



# A Face Recognition Method for Security Applications in Smart Homes and Cities

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## ABSTRACT

*In recent years, it is important to own a reliable security system that can secure our assets as well as to protect our privacy. The traditional security system needs an individual to use a key, identification (ID) card or password to access an area such as home and workplace. However, the present security system has many weaknesses such as, most doors are controlled by persons with the employment of keys, security cards, countersign or pattern to open the door. Hence, there is a need to develop a face-based IoT Access Control System. In this work, the creation of a door lock system is accomplished using facial recognition in conjunction with the ESP32 CAM for more accurate face detection than the present system. The ESP32 CAM, which is powered by a battery, is the system's backbone, and it controls the door's locked and unlocked systems. This door lock system is controlled by face recognition and a smart phone, face recognition and a smart phone are used to run this door lock system. Authorized users can use the face detection system, while unauthorized users can't use the ESP32 CAM. This project is a viable one in the sense that it will go a long way in making it more convenient, easier for home use most especially where serious security is needed. In conclusion, this project is a design which should be encouraged and put into large scale manufacturing because of its various advantages.*

**Keywords:** RFID Reader, GSM, RFID Tag, Arduino Uno, LCD display

## 1. INTRODUCTION

Security is important for everyone, everywhere, in the world and due to the emerging technology, risks have been raised higher and improvement in safety measurements has become a necessity. Home automation is quite a hot debate and has a high demand due to the helping nature of the technology for handicapped, paralyzed and elder people. In this paper main focus is to develop an offline smart home by

making both face recognition and speech recognition independent of the internet connection for the use in remote areas. Many countries are embracing advanced security systems. Accuracy in the identification is the main concern and this can be achieved by many different topologies as biometric finger print, key passwords, sensors and facial recognition techniques. Technology of Face Recognition is beneficial for a wide range of applications. Image Detection and recognition of a low-

resolution up to 21x21 pixels is possible and is the most suitable solution for the controlled environment, which makes it perfect for the guard system of our smart home. In previous research, vast amount of work has been done to make the face recognition technology more reliable and accurate. Face recognition has already been done by various different techniques; Principle Component Analysis, Linear Discriminant Analysis, Local Binary Pattern, Haar-Cascade Classifier, each having a competitive advantage over others. IOT (internet of things) to send the image of the visitor to the owner and to enable the owner to communicate back to the visitor by sending a message back on the door screen. In the proposed offline system, face is detected and then recognized by matching the image taken in the real time with the prestored database as also done in [7], without any communication with the owner, for a faster, easy to use/install and cheap system to help technologically uneducated people in remote areas. Raspberry-Pi microcontroller is programmed with Python language to work with OpenCV algorithms for offline face recognition of smart home. In the present era, crime rates are increasing dramatically. A lot of incidents like theft, burglary, and unwanted intrusions happen abruptly. This gives rise to the need of a security system which can prevent unauthorized access to high-security zones such as locker room of banks, casinos, garage, military sites etc. Till date, many Security Systems such as RFID, OTP based system, biometrics are used to prevent unauthorized access. But merely preventing unauthorized access is not enough. We need a system which would aid in catching the intruder as well as in unfolding his motives. Here, we present a design of Door security system which solves this underlying problem.

It must take into account the actions of people attempting to trespass or cause destruction. Security is the degree of protection against danger, loss and criminals. Throughout history, human have sought to protect their life, property and professions. The busy lifestyle of people is leading to the necessity of controlling the devices at home remotely and increasing the necessity of keeping surveillance over their home. Now when everything is available to us we can now design something that provides us complete security. The very basic of this began with the simple alarm system which include notifying suspicious activities at a very low cost [1]. The need for security system have

rapidly grown from being specialized for high –risk areas such as banks ,companies ,governmental institutions),to be available and demanded rapidly by the average public.

## 2. EXISTING SYSTEM

As technology is still evolving, there is not a specific appropriate standard to define a ‘smart home’ nor a distinctive feature to classifying ‘smart home’ in relation to various related terms used and from similar other systems. We can say home system as ‘smarter’ due to collective intelligence of individual home appliances, all electronics and non-electronic items in collaboration with other devices in surroundings. The term ‘smart home’ is used for all residence those are equipped with something that makes inhabitants to monitoring all things automatically and facilitates home environment so as optimize and automate all facilities designed for basic day today need of an individual.

Development in technology from last few decades open doors to various threats to human and his surroundings. Individuals with the advancement in security had taken several measures to control the threats for safeguarding their belongings. From time-to-time various intrusion detection systems established for earmark intruders from home environment and provide tangible benefits to users, but can also expose users to significant security risk. Smart home security system is gaining popularity for industry, government, and academia as well as for individual that has the potential to bring significant personal, professional and economic benefits. This paper presents design and implementation of smart home security system based on GSM/GPRS (Global System for Mobile Communication /General Packet Radio Service) and response rapidly to alarm incidents and has a friendly user interface including a LCD (Liquid Crystal Display) and keypad. Special emphasis is placed on the empirical security analysis of such emerging smart home platform by dividing into two case scenarios. The paper will conclude by discussing future perspective and challenges associated with the development of security system for home.

The huge need of automated equipment in our day to day lives is going on increasing in order to meet that need automated equipment is coming into limelight Automatic electronic door opener is such a system through which a door can be opened easily

& automatically, through voice control, motion sensors, PIR sensor. Performance of automatic electronic door opener is through sensors; energy level & efficiency of automatic electronic door opener is better but the operating capacity of this system is area limited and inconvenience problems are introduced.

### 3. PROPOSED SYSTEM

The system design for the facial recognition door lock system is based on hardware module. The design system seems complex hence, a modularity method is adopted to break the large system into sub-system according to function each module performs. The stipulated objectives will be used in the system design to achieve the aim of this research work. A conceptual diagram (Figure 1) depicts the arrangement and relationships of key attributes within a system by using a variety of appropriate symbols that are easily understood. Conceptual diagram contains various components that make the system, each of them interact together to establish communication, the components are power supply, ESP32 camera door lock cloud server (database), Android phone.

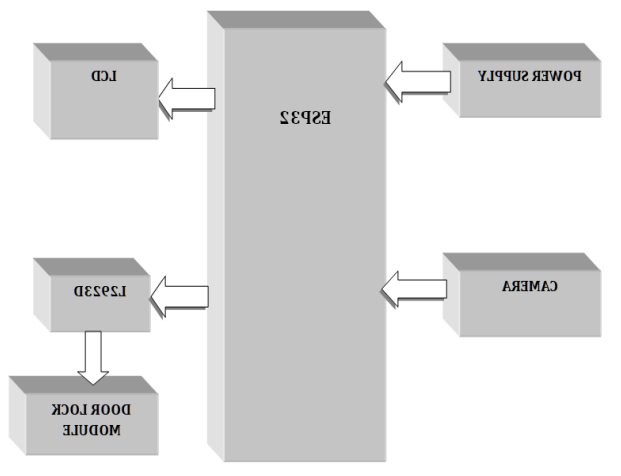


Figure 1: Block diagram of the proposed system

When the system is powered from the DC source, it is supplied to the ESP32 camera and when the camera receives power supply they establish communication, ESP32 camera flash light three times to indicate internet connection. When the system is stable, the ESP32 camera is ready to enroll and access. The IP address of the capture camera is launched on the web browser to connect to the database interface. This interface allows the user to register each individual with their names by clicking on the add user from the interface, thereafter when the access control is pressed,

the camera compares the captured image with the pre-enrolled image. When the images match, it sends signal to the door mechanism to unlock/lock the door.

### 4. RESULTS & DISCUSSION

#### System Testing

Testing is an essential process in the development and realization of any design, be it hardware-based software based or both. System testing gives the detailed performance of the system when it is running. The various components and their circuitry have to be tested to ensure that all the components on board are certified okay and in good working condition. The components that do not give the required output specification were isolated and were troubleshooted to determine the nature and cause of the component failure through careful analysis, that is examination of the working principles of the component.

#### Testing and Result

Testing describes the activities to be tested in order to ensure proper functioning of the system and application. It is divided into two namely, unit test and system test. Unit test is carried out on each separate module to confirm their communication before they are combined to form the system. The unit was tested after and before casing it. Before casing, the Vero board connections were tested for any possible short and open circuit faults. The test was carried out using an ohmmeter set to continuity (0.1ohms) range. None of such faults were found. After casing, operational test was carried out on the unit. While system test is carried out on the whole of the system design, the power cord was plugged to AC main and before casing it.

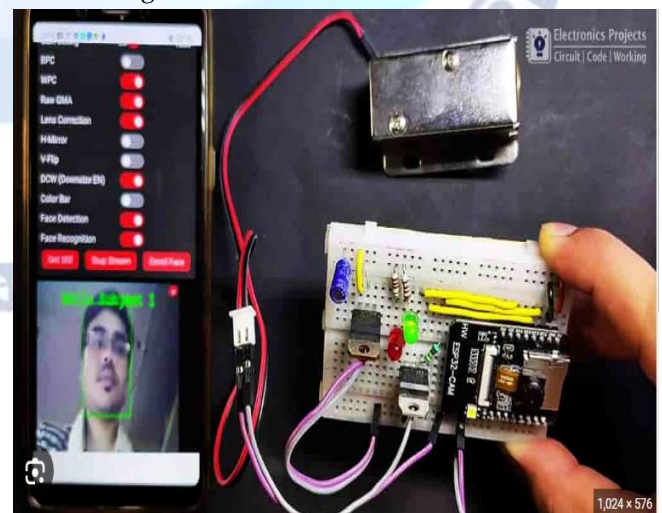
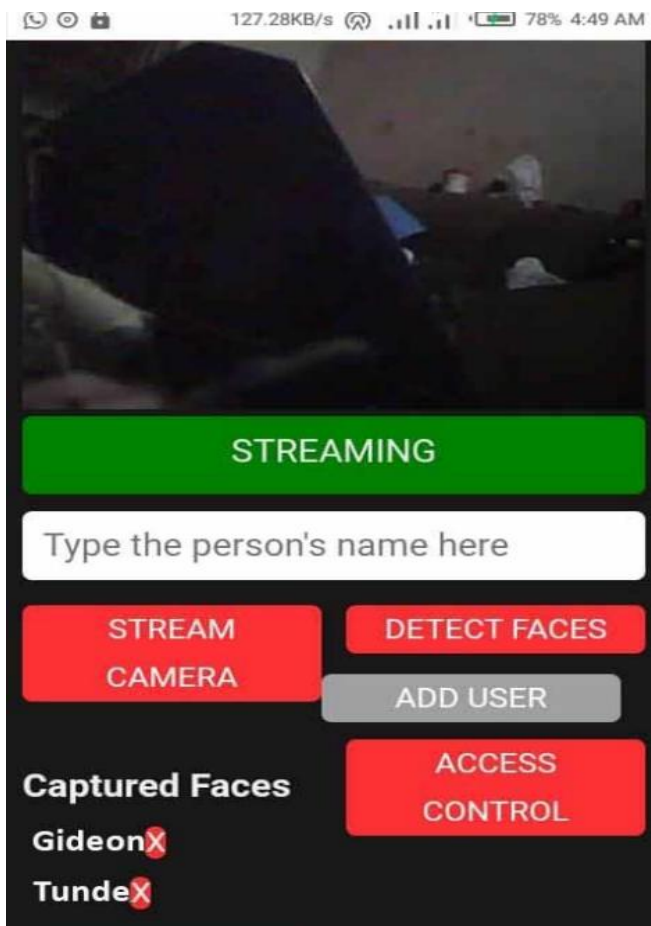


Figure 2: The Developed System During Construction



**Figure 3: Enrollment Interface**

The interface on plate shows various button to be clicked, the first button detects user face, add user allows to add the detected user to the database while access control allow image matching. The result obtained shows that when the image has been pre-enrolled and access control is pressed, then match take place otherwise image not detected, then, the gear mechanism receives signal and unlock/lock the door. The results were accurate and corresponding to some of the pre-captured Faces. While some faces were not detected due to illumination (dark environment) and that are the challenges of the project. The time response of the project was fast as it takes only few seconds to respond to the pre-captured faces. This may vary depending on how closer the face to the camera and the illumination (dark environment) at a certain period of time.

## 5. CONCLUSIONS

Facial recognition door lock system can be for access control in restricted area. The system is implemented by considering low cost, reliability, and automatic access control. The developed system automatically enrolls user, performs image matching before locking or unlocking the door. An IP camera was installed which

was used for enrolment and access control thereby improving the portability and wide compatibility. The project can benefit government agencies, institutions etc., where there is need for access restriction. Research recommends implementing a real-time recognition system to rapidly handle photographs to reduce monitoring expenses and ensure safety in homes and offices by identifying people. The main goal of this study was to create an intelligent face recognition approach using deep learning for intelligent homes

## Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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