

SMART HOME AUTOMATION SYSTEM USING GUI POWERED BY ARDDUINO AND MATLAB

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Abstract - This paper presents a smart home automation and safety system using the Arduino Mega 2560 integrated with IoT technology. The system is designed to monitor environmental conditions and control home appliances automatically. It incorporates sensors such as gas sensor, temperature sensor (DHT11), LDR, IR sensor, and current sensor for real-time monitoring. The system ensures safety by detecting gas leakage and overload conditions, while also improving energy efficiency through intelligent lighting and fan control. Data is displayed on an LCD and transmitted to the cloud using ThingSpeak IoT platform for remote monitoring. The results demonstrate effective automation, safety, and energy management in modern smart homes.

Key Words: Home Automation, Arduino MEGA, IOT, Gas Detection, Energy Monitoring, Smart System.

1. INTRODUCTION

Home automation systems are becoming essential in modern living due to the increasing need for safety, energy efficiency, and convenience. Traditional systems require manual operation, which can lead to energy wastage and delayed response in hazardous situations. With advancements in embedded systems and IoT, smart automation systems can monitor and control appliances automatically.

This project proposes a smart home automation system using Arduino Mega that integrates multiple sensors for real-time monitoring. The system provides automatic control of lights, fans, and safety mechanisms, ensuring efficient and secure operation.

2. LITERATURE SURVEY

R. Piyare and M. Tazil [1] introduced a Bluetooth-based home automation system that allowed users to control household appliances using a mobile phone. This work highlighted the importance of wireless communication in automation systems and provided a low-cost solution for basic home control. Shiu Kumar [2] proposed a ubiquitous smart home system using an Android application and IoT technology. The system enabled users to monitor and control home appliances remotely through a web interface, demonstrating the

advantages of cloud-based connectivity in improving accessibility and flexibility. P. Suresh, J. V. Daniel, and V. Parthasarathy [3] developed a smart home system using Wi-Fi technology, focusing on remote operation and energy efficiency.

M. B. Patil and S. R. Nimbalkar [4] designed an intelligent gas leakage detection and alert system using IoT, which enhanced safety by providing immediate alerts and activating ventilation systems during hazardous conditions. S. Suraj, A. S. Athira, and R. Krishnan [5] proposed an IoT-based smart home system integrated with an energy monitoring module.

From the review of these works, it is evident that most existing systems focus on specific functionalities such as remote control, energy monitoring, or safety.[6] However, there is a need for an integrated system that combines all these features into a single platform

3. EXISTING SYSTEM

Existing home automation systems are primarily designed to perform specific tasks such as lighting control, temperature regulation, or remote appliance operation. Many early systems were based on wired communication or simple wireless technologies like Bluetooth, which limited their range and accessibility.

These systems allowed users to control devices manually through mobile applications or switches but lacked real-time monitoring and intelligent decision-making capabilities.

Some modern systems use IoT technology to provide remote access and monitoring through the internet. However, most of these systems focus on individual functionalities such as energy monitoring or appliance control rather than offering a complete integrated solution. In many cases, safety features like gas leakage detection and overload protection are either not included or implemented separately, reducing the overall effectiveness of the system.

- **Limitations:** Existing systems focus on solving only one specific problem; Lack of integration between object detection, OCR, and navigation systems; require high computational resources; Reduced usability due to separate module operation.

4. PROPOSED SYSTEM

The proposed system is an intelligent smart home automation model designed to improve safety, energy efficiency, and user convenience using embedded system technology. The system integrates multiple sensors such as an LDR for light detection, an IR sensor for human presence detection, a gas sensor for leakage monitoring, and a temperature sensor (DHT11) for environmental monitoring. Additionally, a PZEM module is used to measure electrical parameters like voltage, current, power, and energy consumption.

Based on sensor inputs, the system automatically controls various home appliances through relays. The lighting system operates only when it is dark and a person is detected, ensuring efficient energy usage. A motor (cooling system) is activated when the temperature exceeds a predefined threshold. In case of gas leakage, a servo motor is used to simulate valve control while a fan is turned on for ventilation. The system also includes overcurrent protection, where the load is disconnected if the current exceeds a safe limit.

For user awareness and safety, a buzzer alert system is implemented, which activates during abnormal conditions such as high temperature, gas leakage, or system overload. All system statuses and real-time sensor data are displayed on an LCD screen and also transmitted through the serial monitor for monitoring and analysis.

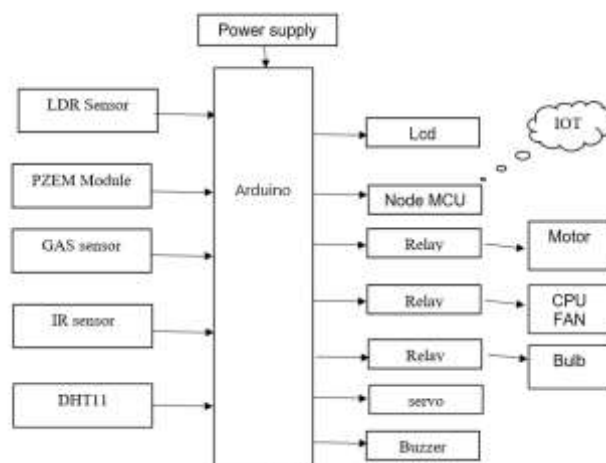


Fig.1: Block Diagram of Smart Home Automation System

5. IMPLEMENTATION AND RESULTS

The system demonstrated reliable performance under different environmental conditions by continuously monitoring sensor inputs and responding in real time. Fig 2 shows the gas detection module worked effectively by identifying the presence of gas leakage and immediately activating safety measures such as turning ON the buzzer, switching ON the exhaust fan, and opening ventilation using the servo motor. This ensures quick response and minimizes the risk of hazardous situations.

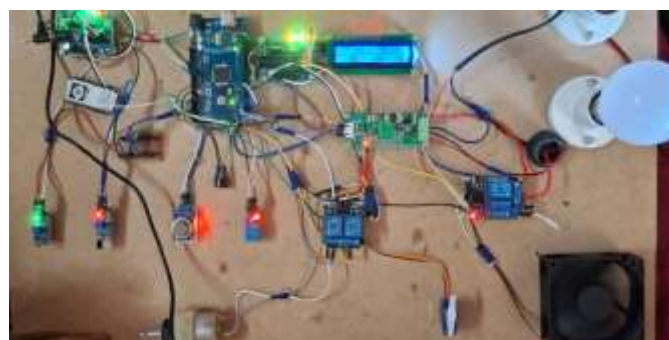


Fig.2: Gas Leakage Detection and Alert System

Fig 3 shows the smart lighting system showed effective energy-saving capability by using both LDR and IR sensors. The light was turned ON only when it was dark and a person was detected, and it remained OFF in all other conditions. This reduced unnecessary power consumption and improved system efficiency.



Fig.3: Automatic Lighting Using LDR and IR Sensor

Fig 4 Describes the overload protection mechanism worked accurately by continuously monitoring the current using the sensor. When the current exceeded the safe limit, the system tripped and disconnected the load, thereby protecting electrical appliances from damage. Additionally, the LCD display provided real-time information about system status, including alerts such as gas detection, high temperature, and system trip conditions.



Fig.4 System Tripped Due to OverLoading

Fig 5 describes the integration of IoT through the ThingSpeak IoT platform enabled remote monitoring of parameters such as temperature, current, and sensor status. The overall results indicate that the system is reliable, responsive, and suitable for real-time smart home applications, providing improved safety, automation, and energy efficiency.



Fig 5 ThingSpeak Cloud Monitoring Dashboard

6. DISCUSSION

The proposed smart home automation system demonstrates effective performance by integrating multiple functionalities such as safety, automation, and energy management using the Arduino Mega 2560. The system responds efficiently to real-time sensor inputs including gas detection, temperature monitoring, light intensity, and human presence. The gas detection module plays a vital role in ensuring safety by activating the buzzer, exhaust fan, and servo motor for ventilation when leakage is detected.

In addition to automation, the system enhances reliability through its overload protection feature, which continuously monitors current and disconnects the load during abnormal conditions to prevent damage to appliances. The LCD display provides real-time system status, while IoT integration using the ThingSpeak IoT platform enables remote monitoring of parameters such as temperature and current.

7. CONCLUSION

The proposed smart home automation system using Arduino Mega and IoT successfully demonstrates an efficient and reliable solution for modern homes. The system integrates multiple sensors to provide safety, automation, and energy efficiency.

It effectively detects gas leakage, controls temperature, manages lighting intelligently, and protects against overload conditions. The inclusion of IoT enables real-time monitoring and enhances user convenience. Overall, the system is cost-effective, scalable, and suitable for real-world smart home applications.

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