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AN IOT-DRIVEN HOME SECURITY AND SAFETY SYSTEM WITH REAL-TIME ALERTS

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Abstract : This paper presents the development and deployment of an advanced IoT-Driven Home security and safety system with real-time alerts. Security is at most concern for anyone nowadays, whether it's data security or security of their own home. With the advancement of technology and the increasing use of IoT, digital door locks have become very common these days. Digital lock doesn't require any physical key but it uses RFID, fingerprint, Face ID, pin, passwords, etc. to control the door lock. In past, we have developed many digital door locks applications using these various technologies. In this proposed solution we will build a Face reorganization system using ESP32-CAM. The AI-Thinker ESP32-CAM module is a low-cost development board with a very small size OV2640 camera and a micro-SD card slot. It has an ESP32 S chip with built-in Wi-Fi and Bluetooth connectivity, with 2 high-performance 32-bit LX6 CPUs, 7-stage pipeline architecture. We will use the ESP32-CAM to build a Face Recognition based Door Lock System using a Solenoid lock for locking and unlocking the door. Not only that it can be monitored by the mobile and can grant the permission to access the door. It also enabled with buzzer when someone is detected by the system and alerts to the owner.

Index Terms **– IoT, Home Security, Safety, ESP32-CAM.**

I. INTRODUCTION

In these modern times, home security is the need of the hour for the development of society as a whole which in turn will help make our cities smart, so the concept of facial recognition to gain access of the house is an idea which is used to make our place of living more secure. A facial recognition system is a system which captures facial images and verifies the identity of a person using a digital camera. The human face assumes an essential part in our social association, passing on individuals' character. Utilizing the human face as a key to security, biometric confront acknowledgment innovation has gotten tremendous consideration in the previous quite a while because of its potential for a wide assortment of utilizations.

Human beings are recognized by their distinctive facial characteristics. In the face recognition approach, a given face is compared with the faces stored in the database in order to identify the person. The aim is to search out a face in the database, which has the highest similarity with the given face. In the field of bio science, face recognition technology is one among the fastest growing fields. The need of face recognition in security systems is attributed to the rise of commercial interest and therefore the development of feasible technologies to support the development of face recognition.

Major areas of commercial interest comprise of bio science, law enforcement and surveillance, human computer interaction, multimedia management (for example, automatic tagging of a particular individual within a collection of digital photographs) smart cards, passport check, Criminal investigations, access control management. A facial acknowledgment framework is a framework which gets facial pictures and confirms the character of a man using a propelled camera. It is an application fit for distinguishing or checking a man from a computerized picture.

One approach to do this is by looking at chose facial components from the picture and a face database. As stood out from other diverse biometrics frameworks utilizing unique mark/palm print and iris, confront acknowledgment has unmistakable favorable circumstances due to its non-contact handle. Face pictures can be caught from a separation without touching the

individual being recognized, and the ID does not require participating with the individual.

It is normally utilized as a part of security frameworks and can be contrasted with different biometrics. It has additionally turned out to be main stream as a commercial recognizable proof and advertising instrument.

II. LITERATURE SURVEY

The integration of the Internet of Things (IoT) into home security systems has revolutionized the way safety is managed in residential environments. With the increasing demand for intelligent and responsive systems, researchers have explored various methods for real-time monitoring and alert generation. Early developments, such as the work by Piyare et al. (2013), demonstrated the use of Arduino and GSM modules to create basic home automation systems capable of sending SMS alerts. Similarly, Alkar and Buhur (2005) laid foundational work for remote-controlled home appliances, although their approach did not prioritize security aspects.

The role of cloud and mobile technologies has also been significant. Gubbi et al. (2013) emphasized the importance of cloud computing in managing and analyzing IoT-generated data, allowing for scalable and efficient operations. Zhao et al. (2018) showcased a smartphone-based interface for home security, improving user accessibility and control. Recent advancements have incorporated artificial intelligence to enhance alert systems. For instance, Kumar et al. (2020) integrated AI and machine learning algorithms to distinguish between normal and suspicious activities, reducing false alarms. Mohammed et al. (2022) introduced edge computing techniques to process data locally, thereby minimizing latency and improving response times.

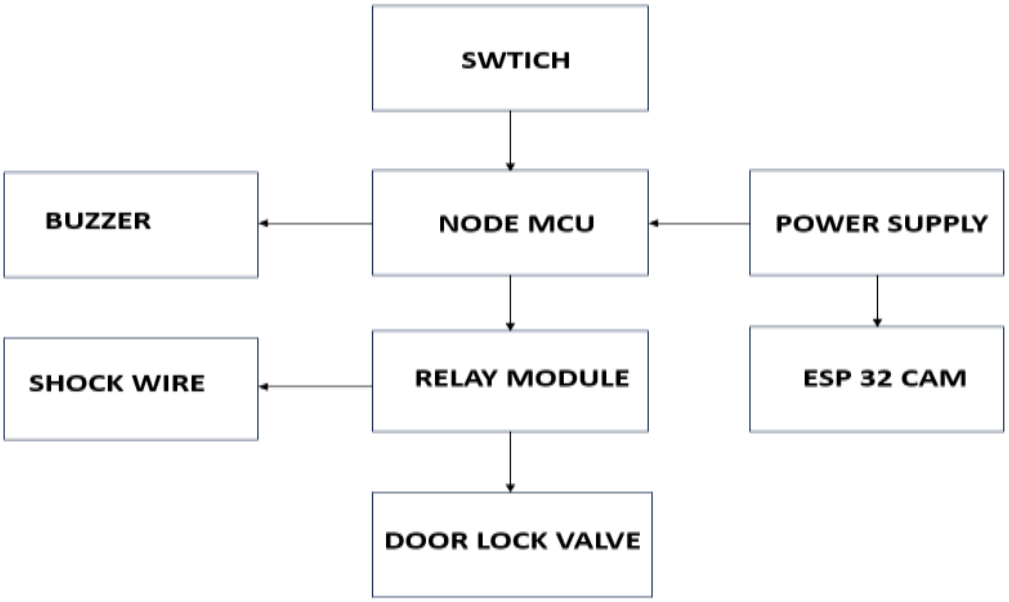
Key technologies observed across these studies include microcontrollers like Arduino, Raspberry Pi, and ESP32, with communication protocols such as MQTT, Wi-Fi, and ZigBee enabling device interoperability. Commonly used sensors include motion detectors, smoke and gas sensors, magnetic door/window sensors, and surveillance cameras. Cloud platforms like Firebase, AWS IoT, and Thing Speak are often used for real-time data synchronization and alert dissemination via push notifications, SMS, or emails.

III. PROPOSED SYSTEM

Uses IOT and ESP 32 CAM for remote monitoring and face recognition through mobile app interface.
In the previous systems they allowed the people without any human intervention but in this proposed system the person who is accessing the app can only allow the people who are known to them. Otherwise the people won't be allowed which is more secured and safer compared to the other systems.

The below block diagram consists of, an ESP-32 micro-controller board for system development, it consists of inbuilt camera module for face recognition, and a relay to control door lock and solenoid as door lock. For the door unlocking system, we wi ll place a solenoid lock at door latch. This lock will be programmed in such a way that when the user authenticates the person in front of the camera and wants to grant access, the solenoid shaft will go inside and latch door will be unlocked. The summarize information about module are described as follows,

The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot. The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, Wi-Fi image upload, QR identification, and so on. This ESP32 microcontroller comes with inbuilt wi-fi, Bluetooth and camera module.



A relay is an electromechanical switch, which perform ON and OFF operations without any human interaction. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. When this relay allows power supply through it solenoid acts as unlock state by that door can be opened otherwise it remains in locked state.

The solenoid lock denotes a latch for electrical locking and unlocking. It is available in unlocking in the power-on mode type, and locking and keeping in the power-on mode type, which can be used selectively for situations. We use power-on unlocking type. The power-on unlocking type enables unlocking only while the solenoid is powered on. A door with this type is locked and not opened in case of power failure or wire disconnection, ensuring excellent safety. This type is used mainly for places requiring crime prevention.

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarms, timers and confirmation of user input such as a mouse click or keystroke. A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

Blynk is a mobile application which was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things. All controlling and monitoring takes place through this application.

We have used chloride safe power sealed adaptors. Having 9v 1Ah, 5v 1 Ah. This is connected to the solenoid and controller module, and in turn given to the regulator that regulated output is supplied to the components.

IV. RESULTS AND DISCUSSION

The prototype was tested in a controlled environment. The prototype which we have discussed have met the Security levels. The Door lock valve closed only when the access is given and ESP 32 CAM is continuously accessing the environments without any delays. An IOT Driven Home Security and safety system can monitor up to longer environments and by using more pixel.

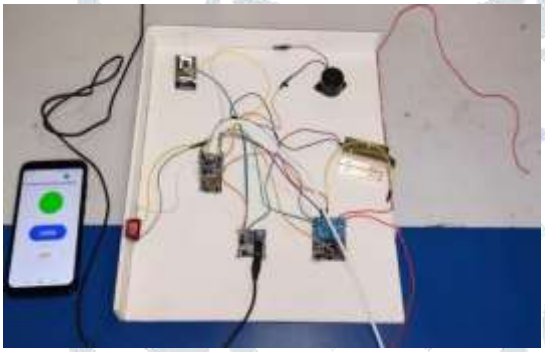


Fig 1: Blynk app opened in mobile

IoT-driven home security and safety systems are revolutionizing how we protect our homes by integrating a network of smart devices to provide real-time monitoring and control. These systems typically include smart cameras, door/window sensors, motion detectors, smart locks. A central hub connects these devices, allowing homeowners to remotely monitor their property and receive immediate alerts on their smartphones or other connected devices in case of unusual activity or potential hazards.

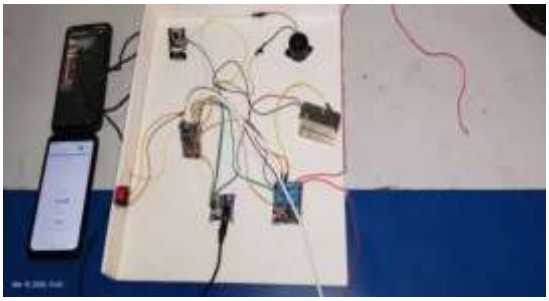


Fig 2: ESP32-camera access to unlock the door using Blynk app

The node MCU consists of mac address which is connected to our smart phones. The ESP32 camera has an standard IP address and with the help of that IP address we can see live streaming video and we can access that from any place. If the person is a known person we can give access to him into the house using mobile phone.

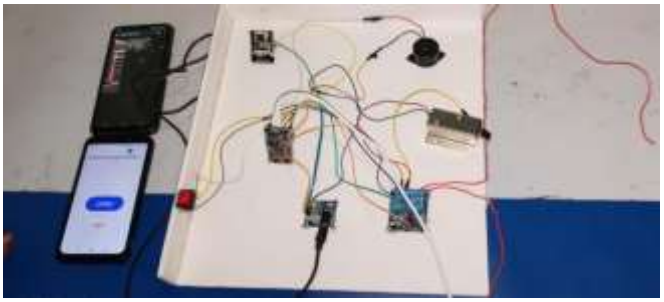


Fig 3: ESP32 camera access to lock the door

In cases where the system detects an unidentified person, it automatically denies access and ensures that the door lock remains engaged for security. The system uses face recognition technology to compare the detected face with a pre-stored database of authorized individuals. If the face does not match any stored profile, the system follows a strict security protocol to prevent unauthorized entry.

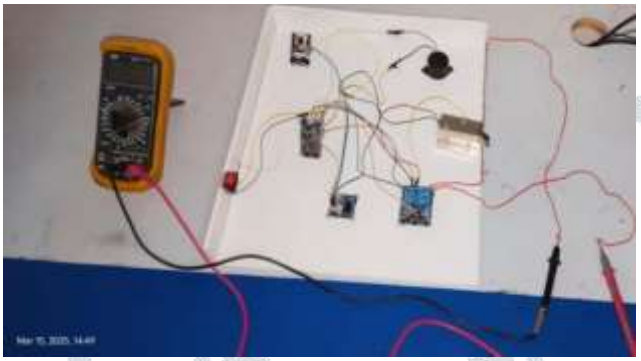


Fig 4: shock circuit for back door purpose

In case if any person wants to breakdown the window or if he wants to enter into the house through back door then the shock circuit gives a shock to that person.

The prototype was tested in a controlled environment. The prototype which we have discussed have met the Security levels. The Door lock valve closed only when the access is given and ESP 32 CAM is continuously accessing the environments without any delays. An IOT Driven Home Security and safety system can monitor up to longer environments and by using more pixel values the System safety levels are met.

V. CONCLUSION

In cases where the system detects an unidentified person, it automatically denies access and ensures that the door lock remains engaged for security. The system uses face recognition technology to compare the detected face with a pre-stored database of authorized individuals. If the face does not match any stored profile, the system follows a strict security protocol to prevent unauthorized entry.

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