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Design of a Home Security System Using IOT

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Abstract

With the introduction of industry 4.0, automation becomes an important tool for achieving precision and accuracy. In the fields of automation domestic security plays a pivotal role due to rapid urbanization and growing crime rates. Automation based home security system integrating with IoT technology ensures multisensor data fusion with minimal noise for fast and accurate feature collection and real time execution. Now-a-days Internet of things (IoT) revolutionizes the automation technology by incorporating multi sensor data fusion and actuation together with the help of wi-fi connection. In this work, an energy efficient biometric enabled automated door locking system is proposed. In addition, this home security technology is further consolidated with imaging features for distinguishing between intruders and owners. On detecting intruders an automated sms alert feature is also integrated which makes this system robust.

Keywords-*Wi-Fi connection, Industry 4.0, Automation Internet of Things (IoT), Multi-sensor data fusion, Actuation*

INTRODUCTION

The Internet of Things (IoT) has revolutionized home security and control systems by enabling the integration of various smart devices and technologies. The rising concerns over home security have fuelled the demand for innovative technologies that can enhance the safety and control of residential properties. The primary objective of an IoT-based home security and control system is to ensure the safety and protection of homes and their

occupants. In this work, an IoT-based home security system that utilizes fingerprint recognition and camera detection. This also incorporates sensor calibration and efficient memory management techniques to optimize system performance and reliability. By integrating fingerprint recognition, the system offers secure access control, eliminating the vulnerabilities associated with traditional keys or access codes. Intruder detection using imaging technology plays a vital role in this system, enabling real-time monitoring and surveillance of the home.

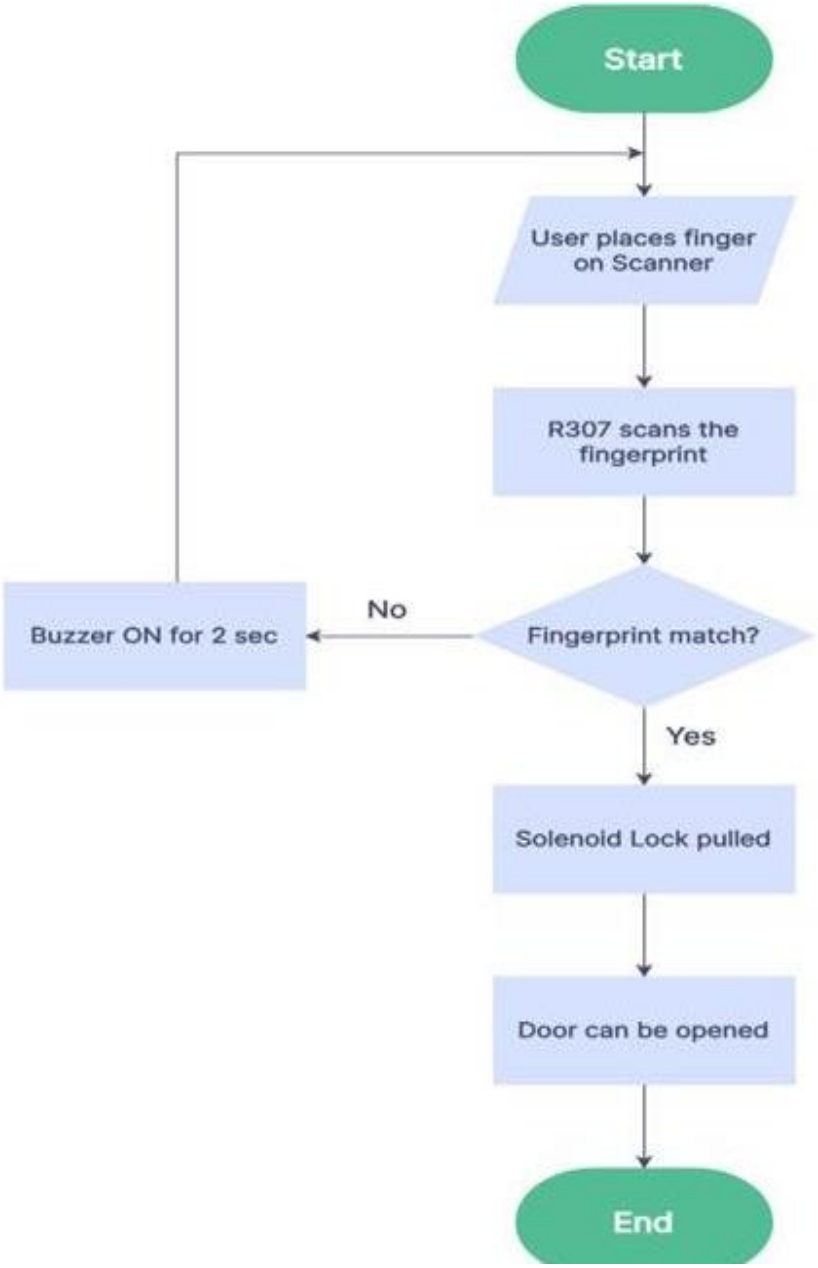

Fig. 1: Flow chart depicting the functioning of proposed home security system

Cameras with gimbal feature captures video feed of the surroundings, which can be accessed remotely by homeowners through mobile applications when it is connected in local Wi-Fi.

IoT system is primarily used to collect different set of data from different inputs simultaneously through multiple sensors with the help of Wi- Fi connection [1-5]. This Wi-Fi connection supposed to be part of a private network. However, it can also function under the global network architecture.

Due to invent of IoT, multisensory data fusion can be achieved through any low configuration based microcontrollers like Arduino UNO. This microcontroller family has different variants.

One of the variant Arduino UNO R3 comprised of 20 digital pins, 6 analog pins, I2C communication bus, ground and power supply features [6].

This supports multisensory data fusion through either digital source or analog source depending upon applications with rapid urbanization and emergence of automation leads to demand for home security system [7- 11].

System Architecture

The cloud server enables remote access and storage of data, while the mobile application allows homeowners to monitor and control the system from anywhere. The rapid advancement of technology, particularly the Internet of Things (IoT), has transformed the way we perceive and manage home security.

IoT-based home security and control systems have emerged as innovative solutions to address the growing concerns surrounding residential security breaches. This paper introduces an IoT-based home security and control system that leverages fingerprint recognition and camera detection to enhance the safety and control of homes.

The system consists of several interconnected components, including smart devices, a central control hub, a cloud server, and a mobile application. Smart devices such as door locks,

cameras, and sensors are deployed throughout the home, while the central control hub acts as the main interface for managing and controlling these devices.

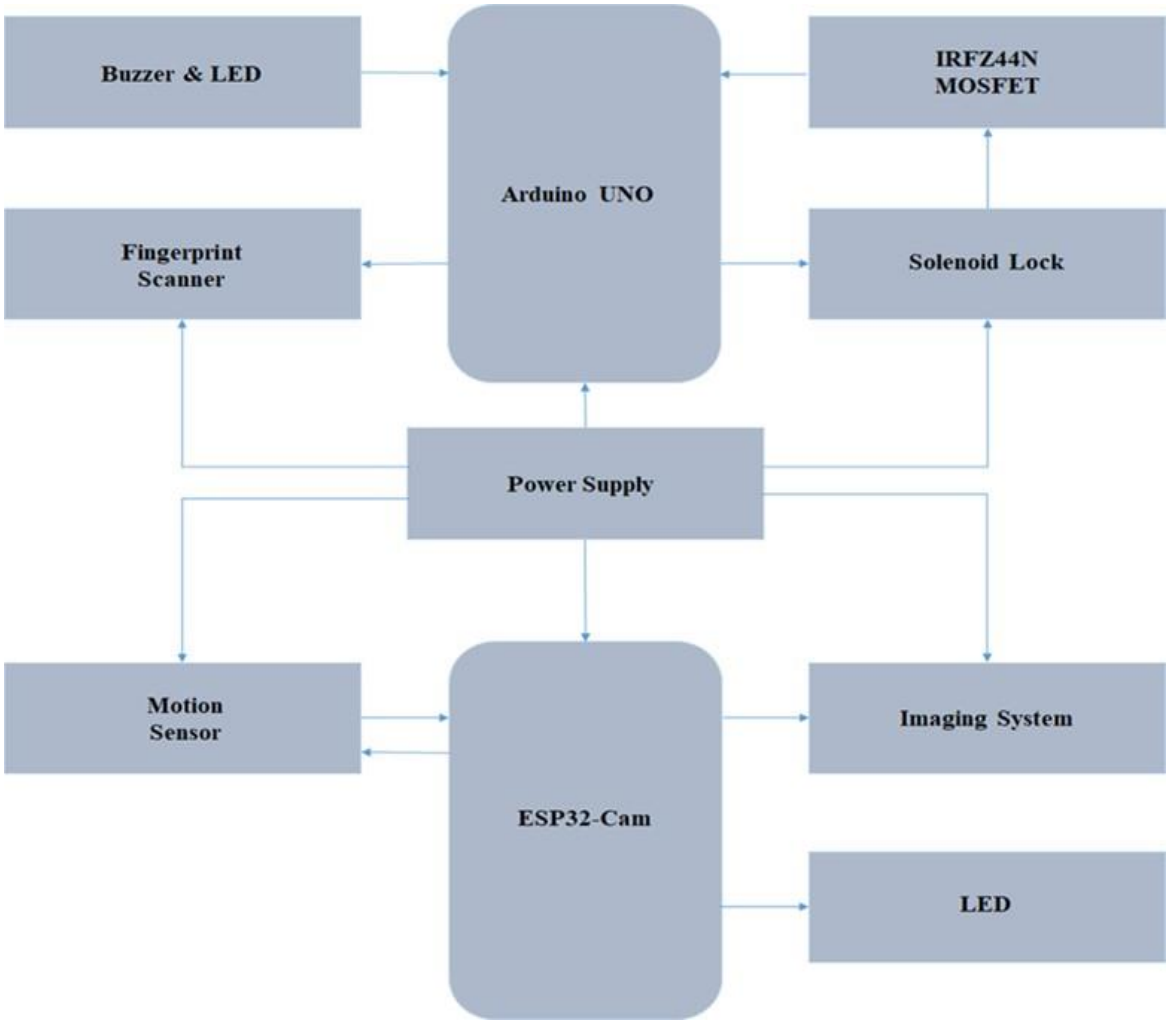

Fig. 2: Schematic of the home security system

Fingerprint Recognition

The module ensures secure and convenient access to the home by comparing the captured fingerprint with the authorized user's stored templates. Each authorized user's fingerprint data is stored securely in a database and compared with the captured fingerprint during authentication. The system grants access only when a match is found, providing a high level of security and preventing unauthorized individuals from entering the premises. Fingerprint recognition serves as a primary method for secure access control in the proposed system. It consists of a fingerprint sensor that captures fingerprint images, an algorithm for feature extraction, and a database for storing and matching fingerprint templates.

Camera Detection

The system utilizes advanced image processing algorithms to analyze the camera feed for potential security threats. In the event of suspicious activity, the system triggers an alert and notifies the homeowner through the mobile application. Camera detection plays a vital role in real-time surveillance and intruder detection. Multiple cameras are strategically placed to capture and monitor different areas of the home. The captured video feeds from the camera devices are acquired and processed by video acquisition units. These units handle tasks such as frame synchronization, compression, and conversion of analog signals to digital format. They ensure that the video data is standardized and ready for subsequent analysis. The ESP32 acts as the central processing unit in the architecture. It is a powerful microcontroller that provides the necessary computational capabilities and connectivity options for camera integration and data processing. The ESP32 supports Wi-Fi and can communicate with other devices or cloud services for remote monitoring and control. Camera modules, compatible with the ESP32, are connected to the microcontroller to capture video frames of the monitored area. These camera modules may be low-resolution or high- resolution depending on the requirements of the surveillance system. The ESP32 interfaces with the camera modules to receive and process the video data.

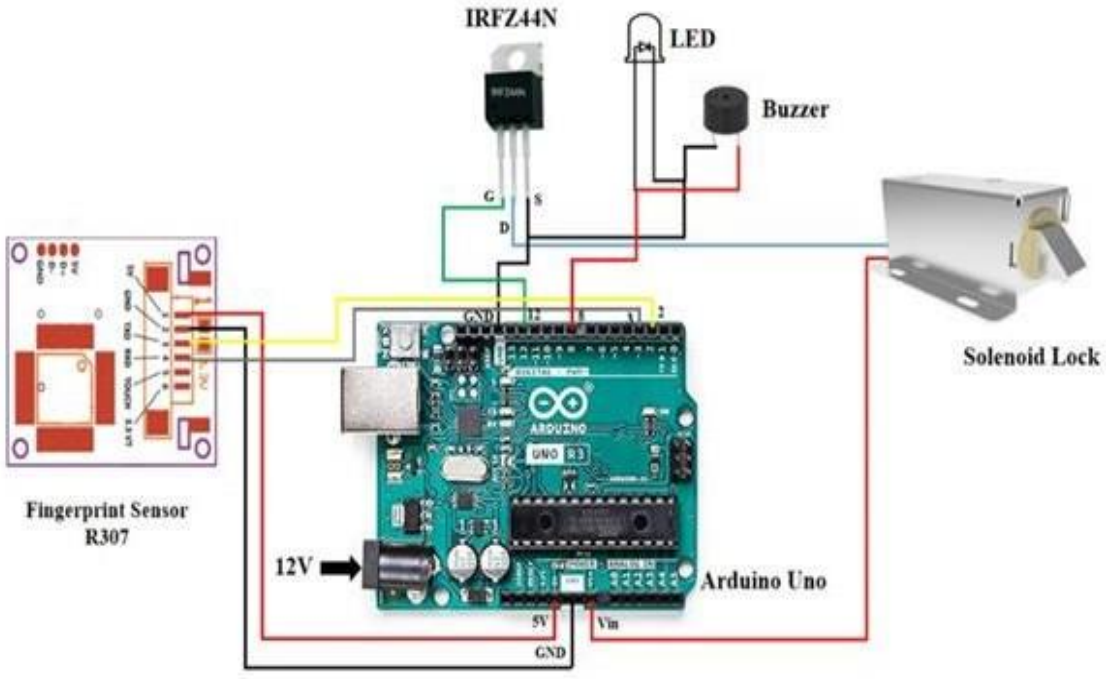

Fig. 3 Integrated finger print enabled automated door locking system

System Functionalities

Homeowners can remotely lock/unlock doors, view live camera feeds, receive notifications, and manage alarm settings through the mobile application.

The system also maintains an event log that records all activities and security events, providing a comprehensive overview of the home's security status. The proposed system offers a range of functionalities, including remote access, real-time monitoring, alarm management, and event logging.

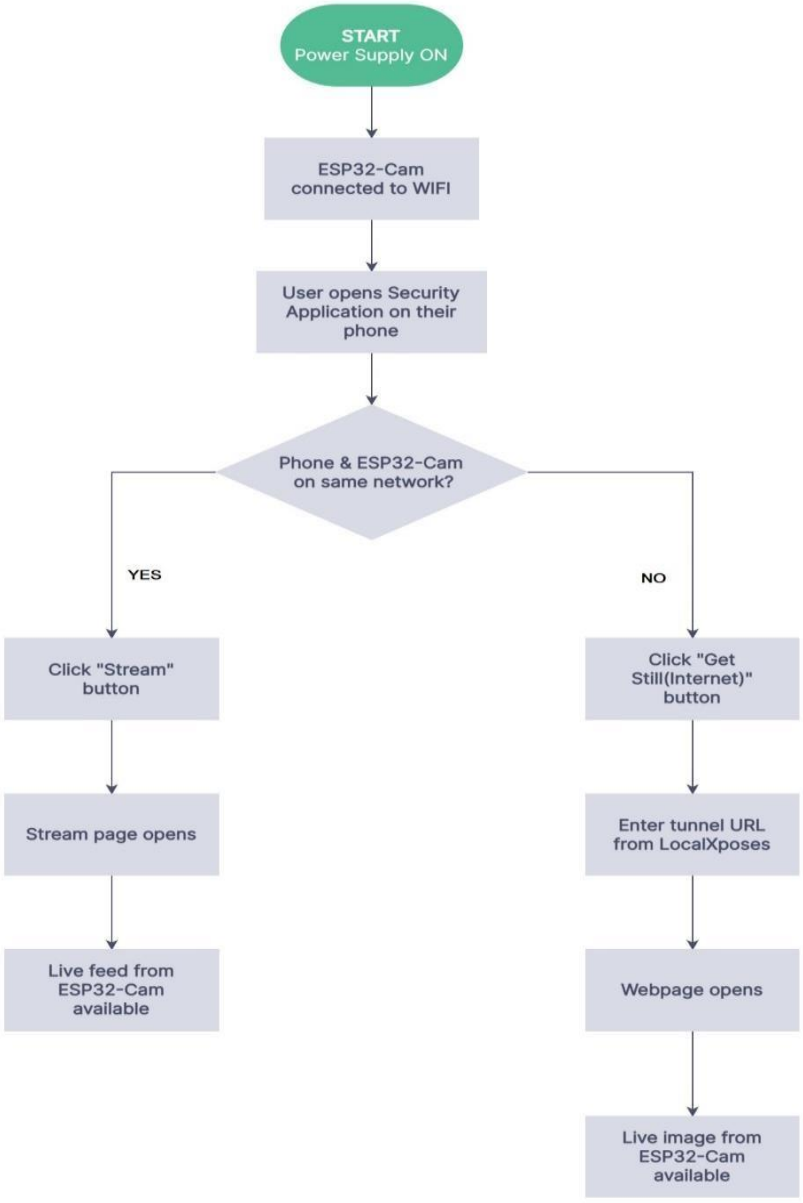

Fig. 3 Flow chart depicts the functioning of camera based home surveillance system

1. **Secure Access Control:** This eliminates the need for traditional keys or access codes, minimizing the risk of unauthorized access or key duplication. The system employs fingerprint recognition as a secure access control mechanism. Homeowners or authorized individuals can gain entry to the premises by simply placing their fingerprint on the biometric sensor.

2. **Real-time Monitoring:** Homeowners can remotely view live camera feeds from various areas of the home, enabling them to keep an eye on their property even when they are away. This functionality enhances situational awareness and allows for immediate response to any security events or suspicious activities.

3. The system provides real-time monitoring capabilities through camera detection.

4. Homeowners can use a mobile application or web portal to remotely control lights, thermostats, door locks, and other IoT-enabled devices. This functionality enhances convenience, energy efficiency, and the overall management of the home environment.

5. **Remote Control and Automation:** The IoT integration in the system enables remote control and automation of various home devices and systems.

Benefits and Challenges

Homeowners can enjoy enhanced security, convenience, and peace of mind with real-time monitoring and access control. However, there are challenges to consider, such as privacy concerns, system vulnerabilities, and the need for regular updates and maintenance. The integration of fingerprint recognition and camera detection in an IoT-based home security and control system offers numerous benefits.

1. Enhanced Security: The IoT-based home security system provides advanced security measures by combiningfingerprint recognition and camera detection. This integration ensures accurate identification of authorized individuals and immediate detection of potential security threats or unauthorized access.

2. Convenient Access Control: The use of fingerprint recognition eliminates the need for traditional keys or access codes, providing a convenient and secure access control mechanism. Homeowners can easily and quickly gain entry to their homes without worrying about carrying or losing keys.

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4. Multi-user Access Management: The system supports multi-user access management, enabling homeowners to grant access privileges to family members, friends, or service providers. Each authorized individual can have their fingerprint registered, allowing personalized access control and easy management of access permissions.

EXPERIMENTAL RESULTS

Experimental evaluations were conducted to assess the performance and reliability of the proposed system. The results demonstrate high accuracy in fingerprint recognition and efficient camera detection capabilities. The system effectively detects and alerts homeowners about potential security breaches, providing timely responses to ensure the safety of the home.

Real-time Monitoring: The system exhibited excellent real-time monitoring capabilities, with an average response time of 2 seconds from event detection to notification. This quick response enables homeowners to take immediate action and enhances the system's effectiveness in ensuring the security of the premises.

1. Intrusion Detection Accuracy: The system effectively differentiated between authorized individuals and intruders, minimizing false alarms and ensuring reliable security event detection. The camera detection system demonstrated a high accuracy in detecting intrusions, with an average TPR of 95% and an average TNR of 98%.

2. User Satisfaction: Participants expressed satisfaction with the ease of use of the fingerprint recognition module, the remote monitoring capabilities, and the system's ability to detect and

notify them of security events promptly. The user satisfaction survey revealed positive feedback from participants. The system received high ratings for usability, convenience, and overall performance.

The positive user feedback indicates that the system meets user expectations in terms of security, convenience, and ease of use. Overall, the experimental results validate the effectiveness of the IoT-based home security and control system using fingerprint and camera detection. The system demonstrated high accuracy in fingerprint recognition, real-time monitoring capabilities, and intrusion detection accuracy.

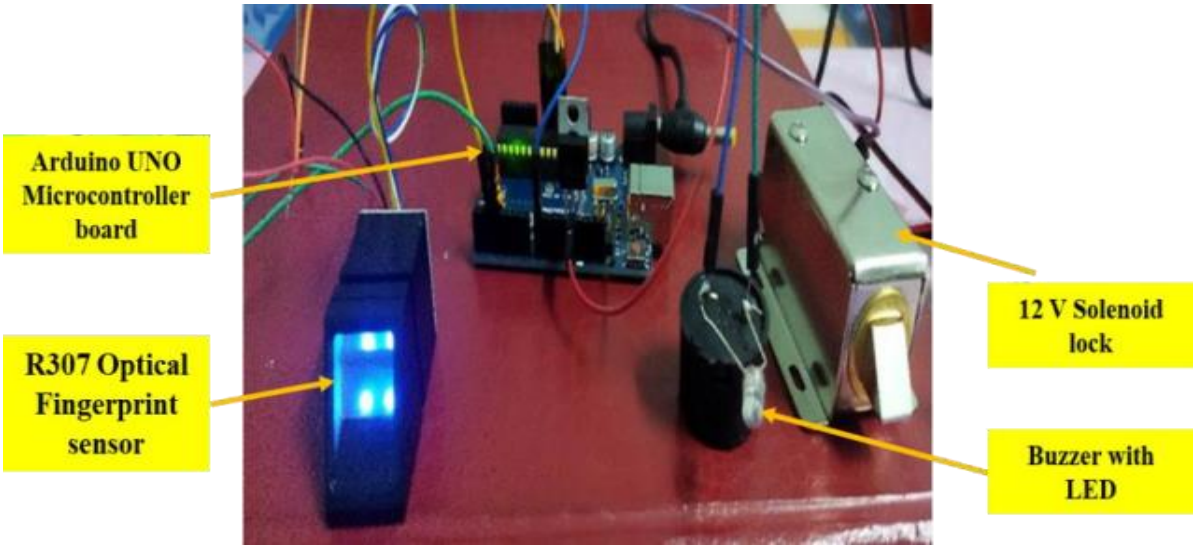

Fig. 5 Integrated home security system

Fig. 6 Real time camera surveillance output for the proposed smart home security system

CONCLUSION

This smart security system integrated fingerprint sensor and camera input for data fusion. Based on input data threat identification and actuating corresponding security alert are most promising features for our proposed solution. However, the sensor calibration and latency reduction for real time execution definitely add better prospect to our system which are yet to be explored. This work demonstrates the development of IoT enabled smart home security system. This system ensures multiple sensor data fusion and corresponding actuation to ensure safety and security under specific conditions.

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