

# Double Layer Home Security System with Face Detection and Recognition

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**Abstract-** Today we live in a technologically advanced world, where any system can be easily hacked & passed through leads to graveness in security. An Internet of things (IoT) based Home Security System has been designed and presented in this paper. The system uses Micro controller (Like NodeMCU) as the main control unit. Double layered security has been implemented using Solenoid locks (Primary & Secondary) with face recognition system (using open CV). User's face has to be recognized by the camera in order to enter in the house. When away, Users can operate & monitor the state of door on the smart phone. This system was designed to overcome the limitations of existing security systems.

**Keywords-** IOT, Micro Controller, Python, OpenCV, Face Detection, Face Recognition

## I. INTRODUCTION

Automated systems are already in demand since last 15 years. Due to advancement and research in automation technologies over the years, many home security system already exists. The main goal behind this research is to overcome the limitations in existing security systems such as communication range, security level, monitoring and cost effectiveness.

The Double layered security system has been designed in such a way that the authorized person can only enter the house once his face is recognized. The camera captures the face of authorized user and this is when the Primary solenoid lock opens.

In case of a burglar tries to break the primary lock forcefully, the sensor detects it and immediately activates the secondary solenoid lock which can be deactivated by authorized user.

### A. Objective

The Objective of this paper is to identify the most important elements related to the features of existing system in order to develop smart security system with face detection and recognition which aims to protect the objects inside the house from burglary and intrusion which the help of face and locking system. This paper provides a baseline study for

analyzing different methods that brings a huge success to the user.

### B. Challenges in face recognition

Detection and recognition of faces are the most challenging task as the face has a variability in shapes, size, texture and poses. The problems in facial detection are:

#### 1. Facial Expression:

- Face is one of the most important biometrics as its unique features and this plays a major role in providing human identity and emotions.
- Varying situations cause different moods which result in showing various emotions and can change in facial expressions.
- Different expressions of the same individual are another important factor that needs to be taken into account.
- Human expressions are macro-expressions which are happiness, sadness, anger, disgust, fear, surprise.

#### 2. Occlusion:

- Occlusion is a blockage, and it occurs when one or other parts of the face are blocked and whole face is not available as an input image.
- Occlusion is considered one of the most important challenges in face recognition system. It occurs due to beard, moustache, accessories (goggle, cap, mask, etc.), and it is prevalent in real-world scenario.
- The presence of such components makes the subject diverse and hence making automated face recognition process a tough nut to crack.

#### 3. Low Resolution:

- The minimum resolution for any standard image should be 16\*16. The picture with the resolution less than 16\*16 is called the low resolution image.
- These low resolution images can be found through small scale standalone cameras like CCTV cameras in ATM cameras, supermarket security cameras.
- These cameras can capture a small part of the human face area and as the camera is not very close to face, they can only capture the face region of less than 16\*16.
- Such a low resolution image doesn't provide much information as most of them are lost. It can be a big challenge in the process of recognizing the faces.

#### 4.Ageing:

- Face appearance/texture changes over a period of time and reflect as ageing, which is yet another challenge in facial recognition system.
- With the increasing age, the human face features, shapes/lines, and other aspects also change. It is done for visual observation and image retrieval after a long period.
- For better accuracy checking, the dataset for a different age group of people over a period of time is calculated.
- Here, the recognition process depends on feature extraction, basic features like wrinkles, marks, eyebrows, hairstyle..

## II. LITERATURE REVIEW

Md. Nasimuzzaman Chowdhury, Md. ShibleeNooman and SrijonSarke has executed the security system where if any person comes near the door it will be notified to the authorized house owner via e-mail and twitter then the user can view the person who comes near the door using camera from their remote location. The image of the person is captured and now the captured image is sent to the owner through twitter and E-mail. They have started a system where user can control the door remotely. They have concluded that this system is useful for preventing unauthorized access. [3]

Khushbu H Mehta, Niti P Gupta have presented real time monitoring and security system using Raspberry Pi. This system allows user to live monitor from any place. In this system Authors have discussed that if motion is detected, it will check for face detection and if the face is detected it will be stored on local storage. For detecting the human face they have used background subtraction Algorithm for face

detection. Authors has concluded that this system is found to identify faces and user can able to monitor remotely. [4]

Harikrishnan G.R., Noufal V.P., Latheesh S has executed home automation and security system in which user can continuously monitor their house from remote location if the intruder detected system, it will generate alarm and captures the image of the intruder and the captured image will be send to owners mobile through SMS, WhatsApp, Call, E-mail. They have discussed few advantages of this system. Authors have concluded that this system is useful for securing commercial places. [5]

K Saravana Kumar, Jestin Thomas, Jose Alex, Raag Malhotra, has developed a security system with proximity sensor, Raspberry Pi, and Camera, proximity sensor to detect the person. After detecting the person, the camera will be initiated and captures the image and image will be uploaded to drop box and user gets notified about the intruder in the form of SMS. They have discussed few advantages like cost effective, portable. Authors concluded that this security system is useful for security of homes. [6]

Eigen-face is one of the most widely used methods in face recognition and detection which are broadly known as the principle components in statistical terms. The eigenvectors are ordered to represent different amounts of the variations in the faces. [7]

Neural networks are highly used in the face recognition and detection systems. An ANN (artificial neural network) Was used in face recognition which contained a single layer Which shows adaptiveness in face recognition systems. The face verification is done using a double layer of WISARD in neural networks. [7]

Graph matching is other option for face recognition. The object as well as the face recognition can be formulated using graph matching performed by optimization of a matching function. [7]

## III. EXISTING SYSTEM AND ITS FLAW

GSM-based automation requires lots of repeaters in order to increase the range of coverage. This GSM is completely based on the pulse transmission technology that is sometimes affected by the interference of some electronic devices. When it comes to the RFID security system, they are very expensive than barcode systems and there is a high possibility that more than one tag may respond to the transceiver at the same time due to electromagnetic interference. Implementation of RFID systems is more complex. In fingerprint-based security systems biometric

data that are stored in the device can still be breached and also this system can limit the privacy of the users & implementation is also expensive. Inaccuracy and false positives in this security system are common because these types of images need high image quality and processing & fingerprint pads don't function properly when the fingers of the user are not clean and dry during the usage. And coming to Retinal security systems they are very expensive to implement than any other security system that is mentioned earlier. Like the fingerprint security system, this retinal security system also can limit the privacy of the users so in some cases general public won't accept it to some extent. Project construction and implementation of such a security system are very hard and complex. And Hexpad based security system has a primary flaw that if the user forgets the pin code to unlock the door it will be a huge task to reset the password again, a normal cannot reset themselves. Storage and encryption are needed to make the system more secure. If multiple users are using this type of system then they have to manually touch the keypad to gain access so if the hands of the user are not clean then it may cause disease to the other users.

#### IV. PROPOSED METHODOLOGY

##### A. Face Detection and Recognition:

In order to propose and design this system first we will have to create the datasets. When the image quality becomes beneficial various policies will take place in the face recognition system the tasks are performed using the python queries. The input will be taken from the dataset and then the face is detected by loading Haar-Cascade algorithm by initializing the camera. The frames from the camera is read and converted the color image into gray-scale image by normalization technique. Then the converted gray-scale image is illustrated using rectangle face co-ordinates and finally the frame is detected. Then the detected face is trained using OpenCV algorithm and finally the face is recognized. We can resize, crop the image for proximity with the objective for getting the desired output. The classifier along with OpenCV libraries will enhance the outcome in the face recognition system.

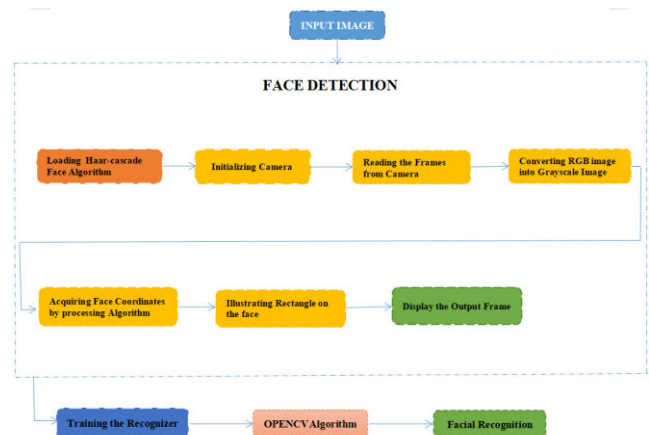


Fig 1: Proposed Face Recognition System

##### B. Home Security system:

This System is basically an EM(Electro-Magnetic) Locking system that contains two locks one is primary and the other is secondary, The entry access is given to the user by facial recognition. This dual locking system is used in order to make the system more secure. When a user tries to enter the house through the main door the security system initially detects the face of the user or the person outside the door and once after the face detection the system recognizes the registered face. If the detected face matches with the registered faces the primary electromagnetic lock gets deactivated & the door are opened whereas, if the detected face doesn't match with the registered faces the primary lock stays activated and the secondary lock is also triggered. So, In this case, both of these locks get activated and the door remains locked. And the same condition will be maintained if a burglar or an unknown person tries to enter the house by breaking the door. This double security system is secure because only the user knows that a secondary lock exists behind the door but from a third person's perspective they only think that only a single lock (Primary) that is existing behind the door.

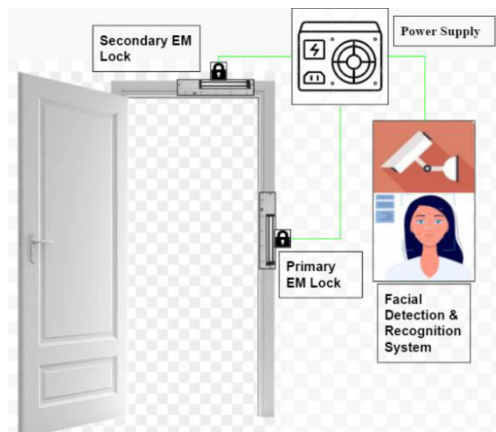


Fig 2: Proposed Smart Home Security System

Step -4 : If the detected face doesn't matches with the registered template or if a burglar tries to break the system or the door, the secondary lock is triggered and the primary lock remains locked.

Step -5 : Basically both the locks remain activated.

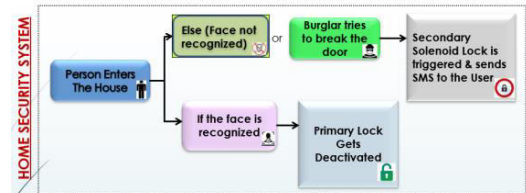


Fig 4: Smart Home Security System

## V. EXPERIMENTAL RESULTS AND ANALYSIS

### A. HaarCascade Algorithm

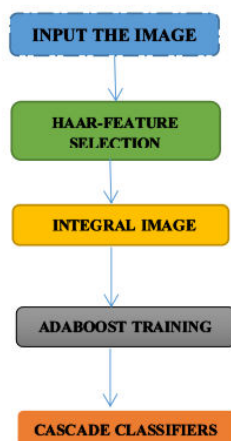


Fig 3: HaarCascade Algorithm

### B. Security System Algorithm

Step -1 : Initially if a person tries to enter the house, the security system recognizes the face of the person.

Step -2 : Then the face detection technique is carried out by the system.

Step -3 : If the detected face matches with the registered template, then the primary lock deactivation is done.

### C. Implementation of the system using OpenCV

Face Detection is a technique used for locating the faces in the image and further it extracts the image for face recognition purpose.

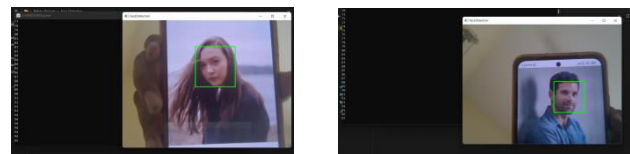


Fig 5: Face Detection

Face recognition is a technique used to identify and verify the image by finding its features and expressions of the faces by its extracted, resized, cropped image and then it is usually converted into gray-scale image.



Fig 6: Face Recognition (Cropped & Resized Image)

## VI. CONCLUSION

In this paper, We have proposed the smart home security system with face recognition which has been successfully tested with dual door lock system based on facial recognition method by identifying and verifying the registered face input. If a burglar tries to open the door the system notifies to

the respective user. This proposed system can also be used in the area like Banking Sector to provide more security to lockers. In this way we can improve and enhance the proposed system efficiently by making changes according to the requirements.

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