and ensure functionality without requiring physical components.

Features of Proteus:

- Circuit Simulation: Allows real-time simulation of electronic circuits, ensuring proper functionality.
- Microcontroller Integration: Supports Arduino and other microcontrollers, enabling firmware testing and debugging.
- Visual Design Interface: Provides an easy-to-use graphical environment for placing and connecting components.
- Virtual Components: Offers a library of sensors, actuators, displays, and communication modules for testing different scenarios.
- Code Execution: Enables running embedded code within the simulation to observe system responses.

Proteus in the Smart Environmental & Safety Monitoring System:

In this project, Proteus can be used to simulate the Arduino-based sensor interactions, verifying that data from the MQ-2 gas sensor, flame sensor, LM35 temperature sensor, tilt sensor, and water level sensor are correctly processed. The simulation also helps test outputs like the LCD display and GSM module, ensuring alert messages are properly generated.

Using Proteus minimizes errors by identifying circuit and logic issues early, reducing debugging time and ensuring a smooth transition to hardware implementation. By testing connections, sensor responses, and data flow within a virtual environment, developers can refine their system efficiently and achieve a reliable final design.

E Arduino

IDE The Arduino IDE (Integrated Development Environment) is the primary software platform used for programming Arduino microcontrollers. It provides an intuitive and user-friendly interface for writing, compiling, and uploading code to Arduino boards. As an open-source development environment, it supports C and C++ programming languages with additional Arduino-specific functions to simplify embedded system programming.

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Features of Arduino IDE:

- Code Editor: Allows writing and modifying programs with syntax highlighting and error detection.
- Library Support: Offers built-in and external libraries for integrating various components like sensors, communication modules, and displays.
- Compilation and Debugging: Converts source code into machine-readable format and identifies errors before uploading.
- Serial Monitor: Enables real-time communication between the Arduino and a computer for debugging sensor data and system responses.
- Board Management: Supports multiple Arduino boards, allowing users to select the appropriate microcontroller for their project.

Arduino IDE in the Smart Environmental & Safety Monitoring System:
The Arduino IDE plays a crucial role in developing and testing the program logic for the Smart Environmental & Safety Monitoring System. It facilitates the coding process for handling sensor inputs, decision-making conditions, and triggering necessary outputs like LCD displays and GSM notifications. The Serial Monitor aids in testing and debugging by displaying sensor readings and system responses in real time. 8 By using the Arduino IDE, developers can efficiently write, refine, and implement embedded code, ensuring the system operates reliably in monitoring environmental

Sensor Testing Overview:
Before integrating the sensors into the complete system, individual testing of the flame sensor, gas sensor, and temperature sensor was conducted to ensure their functionality and reliability. These sensors are critical to the Smart Environmental & Safety Monitoring System, as they detect hazardous conditions like fire, gas leaks, and temperature fluctuations.
The testing was carried out in a step-by-step manner, where each sensor was connected to the Arduino Uno R3 and its output was observed.

The purpose of this approach was:

- To verify the accuracy and responsiveness of each sensor.
- To confirm proper communication between the sensor and the Arduino.
- To validate the system's programmed responses, such as displaying alerts on the LCD and triggering notifications via the GSM module.

Each sensor's functionality was tested under both normal conditions and abnormal or hazardous conditions, ensuring the system reacts appropriately. The following sections detail the circuit setup, code, and observations for each sensor individually.

Flame Sensor Testing:
Objective:
The purpose of this test is to validate the functionality of the flame sensor in detecting fire and ensuring the system responds correctly.

Setup Description:
The flame sensor was connected to the Arduino Uno R3, with the LCD display and power supply integrated into the circuit. The system was programmed to display "No Fire" during normal conditions and "Fire Detected" when the flame sensor detects fire.

Circuit Before Fire Detection:

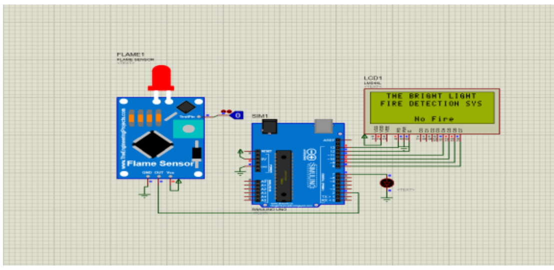

Figure 2 Flame Sensor Circuit Before Fire Detection

The flame sensor continuously monitors the environment. In this state, the sensor detects no fire, and the LCD display outputs the message "No Fire". This confirms that the sensor is properly connected and functioning as expected under normal conditions.

Circuit After Fire Detection:

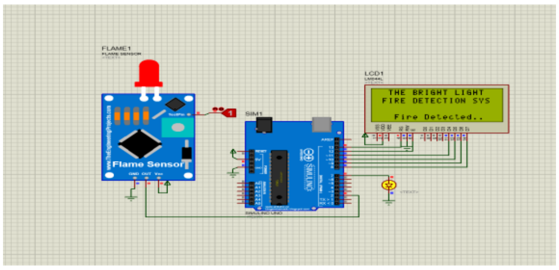

Figure 3 Flame Sensor Circuit After Fire Detection

When the gas sensor detects a concentration above the threshold level, it triggers an alert. The LCD displays "Gas Detected", and the LED turns on, warning the user of potential gas leakage. This validates the system's responsiveness and proper execution of programmed logic.

Gas Sensor Testing:
Objective:
To validate the functionality of the gas sensor in detecting hazardous gas levels and to ensure the system responds appropriately by triggering alerts.

Setup Description:
The gas sensor (MQ-2) was connected to the Arduino Uno R3 for monitoring air quality. The system was programmed to display "Safe Environment" on the LCD screen under normal

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conditions and "Gas Detected" when the gas concentration exceeds a specified threshold. The system also activates an indicator (e.g., LED or buzzer) during hazardous conditions.

Circuit Before Gas Detection:

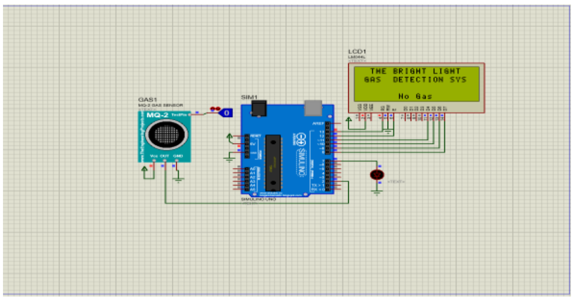

Figure 4 Gas Sensor Circuit Before Gas Detection

In this condition, the gas sensor continuously monitors the air quality. Since no Hazardous gas is detected, the LCD displays "No Gas", and the LED remains off, confirming the system's normal operational state.

Circuit After Gas Detection:

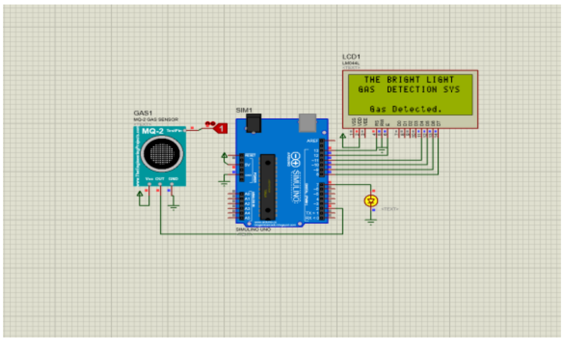

Figure 5 Gas Sensor Circuit After Gas Detection

When the gas sensor detects a concentration above the threshold level, it triggers an alert. The LCD displays "Gas Detected", and the LED turns on, warning the user of potential gas leakage. This validates the system's responsiveness and proper execution of programmed logic.

Temperature Sensor Testing:

Objective:

To validate the functionality of the LM35 temperature sensor in monitoring environmental temperature and to ensure the system responds appropriately when the temperature exceeds a predefined threshold.

Setup Description

The LM35 temperature sensor was connected to the Arduino Uno R3, along with an LCD display and an LED indicator. The system was programmed to display "Normal Temp" on the LCD when the temperature is within safe limits. When the temperature exceeds a certain threshold, the system displays "High Temp" on the LCD, and the LED turns on as a visual alert.

Circuit Before High Temperature Detection

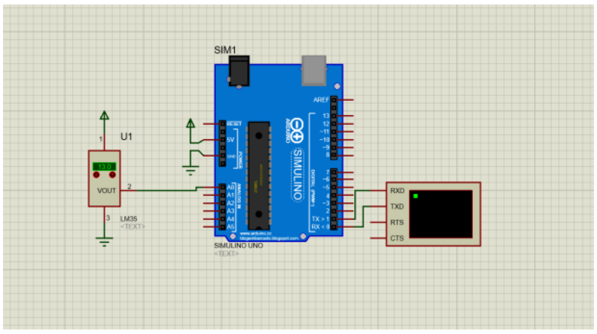

Figure 6 Temperature sensor Circuit Before Temperature Detection

In this state, the temperature sensor detects that the ambient temperature is within safe limits. The LCD displays "Normal Temp", and the LED remains off, indicating normal conditions.

Circuit After High Temperature Detection

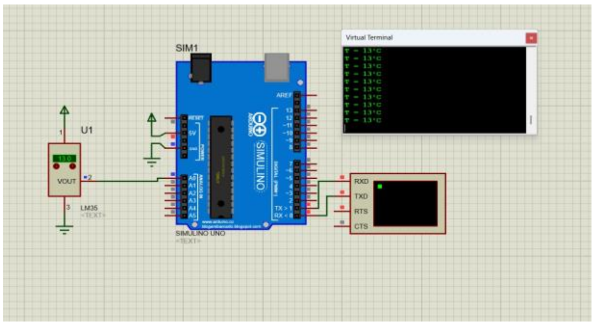

Figure 7 temperature Sensor Circuit After Temperature Detection

When the temperature sensor detects a value above the defined threshold, the system triggers an alert. The LCD displays "High Temp", and the LED turns on, warning the user of elevated temperature levels. This validates the sensor's responsiveness and the effectiveness of the programmed logic.

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III. BLOCK DAIGRAM

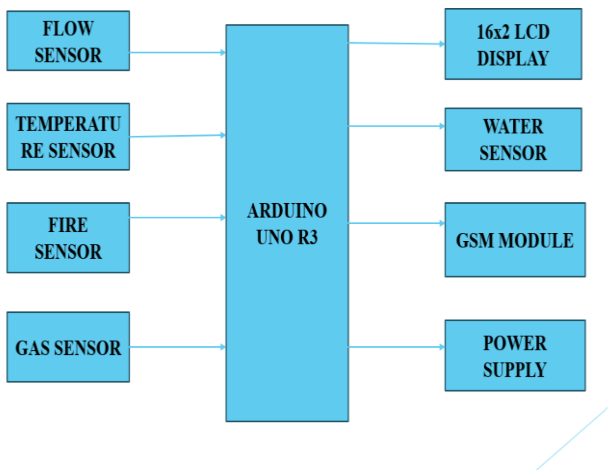

Figure 8

The block diagram for the Smart Environmental & Safety Monitoring System offers a comprehensive visual layout of the project's entire operational framework. It places the Arduino Uno R3 at the core, showcasing its role as the central controller that manages interactions between inputs and outputs. The inputs, which consist of various sensors such as the MQ-2 gas sensor, flame sensor, LM35 temperature sensor, tilt sensor, and water level sensor, continuously gather real-time data on environmental conditions. These inputs are clearly linked to the Arduino, which processes the collected data for abnormalities or hazards.

On the output side, the diagram highlights the 16×2 LCD display, which serves as a real-time interface for showing critical readings and alert messages. The integration of the GSM module stands out as a key feature, facilitating remote communication by sending SMS alerts during emergencies. This ensures timely notifications to concerned personnel. The presence of a 5V power supply in the diagram emphasizes the reliable and uninterrupted operation of all system components.

The structured representation of the block diagram not only clarifies the flow of data—from sensors to processing and output devices—but also underscores the practical efficiency of the system in hazard detection and mitigation. It serves as a simplified yet detailed blueprint for understanding the interconnections and functionality of the system components, aiding both implementation and troubleshooting.

IV. FLOW CHART

The flowchart for the Smart Environmental & Safety Monitoring System simplifies the working logic of the project into an easy-to-follow sequence of steps. It starts with the system being powered on, during which the Arduino Uno R3 and the sensors are initialized, making them ready for operation. Once initialized, the sensors begin continuously monitoring environmental conditions like gas levels, water presence, tilt angles, temperature changes, and fire hazards. This ensures that the system is actively gathering real-time data to detect potential risks.

At each step, the flowchart introduces decision points that assess the data from the sensors. For example, it checks whether the gas concentration exceeds safety limits, whether the water level crosses critical thresholds, or if the temperature rises dangerously. If no abnormal condition is detected, the system continues monitoring.

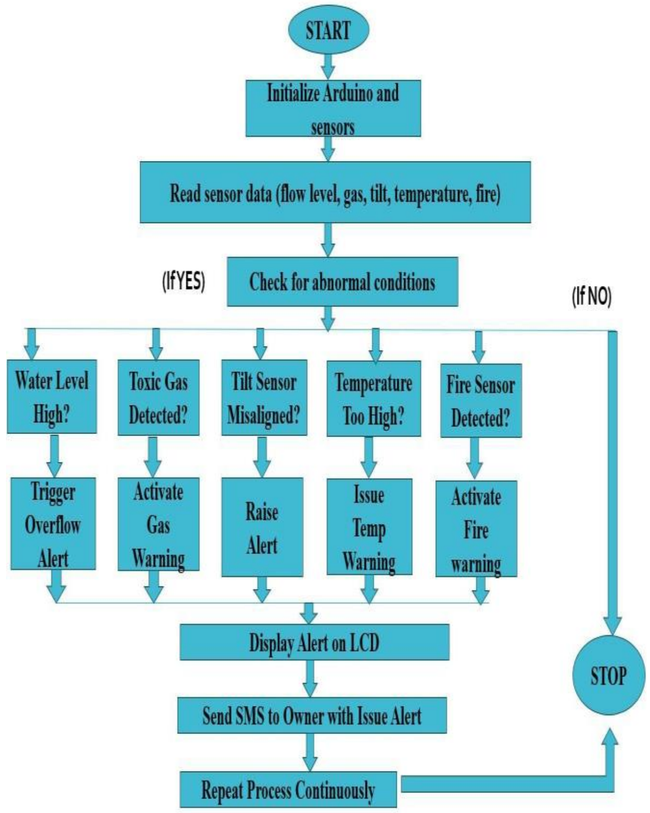

Figure 9

However, if an abnormal condition is identified, the system takes immediate action such as displaying warning messages on the 16×2 LCD display and sending alerts through the GSM module. These alerts ensure timely communication about hazards, helping prevent accidents or damage.

The flowchart is designed to be clear and straightforward, representing the path from initialization to hazard detection and response. It emphasizes the system's ability to respond dynamically based on sensor inputs, focusing on efficiency and reliability. This structured visual representation not only makes the functionality of the system easy to understand but also serves as a guide for implementation and troubleshooting, ensuring that all actions follow a logical progression.

V. RESULTS AND EXPLANATIONS

The Smart Environmental & Safety Monitoring System was successfully assembled and tested, confirming its ability to detect and respond to environmental hazards. When a fire was detected, the flame sensor promptly triggered an alert, displaying "Fire Detected" on the LCD and sending a notification via GSM. Similarly, the gas sensor (MQ-2) effectively identified hazardous gas concentrations, activating the message "Gas Detected" and ensuring timely alerts. The temperature sensor (LM35) accurately monitored ambient temperature, displaying "High Temp" when thresholds were exceeded.

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The system also demonstrated effective monitoring of water accumulation and structural movement. The water level sensor successfully identified high water levels and displayed "Water Level High", providing real-time detection for potential flooding risks. Meanwhile, the tilt sensor responded to vibrations or abnormal shifts, triggering the message "Tilt Vibration Detected" when movement was observed. All sensor data was processed efficiently by the Arduino Uno, and alerts were successfully transmitted through the LCD display and GSM module, ensuring reliable communication of environmental warnings.

The test results validate the system's ability to monitor multiple safety parameters and respond accordingly. The integrated hardware setup ensures timely detection and alerts, making the system effective for real-time hazard prevention and environmental monitoring.

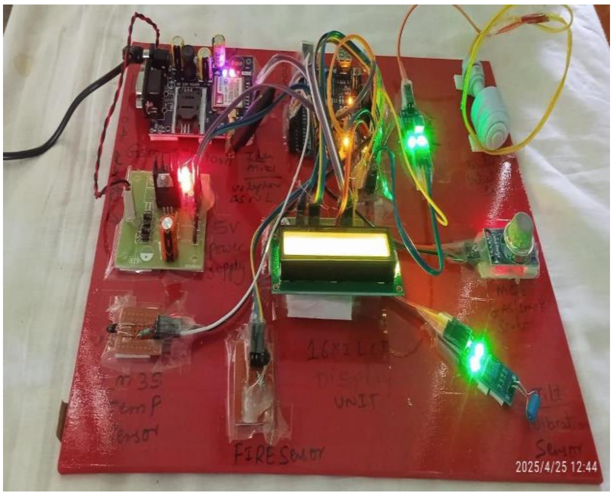

Figure 10 hardware Result

System Outputs

1. Temperature Alert:

- Output: TEMP=47
- Triggered when the temperature exceeds the predefined safety threshold.

2. Gas Alert:

- Output: GAS Alert
- Triggered when the gas concentration crosses the hazardous limit.

3. Tilt/Vibration Alert:

- Output: TILT/VIBRATION Alert
- Activated upon detecting abnormal structural movement or vibration.

4. Fire Alert:

- Output: FIRE Alert
- Issued when the flame sensor detects fire or high heat levels.

5. Water Level Alert:

- Output: Water Level Alert
- Raised when the water level surpasses the predefined threshold.

Figure 11 Output at Mobile Send by GSM Module

VI. CONCLUSION

The Smart Environmental & Safety Monitoring System successfully integrates hardware and sensors to address critical environmental hazards through real-time detection and responsive alerts. By implementing sensors such as flame, gas, temperature, tilt, and water level, along with the GSM communication module, the project achieves its objective of providing reliable safety monitoring. The system demonstrated consistent accuracy in detecting fire, gas leaks, and temperature changes, offering timely notifications via LCD display and GSM messages. The inclusion of hardware components like the tilt and water level sensors further enhances the versatility of the system, making it adaptable for future enhancements. The results validate the system's reliability and performance, while its energy- efficient design and cost effectiveness highlight its practical applicability.

This project serves as a robust foundation for addressing environmental hazards in residential, industrial, and urban settings. With potential upgrades such as IoT integration, additional sensors, and advanced communication protocols, the system can evolve into a comprehensive solution for proactive safety monitoring.

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VII. REFERENCES

[1] Silvia Liberata Ullo, & G. R. Sinha. (2020). Advances in Smart Environment Monitoring Systems Using IoT and Sensors. Sensors, Volume 20, Issue 11. https://doi.org/10.3390/s20113113

[2] Rauf Jamadar, Harsh Uike, Piyush Kakade, & Shital Pawar. (2023). GSMBased Fire Alert System. Journal for Research in Applied Science and Engineering Technology. https://doi.org/10.22214/ijraset.2023.52591

[3] Soujanya Reddy Annapareddy. (2022). Design and Implementation of Smart Sensor Technologies in Embedded Systems. ESP Journal of Engineering & Technology Advancements, Volume 2, Issue 3.

https://doi.org/10.56472/25832646/JETA-V2I3P122

[4] Pratik Nawkar, Tanmay Kumbhar, Ayush Nemnar, & Ankit Nimbolkar. (2023). GSM-Based Fire Alert System. International Journal of Novel Research and Development, Volume 8, Issue 12.

https://www.ijnrd.org/papers/IJNRD2312013.pdf

[5] Pallab Chatterjee. (2013). Microcontroller Systems for Sensor Control and Interface. DigiKey Articles. https://www.digikey.in/en/articles/microcontrollersystems-for-sensor-control-and-interface