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Smartguard: Home Surveillance System using Arduino and Telegram With IOT and Ml

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Abstract - The rapid development in Internet of Things technology has made it possible to develop a smart and cost-effective solution for home security and environment monitoring. This paper proposes a unified framework for home security and environment monitoring using Internet of Things technology. In this paper, Arduino Uno has been used as the main controller, and the flame sensor, gas sensor, DHT11 sensor, and PIR sensor have been used to detect fire hazards, gas leakage, environmental changes, and human movements in the surroundings. This system can efficiently monitor the sensor readings and detect abnormal conditions. When this system detects any abnormal conditions, a buzzer alarm can be used to send alarm notifications. In addition to this, the status can also be displayed on a 16x2 LCD screen. Moreover, the system can also be enabled with NodeMCU technology to send instant notifications to the user through Telegram. In addition to this, OpenCV can also be used for image processing to detect authorized and unauthorized individuals in the surroundings using facial recognition techniques. When this system detects any unauthorized individuals in the surroundings, pictures can be taken of the individuals and sent to the user through Telegram for taking instant action.

***Key Words*:** Home Security System, Arduino Uno, NodeMCU, OpenCV, Telegram Alerts, Smart Surveillance.

1.INTRODUCTION

The rapid growth in urbanization, along with the increasing number of fire accidents, gas leakages, and unauthorized intrusions, has led to the need for intelligent and integrated security systems in residential areas. Conventional alarm-based security systems have shown their inability in providing real-time monitoring and sensing the environment. Recent research studies have emphasized the development of smart home security systems using the Internet of Things (IoT) concept, which integrates various sensors, microcontrollers, and wireless communication modules to provide real-time intruder detection. In addition, the efficiency of multi-sensor-based IoT frameworks in environmental sensing has also been demonstrated in the research article presented by [2].

Keeping this motivation in view, in this paper, a smart security and environmental monitoring system based on IoT technology with Arduino Uno as a controller is proposed. In the proposed system, a flame sensor, gas sensor, DHT11 sensor, and Passive Infrared Sensor are used to detect flame, gas leak, environmental changes, and intrusion. The values are processed in real-time. When any abnormality occurs, a buzzer is activated, and messages are displayed on a 16x2 LCD display. Additionally, in the proposed system, image processing using OpenCV with the help of NodeMCU is done in the event of any abnormality through Wi-Fi. This system can be used in residential or industrial applications. This is a cost-effective and energy-efficient security system.

2.1 LITERATURE SURVEY:

The rapid development in Internet of Things (IoT) technology has significantly enhanced smart security systems in homes. Various security systems have been developed with the help of microcontrollers, sensors, and communication technologies to provide better security in homes.

Cahyono et al. in [3] have developed a security system for homes using ESP32-CAM with Telegram for instant image transmission. The security system has been designed with motion sensors to detect intruders.

Harun and Zainal in [4] have developed a face recognition-based smart door lock security system using ESP32-CAM with Telegram for secure access control.

Marathe et al. in [5] have stated that security systems in homes are not effective in dealing with intricate security threats due to the sensor-based nature of these security systems, which are not based on real-time technology. To develop effective security systems in homes, security systems based on IoT with ESP32-CAM technology have been developed with the facility to send instant alerts through Telegram.

Kumar et al. [6] also proved that IoT devices integrated with notification systems provide a cost-effective surveillance system.

Balshetwar et al. [7] proposed a smart surveillance system by utilizing the ESP32-CAM module, which provides motion detection and cloud storage support for recording and playing the video. Though the existing system provides real-time notification and surveillance, it only provides motion detection and does not provide a multi-sensor-based security system. This is where the existing system needs to be improved.

Ezugwu et al. [8] has provided a detailed explanation of the smart home automation system (SHAS), where the importance of SHAS has been highlighted in the context of providing convenience, safety, and efficient utilization of resources by utilizing IoT technology. It has highlighted the most significant aspects and technologies used in the development of SHAS and the significant problems that restrict the utilization of SHAS. It has highlighted the possible solutions that may be used to make SHAS a reality.

2.2 EXISTING METHOD:

The conventional home security systems are mostly dependent on standalone CCTV cameras and conventional security systems that require constant human involvement. Most of the conventional and existing forms of IoT security systems are not highly efficient in terms of their application in smart homes due to various limitations in terms of system integration and various problems associated with conventional security systems. These conventional security systems are not highly efficient in terms of their application in smart homes [9].

The existing security systems using various forms of IoT technology can be based on simple motion detection using a PIR sensor and a microcontroller that can activate a buzzer in the case of any motion detected. These conventional security systems mostly focus on single-parameter security systems and do not incorporate various safety parameters such as gas leakage, fire, and temperature analysis in a single system [10].

Moreover, the existing forms of IoT technology for camera-based security systems mostly focus on motion detection and sending alerts over the network. These security systems do not incorporate various forms of safety parameter analysis using various sensors, as discussed in [11]. Hence, the existing security systems are not highly efficient in terms of their application in smart homes.

2.3 PROPOSED METHOD:

The proposed system is designed to work as an IoT-based smart security and environmental monitoring system that integrates various sensors with wireless communication capabilities. The overall system architecture is designed to incorporate two parts: one is related to the sensor and processing part using Arduino Uno, and the other is related to the communication part using NodeMCU with Wi-Fi connectivity.

In this system, various environmental and security parameters are monitored using a flame sensor, gas sensor, DHT11 temperature and humidity sensor, and a PIR motion sensor. These sensors are connected to Arduino Uno, which is used as a central processor. Arduino Uno collects real-time information from sensors and compares it with threshold values to detect abnormal conditions such as fire hazards, gas leakage, abnormal temperature variations, and motion detection.

In case of any abnormal condition detected by Arduino Uno, a local alert is sent using a buzzer and a message is

displayed on a 16x2 LCD module. Simultaneously, information regarding abnormal conditions is sent to NodeMCU.

The Wi-Fi communication module used in the proposed project is NodeMCU. The Wi-Fi facility is provided for the ease of real-time remote monitoring. The facility for reconnecting in case of any interruption in the network is provided in the NodeMCU module. In abnormal conditions such as gas leak detection, fire detection, and motion detection, messages are sent to the users through a Telegram application. In motion detection, image recognition is performed through an OpenCV library for identifying individuals. In motion detection, messages are sent to users, whereas in detection of unauthorized individuals and detection of authorized individuals, images are sent immediately and not sent, respectively.

The system is continuously in a loop of monitoring and controlling. It is modular and can be easily expanded by adding more sensors or even sophisticated analytical tools. By utilizing multi-sensor detection systems and local alarm systems along with remote communication through IoT technology, this methodology can improve the reliability and efficiency of a security system compared to conventional alarm-based systems.

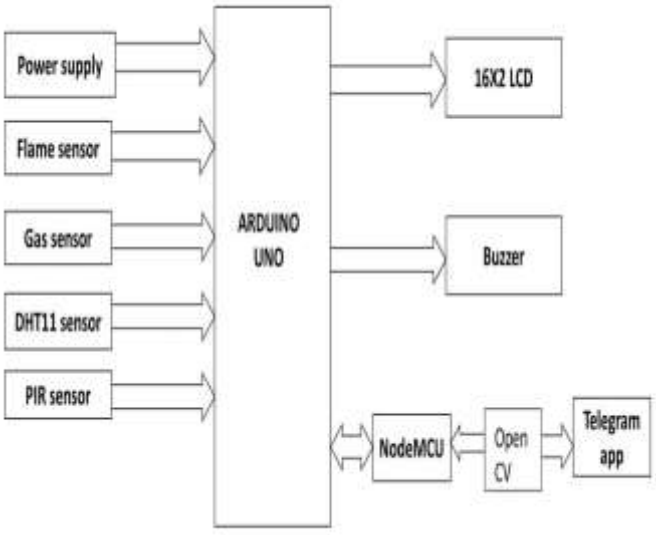


Fig -1: Block diagram of proposed method

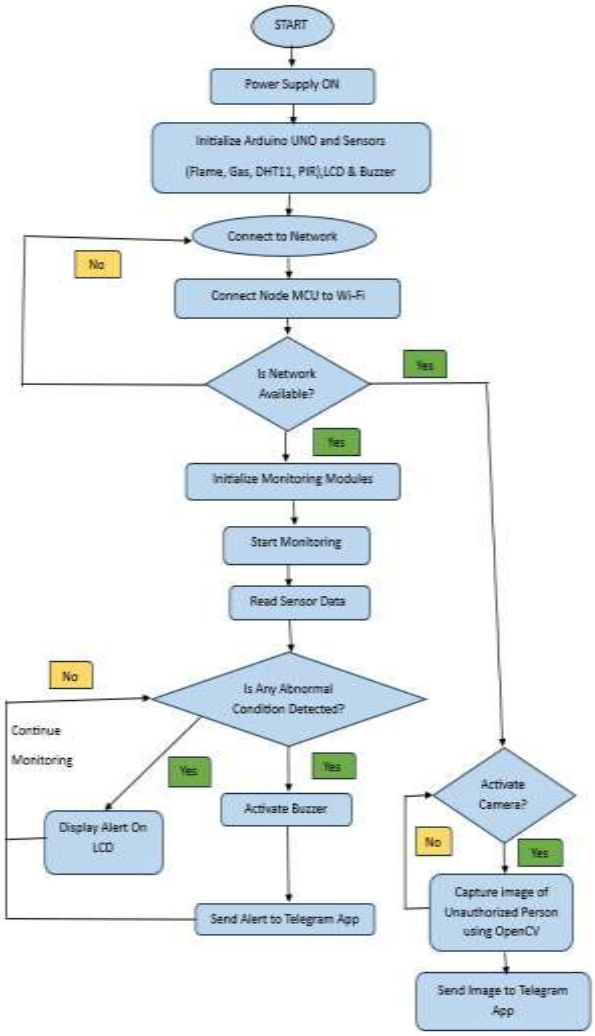


Fig -2: Flowchart of proposed method

2.4 RESULTS:

The developed IoT-based smart security and environment monitoring system has already been implemented and tested under abnormal conditions like flame detection, gas leakage detection, temperature change detection, and human motion detection. Based on the experimental outcomes of the proposed system, it has been observed that the flame and gas sensors can be used to detect abnormal conditions. It has also been observed that the DHT11 sensor can be used to detect abnormal conditions like temperature and humidity level change by considering a certain threshold value. It has also been observed that the PIR sensor can be used to detect abnormal conditions like human motion and alert the user accordingly. Once abnormal conditions are detected by the proposed system, it will immediately alert the user by ringing a buzzer and send a real-time alert message to the user by utilizing a Telegram application through a NodeMCU Wi-Fi module. It has also been observed that the developed system can be used to send images by utilizing OpenCV to detect

abnormal conditions like motion detection. It has also been observed that the developed system can be used to replace a conventional security system.

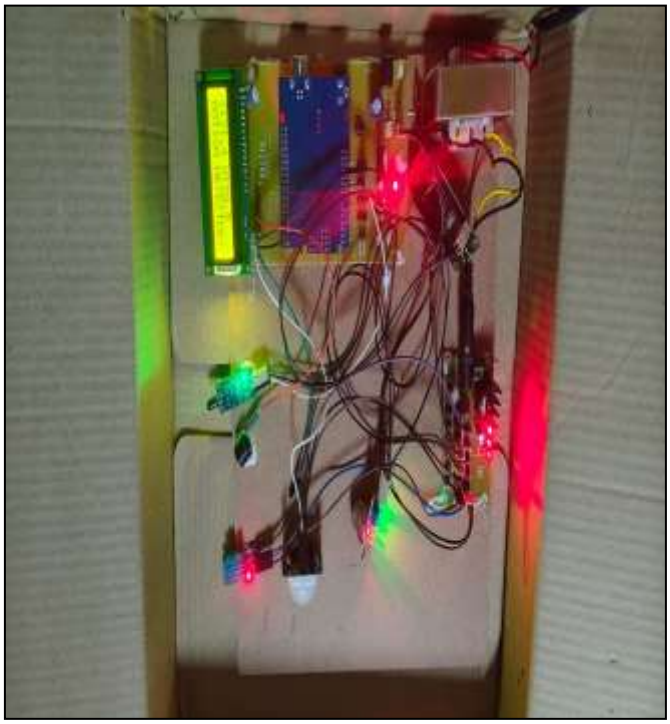
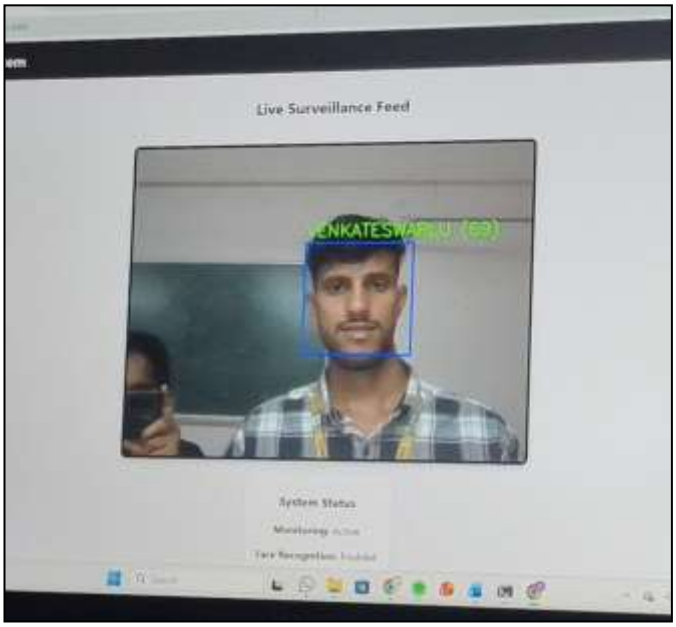


Fig -3: Hardware Implementation of the SmartGuard IoT Home Security System



Using OpenCV

Fig -5: SmartGuard System – Features and Alert Mechanisms

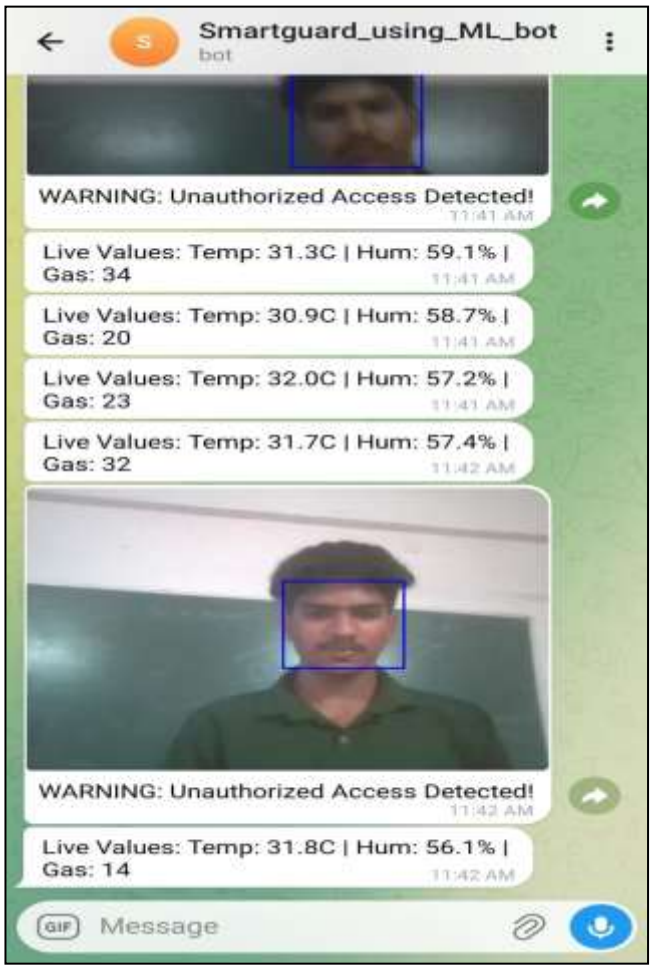


Fig -6: Smart Home Security System – Telegram Alert Output

3. CONCLUSIONS

In this paper, the smart security environment monitoring system based on IoT technology with Arduino Uno, NodeMCU, flame sensor, gas sensor, DHT11 sensor, and PIR sensor has been discussed. The sensors are used for flame detection, gas detection, environment detection, and security. The buzzer is used for immediate alerting through LCD and Telegram. OpenCV is used for image transmission. From the experimental results, it is clear that the proposed system is reliable, cost-effective, and energy-efficient. Hence, the proposed system can be implemented in small-scale applications only.The smart security environment monitoring system can be enhanced with AI for threat detection, cloud for data storage, and a mobile app for interaction.

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