Design and Implementation of an Arduino-Based Home Security System with Fire, Gas, and Intrusion Detection

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Abstract – Home security has become a major concern due to increasing incidents of fire hazards, gas leakage, and unauthorized intrusions. Traditional security systems are often expensive and limited to a single function. This paper presents the design and implementation of a low-cost Arduino-based home security system capable of detecting fire, gas leakage, and human intrusion using a flame sensor, MQ-2 gas sensor, and PIR motion sensor. The system provides real-time alerts through a buzzer and a 16×2 LCD display. Experimental results show fast response time, reliable performance, and effective hazard detection. The proposed system is economical, easy to implement, and suitable for homes, offices, and small commercial environments.

Index Terms - *Arduino Uno, Home Security System, Flame Sensor, MQ-2 Gas Sensor, PIR Sensor, Embedded Systems*

I. INTRODUCTION

With increasing urbanization and dependence on electrical appliances and gas-based cooking systems, the risks associated with fire accidents, gas leakage, and burglary have increased significantly. Conventional security solutions such as mechanical locks and standalone alarms provide limited protection and often require manual monitoring.

Advancements in embedded systems and microcontrollers have enabled the development of intelligent, automated, and cost-effective home security solutions. Arduino is an open-source microcontroller platform that supports easy interfacing with various sensors and modules, making it ideal for real-time monitoring applications.

This paper proposes an Arduino-based home security sys- tem that integrates fire detection, gas leakage monitoring, and intrusion detection into a single compact unit. The system continuously monitors environmental parameters and provides instant alerts using visual and audible indicators.

II. LITERATURE SURVEY

Early home security systems relied on mechanical locks and basic alarm circuits triggered by door sensors. Although effective for intrusion detection, these systems lacked environmental hazard detection. Later, infrared-based motion detection systems were introduced but were costly and unsuitable for domestic use.

Microcontroller-based systems improved automation and response time. Researchers demonstrated the effectiveness of flame sensors for early fire detection and MQ-series sensors for detecting combustible gases. PIR sensors became widely used for motion detection due to low power consumption and reliability.

Recent research focuses on IoT-enabled security systems using GSM and Wi-Fi modules for remote alerts. However, these systems increase complexity and cost. Arduino-based systems remain popular for domestic applications due to their affordability and simplicity.

III. PROBLEM STATEMENT

Modern homes face multiple safety threats such as fire, gas leakage, and unauthorized entry. Existing systems usually address only one hazard and require manual supervision or expensive installation. There is a need for a low-cost, automated, and multi-functional security system capable of continuous monitoring and real-time alert generation.

IV. SYSTEM ARCHITECTURE

A Block Diagram

Figure 1 shows the block diagram of the proposed system. Arduino Uno acts as the central controller interfacing with flame sensor, MQ-2 gas sensor, and PIR motion sensor. Output devices include a buzzer and a 16×2 LCD display.

Sensors (PIR motion sensor and gas/smoke sensor) monitor movement and fire conditions.

Sensor outputs are sent to the Arduino Uno microcontroller.

Arduino processes the data and makes decision based on predefined thresholds.

Output devices (LCD, buzzer, LEDs) display status and generate alerts.

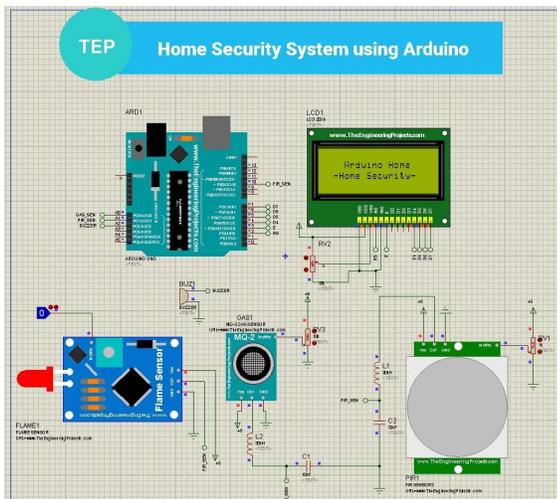A regulated power supply provides power to the entire system

Fig. 1. Block Diagram of Arduino-Based Home Security System

A. Circuit Diagram

The circuit diagram in Figure 2 illustrates the physical connections between sensors, Arduino Uno, LCD, and buzzer.
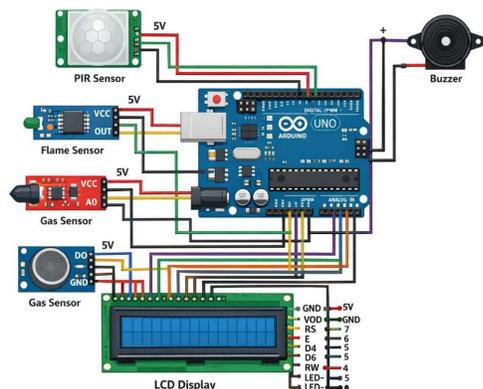

Fig. 2. Circuit Diagram of Home Security System

V. WORKING PRINCIPLE

The system operates on real-time sensing and threshold-based decision making. When powered ON, Arduino initializes all sensors and displays system status on the LCD. The MQ-2 gas sensor requires a short warm-up time to stabilize readings. The flame sensor detects infrared radiation emitted by fire. If detected, the Arduino activates the buzzer and displays a fire alert. The MQ-2 gas sensor monitors gas concentration and triggers an alert when it exceeds safe limits. The PIR sensor detects human motion based on infrared radiation changes and alerts the user in case of intrusion.

VI. IMPLEMENTATION

The hardware was initially assembled on a breadboard and later mounted on a permanent base. The MQ-2 sensor was connected to analog pin A0, while flame and PIR sensors were connected to digital pins. The LCD was interfaced using I2C communication to reduce wiring complexity.

The software was developed using Arduino IDE. Sensor values were read continuously using analogRead() and digitalRead() functions. Conditional logic was implemented to generate alerts. Multiple tests were conducted under real conditions to validate system performance.
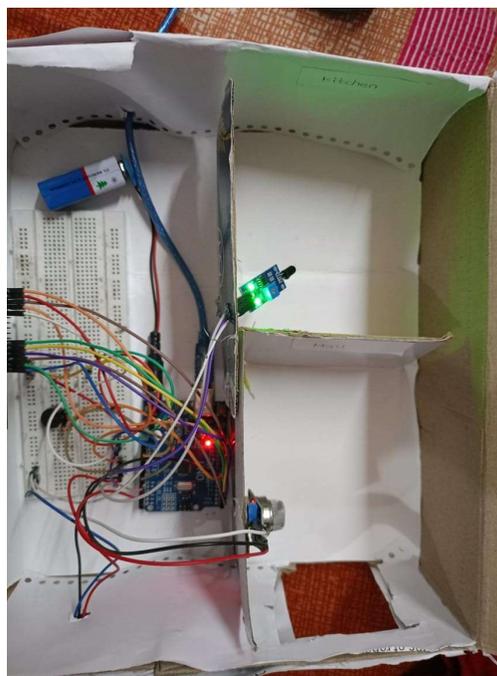

Fig. 3. Implemented Hardware Prototype

VII. RESULTS AND DISCUSSION

The system successfully detected fire, gas leakage, and motion in real-time. The response time was fast, and alerts were clearly displayed on the LCD and buzzer. The MQ-2 sensor required calibration to minimize false alerts. The PIR sensor performed reliably under indoor conditions.

The results confirm that the proposed system is cost-effective, reliable, and suitable for domestic safety applica-

tions. Environmental sensitivity of sensors is a limitation that can be addressed through calibration and proper placement.

VIII. CONCLUSION

This paper presented the design and implementation of a low-cost Arduino-based home security system integrating fire, gas, and intrusion detection. The system demonstrated reliable performance, fast response time, and ease of implementation. Its modular design allows future enhancements such as IoT and GSM-based remote alerts. The proposed solution is suit- able for homes, offices, laboratories, and small commercial environments.

REFERENCES

[1] Arduino, "Arduino Uno Rev3 Datasheet," Arduino.cc.

[2] Hanwei Electronics, "MQ-2 Gas Sensor Datasheet."

[3] Parallax Inc., "PIR Motion Sensor Datasheet."

[4] A. Kumar et al., "Microcontroller-Based Fire Detection System," *Inter- national Journal of Engineering Research*, 2014.

[5] R. Ramesh et al., "IoT Based Smart Home Security System," *IEEE Conference*, 2020.