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Intelligent Door Lock System with Face Recognition

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Abstract: ***Internet of Things (IoT) is mainly used to conceptualize the idea of remotely connecting and monitoring real world objects (things) through the Internet. When it comes to our house or office, this concept can be capably integrated to make it smarter, safer and automated. This paper focus on building the intelligent security system using wireless technology which is capable of sending automatic alert messages to the owner by using network in case of any intrusion and raise alarm optionally. There are many security systems currently available in the market which was too priced which cannot be purchased by the ordinary person. The paper target is to supply the primary information to the user about the utilization of open source technology which comprises of OpenCV2, LBPH algorithm, SMTP. The implementation area is mainly focused on local level like home, campus and offices. The system has come up with the real time face detection and recognition once the camera is started. The captured image is examined with the images available in the database and if it is a match, the entry is granted and door will open. On the other side which is, if the captured face did not match with the images available in database then the captured image is sent to the owner's mail. The system is going to wait for the response from owner with an appropriate action. Based on the action retrieved from the owner it will decide either access will be granted or denied. The main goal of the project is to develop a recognition system which uses real time faces of the person as well as to provide security to ordinary persons with low cost.***

Keywords: OpenCV2, LBPH, SMTP, Security, Face Recognition.

I. INTRODUCTION

A well organized and error-free home security system which is developed on the basis of facial recognition is very important for wide range of security based application. Security is considered as an important feature in smart home applications. Most of the countries are cautiously adopting home security system [3].The most important part of home security systems is identifying the person exactly who is going to enter through the door. Facial recognition is probably the most unique way to perform authentication among human beings. It is the most popular authentication technique after fingerprint technology. This proposed system can be used for both trespasser detection and also provide security for house with the help of the alert messages sending to the owner. A person is recognized as an intruder within a home environment attained by capturing image of the person from webcam and filtering will be done on captured image to identify the face of the intruder [4].The camera capture the sequence of images once the object is detected in defined area of the home premises and also it sends automatic alert to the owner to take the necessary actions. The advantage of this system is that giving the alert to the house owner while the unknown person is entering the house. If an unauthorized person is detected it gives the alert Message as intruder alert and as well as captured image to mail [8]. The complete process is performed using facial detection technique. Face recognition includes mainly the feature extraction from the facial image, recognition or classification and also the feature reduction. Haar Cascade is an effective feature extraction method used based on face as a global feature. It successfully reduces the dimension of captured images and at the same time grasp the primary information. In this project, face recognition system is implemented based on standard Haar Cascade. Classification or Recognition has been almost done by using the measuring method such as Euclidean distance technique, which is used to classify the feature of images stored in the database and captured test images[5].The aim of this project is to propose a system which is capable to detect human faces in digital images effectively no matters whatever the person's ethnic pose. The input images can be varied with face size and also whatever the background and lighting condition.

II. LITERATURE SURVEY

In (Omkar Pawar, Prathamesh Lonkar, Randhir Singh, Vivek Salunke 2019), a face detection system is implemented where image are detected from camera [1]. This paper explains how to build a door unlocking system that can accept the face of the owner and give entry to the door. It can be done by using face recognition algorithms which are obtaining much importance in this epoch of Artificial Intelligence. The solidity provided by this system is it can send alerts and notifications to the remotely located authorized user to his mobile phone if any threat of someone breaking into the house rises.

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A Home automation is designed by (N.L.Mahind, G.V.Gujar, H.S.Patel, P.S.Nikam 2018) using IoT [2]. The implementation provided here is additionally on home automation and not on the face recognition. This system controls the home appliances through android application based on raspberry-pi using internet from anywhere around the world globally. It is meant to save electrical power and human energy.

III. PROPOSED SYSTEM AND IMPLEMENTATION

The proposed intelligent door locks system to control the present barriers in conventional door locks. The main purpose of the system is to detect and recognize the human face using the OpenCV library on the Arduino platform. Instead of keep an eye on passwords or pins unique faces can be used, because unique faces are one's biometric characteristic. These are natural and cannot be altered or stolen easily. The level of security can be increased by using face detection. The proposed system has been elaborated to stop robbery in extremely surveillance areas like home environment with less power consumption and more reliable standalone security device for both intruder detection and also for door security. Whenever the person comes in front of the door, it recognizes the face and if the person is authorized then it unlocks the door, if the person is unauthorized it will raise an alarm and sends the captured image to owner mail account and an alert message to mobile. If the unauthorized person is known to the owner and if owner want to grant access he can use the website and can give access permission to unauthorized person.

The working principle of the Architecture of the Intelligent Door Lock System with Face Recognition is classified as Input unit, Processing unit and Application unit.

A. In input unit, the Facial images for Face Recognition and images for the person identification are captured from camera input devices respectively i.e. from Webcam.

B. Processing Unit: The data which is collected from Input unit which is nothing but the captured Image is given to the processing unit in which the computations are performed on the proposed person identification and door lock system module. Here the processing unit is nothing but a computer along with code scripts of the implemented modules.

C. The Application module is a combination of arduino and other components which gets input from the processing module and based on the results obtained it will perform door open or start buzzer and sending data to the mail account using internet and also it allow accessing from website.

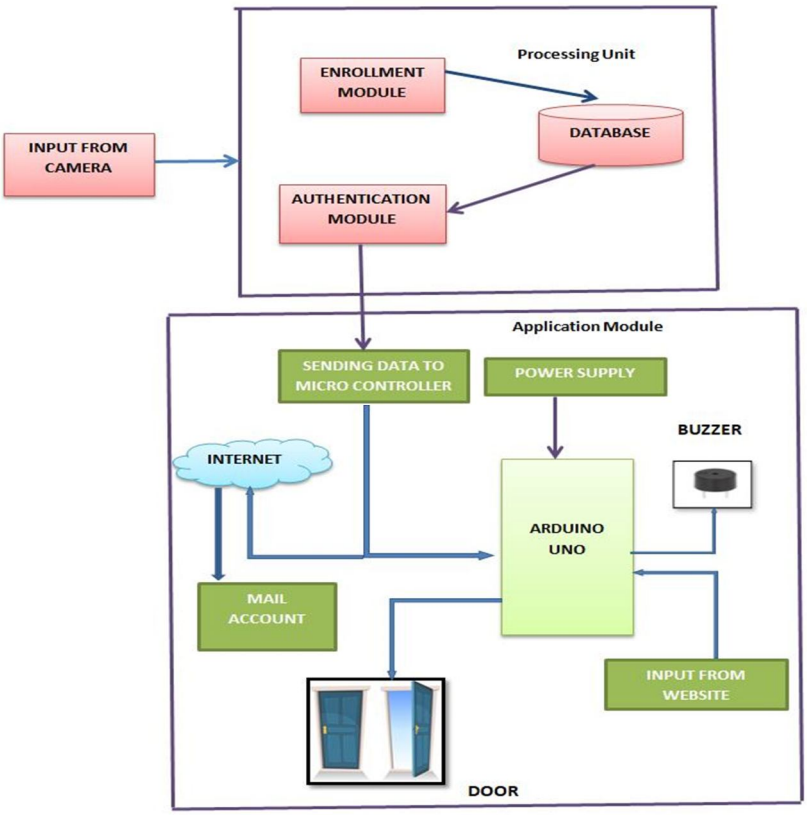


Figure 1: Architecture of the Intelligent Door Lock System with Face Recognition

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IV. EXPERIMENTAL SETUP AND RESULTS

Let starts with Arduino-Uno as a functioning model associated with LED's and Buzzer and other components attached to it as show in the Figure 2.

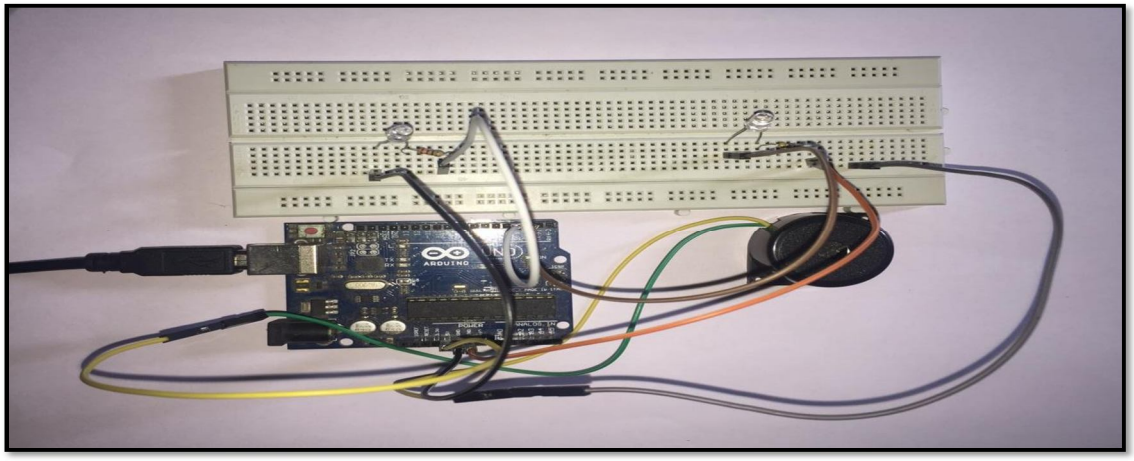


Figure 2: Buzzer and LED Light Connected to Arduino

The Web Camera is used for Detection and Capturing of the Face and recognize the authorized person face with the label and value it is shown in Figure 3.



Figure 3: Face Detection and Reorganization using Machine Learning Algorithm

The captured images are trained and then stored in a folder by using machine learning supervised clustering algorithms; these images are called trained data set which is used for checking with the captured images. The Data set is shown in Figure 4.



Figure 4: Trained Image Data Set

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The system is to be trained with certain number of images captured from the authorised persons, by allocating unique number for it. images of the authorized persons with different poses are shown in Figure 5.

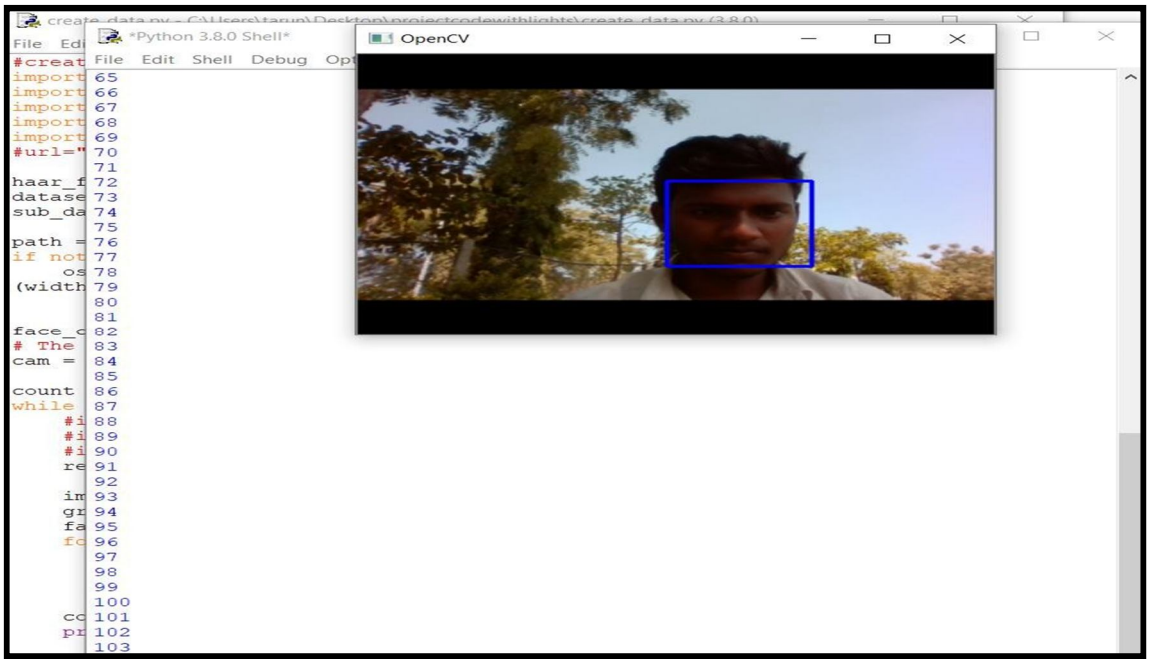


Figure 5: Train the system with multiple images of the Authorized person

The system captures the authorized person image along with Label (Which is the name of the person) and its value and it is shown in Figure 6.

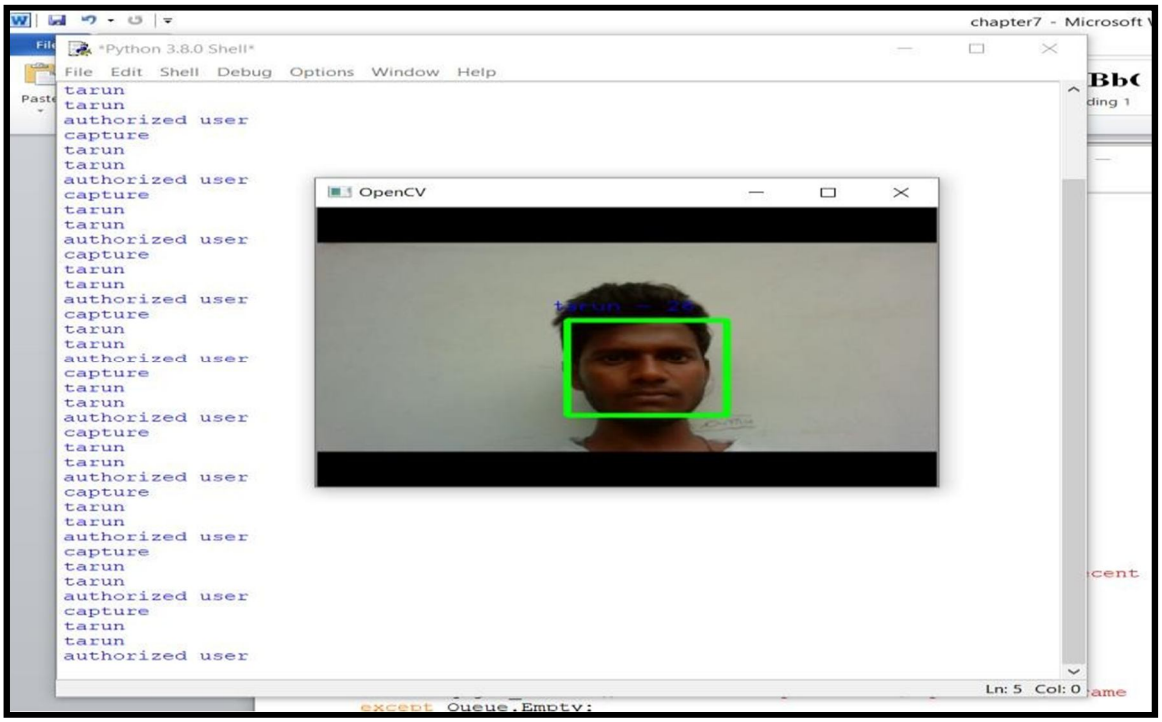


Figure 6: Recognizing the Authorized Person

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When the authorized person face is detected the White LED will give indication of opening door which is shown in Figure 7.

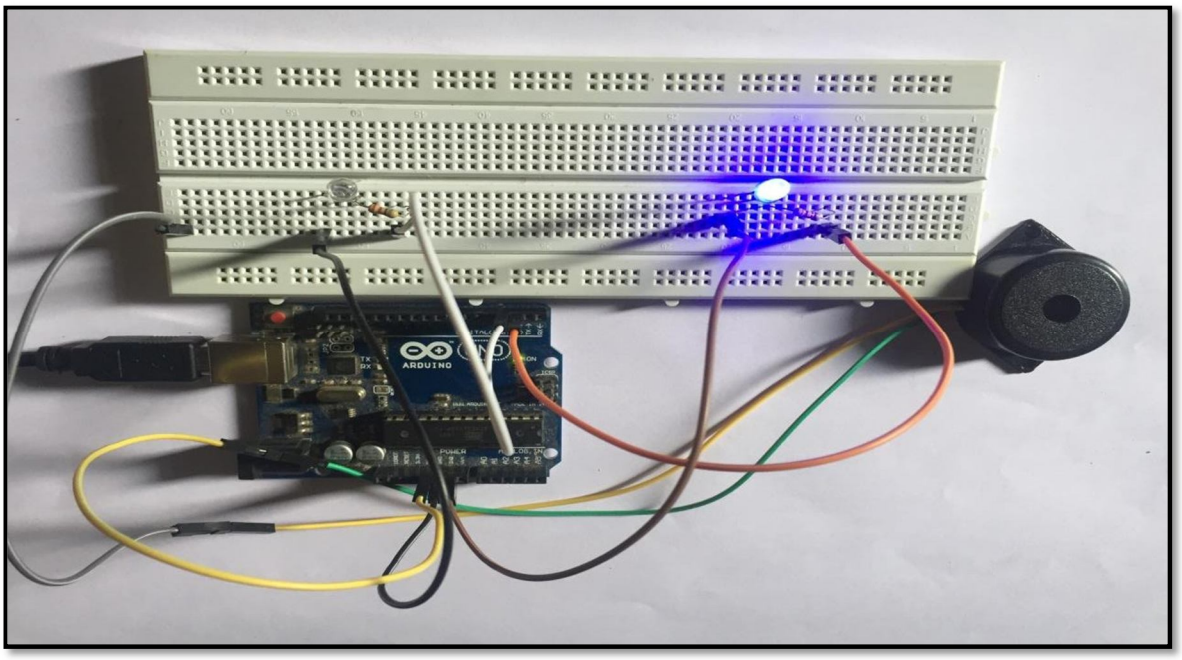


Figure 7: Authorized Person Alert Indication-Access for Open the Door

The system captures the image using camera and can differentiate between authorized and Unauthorized person image and it is shown in Figure 8.

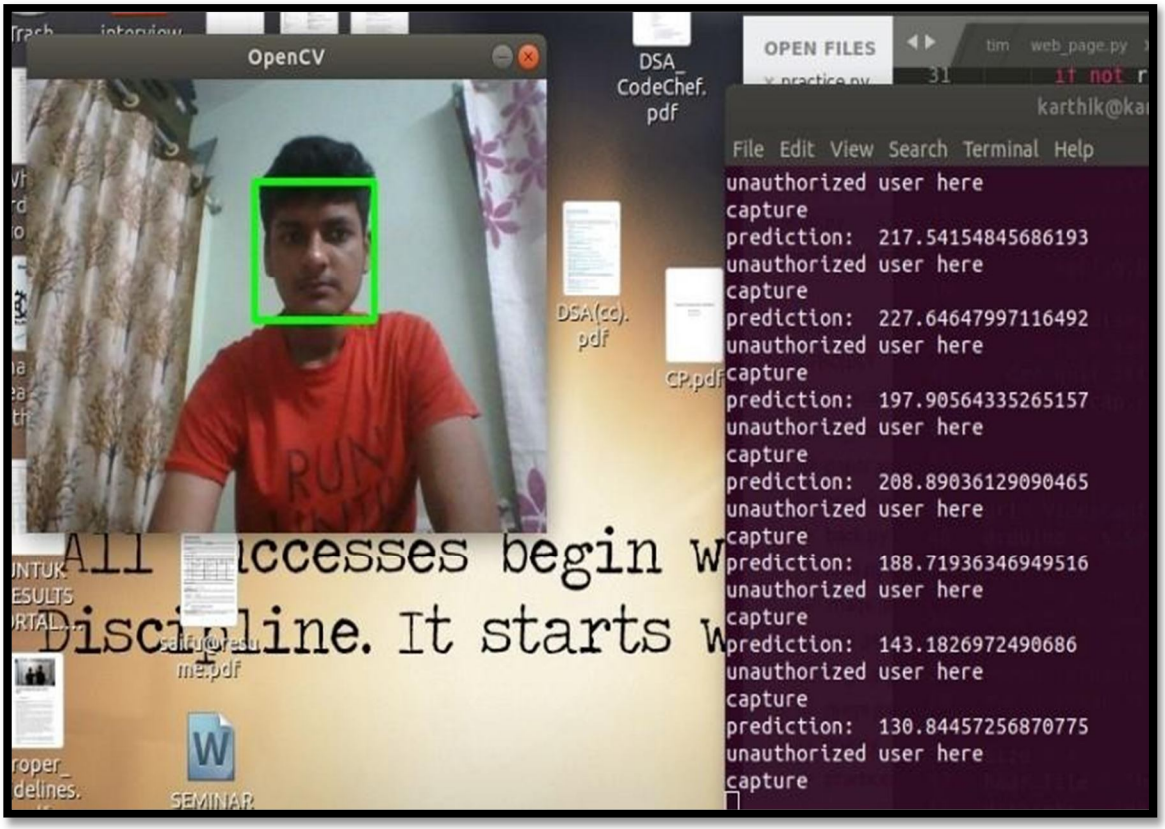


Figure 8: Recognizing the Unauthorized Person

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When the Unauthorized person face is detected the Red LED will give indication of alert which is shown in figure 9

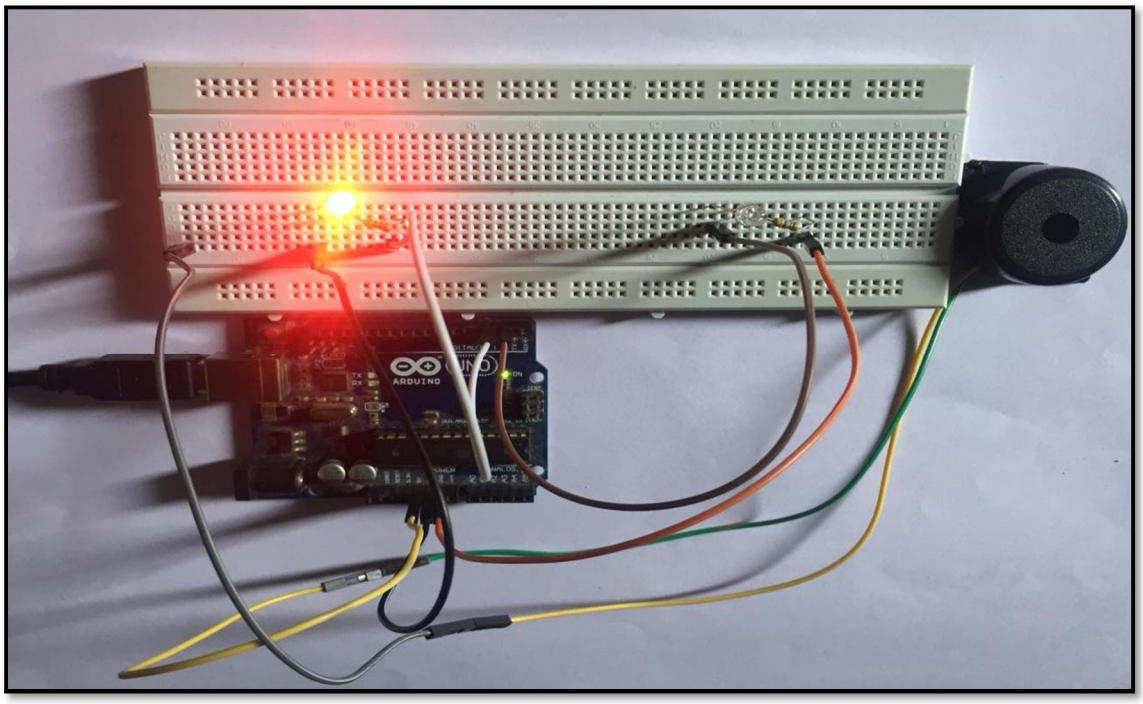


Figure 9: Un-Authorized Person Alert Indication

If unauthorized person is identified then the alert message will be sent to the user phone using Twilio account as shown in the Figure 10.

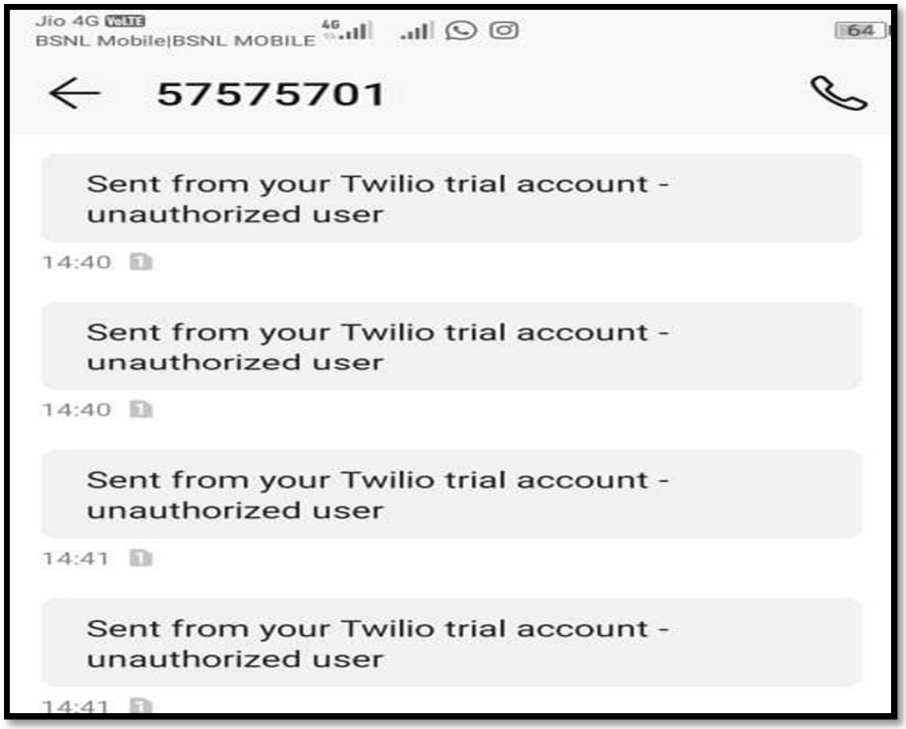


Figure 10: SMS Alert to Authorized Registered Mobile

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If unauthorized person is identified the Captured image will be sent to the user via mail as shown in the Figure. 11. The Subject to the user is "Unauthorized person" and the body of the mail will show "image of the Person".

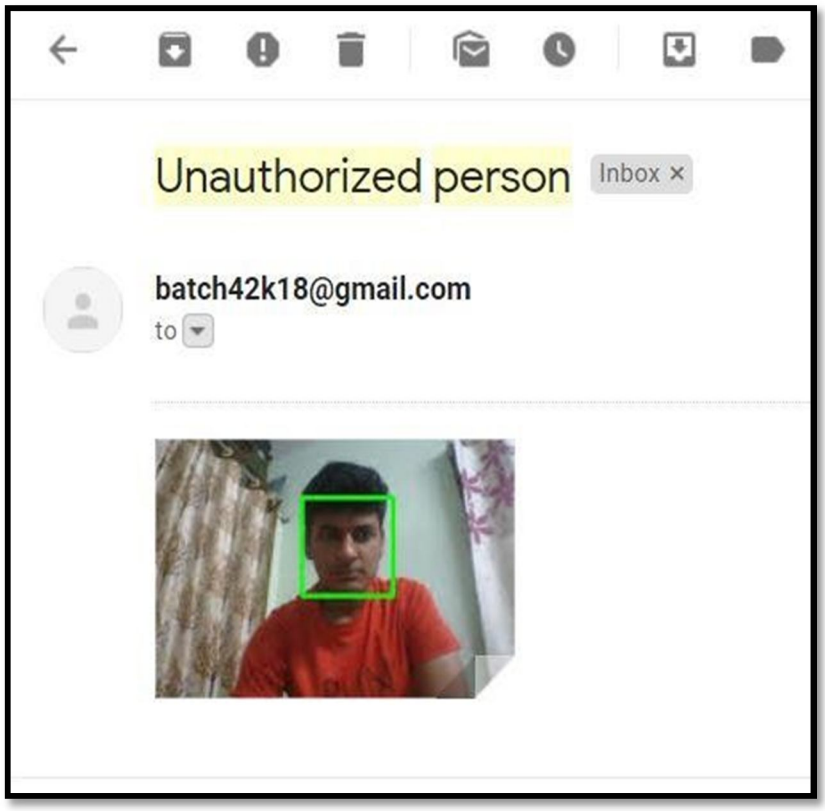


Figure 11: E Mail alert to access Unauthorized person

The number of testing faces, number of training images used to find the accuracy of the system is shown in Table 3. From [5] False Acceptance Rate (FAR) is calculated as FAR= Number of False Acceptance/Number of testing faces and False Rejection Rate (FRR) is calculated as FRR= Number of False Rejections/Number of testing faces and Accuracy as Accuracy = (1 – (FAR+FRR)/2)*100.

Table 1: Sample Data sets used to find FAR and FRR

No.of Testing Faces	No.of Training images	False Acceptance Faces	False Rejected Faces	FAR(False Acceptance Rate)	FRR(False Rejection Rate)	Accuracy
5	50	2	1	0.4	0.2	40%
7	125	4	3	0.57	0.42	51.5%
12	200	3	2	0.25	0.16	79.5%
15	250	2	1	0.133	0.066	90.05%

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The following figure 12 shows the False Rejection Rate (FRR), False Acceptance Rate (FAR) and Recognition Rate attained from the system. It is clearly showing that the accuracy of the system will be improved when we increase the number of testing faces.

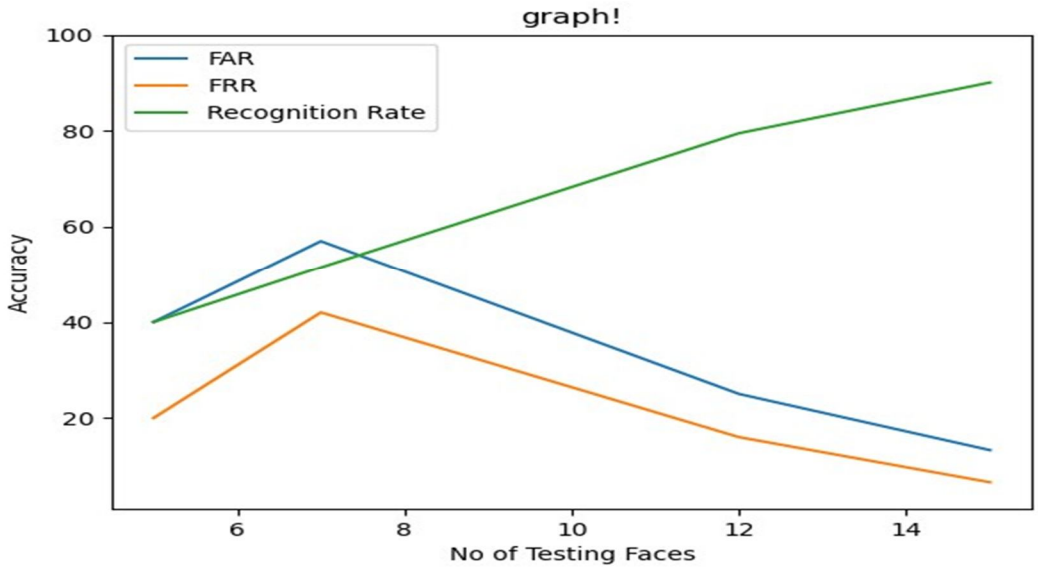


Figure 12: Accuracy Rate of FAR and RR

V. CONCLUSION

This paper offers a low cost environmental setup and impressive computing system for face recognition. The convenience of opencv proves to be favourable to design Face recognition system more on local level. The authority provided to the owner via mail plays an important role. The more variations while training the face recognition system has the better face recognition and also the less chances of naming the unknown face from one of the available database. This development scheme is cheap, fast, and highly reliable and takes less power and provides enough flexibility to suit the requirement of different people. The system is completely able to operate independently and it is wireless which made this system a reliable, robust, easily operable, and low price security system.

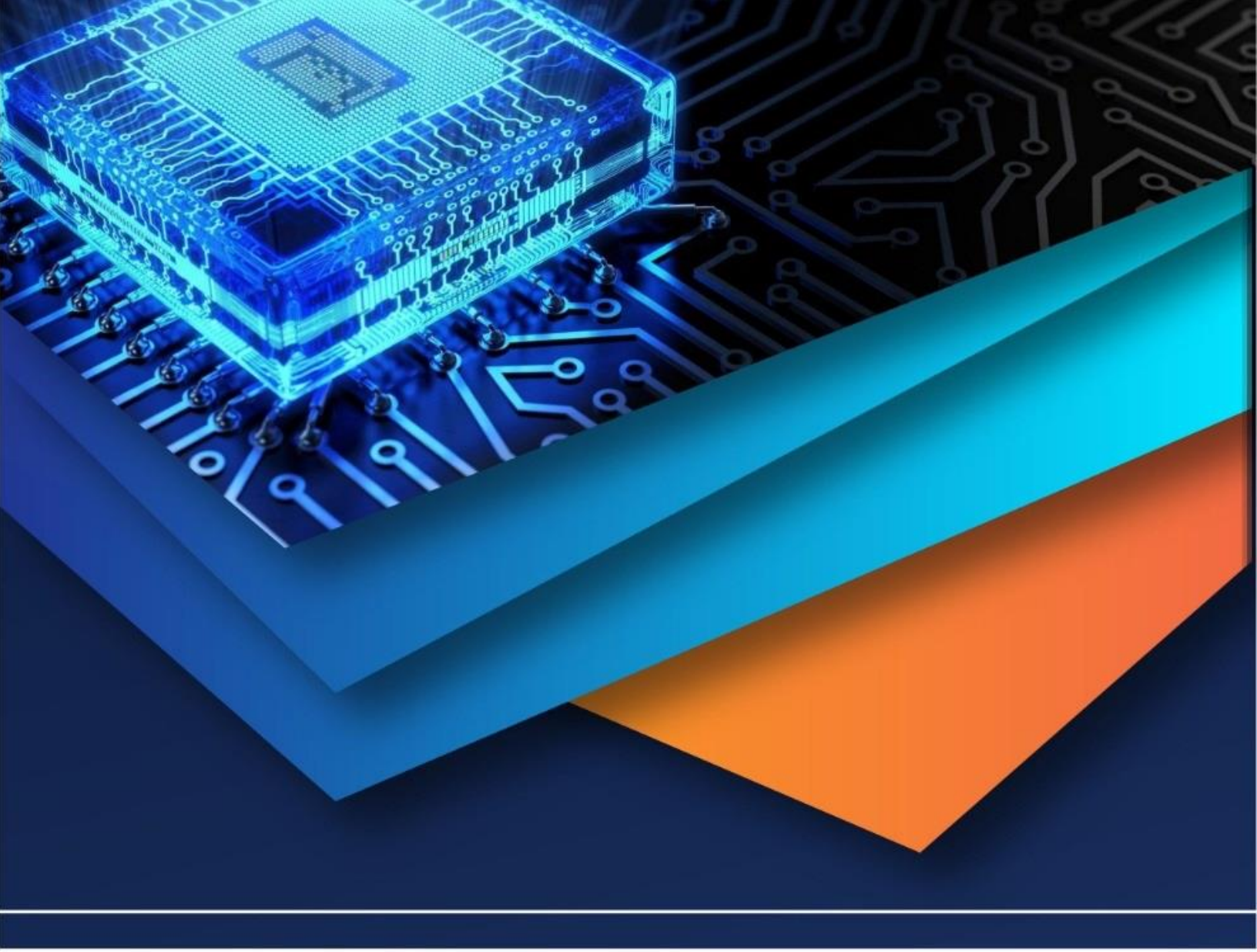
VI. FUTURE WORK

The proposed system can be utilized by making required modification to the system in areas like identify the criminals who are blacklisted in a particular area. Another one is in the banking to provide more security to the closet, based on their facial authentication and can also keep track of account holders record of information when and who is accessed the closet. In this following manner we can enhance the proposed system effectively by making some modifications according to requirements.

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