

Face Recognition Enabled Smart Lock

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ABSTRACT

Automatic identification and access control system has become necessary to overcome the security threats. Face recognition system can be used for security purpose. For implementing an embedded lock access control system an appropriate face recognition system using raspberry pi is developed. Recognition is implemented by using Eigen face method. This method combines the facial metrics with the Eigen face representation. The module contains a raspberry pi configured with video capture camera and this module controls the lock for door unlocking. For security breach alert GSM module is used.

Keywords:- facial recognition and detection, raspberry pi 3, security breach alert, GSM module

I. INTRODUCTION

Face recognition is used in many applications like air ports, military bases, government offices, daily attendance purpose and home automation. Security is an important aspect in all these applications. A door access control system based on face recognition must be compact, inexpensive and highly reliable. Most doors are controlled by persons with the help of keys, security cards, password or pattern to open the door. But biometric security systems need not require any touched hardware. Basic types of biometric systems include face recognition, fingerprint recognition, iris recognition etc. Now a day's

Face recognition is the popular one. The major part of any door security systems are identifying accurately the persons who enter through the door. Face is a complex Multidimensional structure and require good Computing techniques for recognition. Face Recognition system is implemented based on PCA (principle component analysis) algorithm. The web camera captures the series of images of the person in front of the camera and compares with database which is created in prior. If the face is detected then the lock will open automatically and if not, the door is unlocked, alarm rings for unknown

person and security alert is sent to admins email and mobile.

II. METHODOLOGY AND WORKING OF PROPOSED SYSTEM

The block diagram of proposed system is shown in figure 2.1

Hardware requirements in proposed system are:

Raspberry pi 3 model B, web camera, GSM, buzzer, solenoid lock

Software requirements are: open CV image processing software

Language: python

The system will works in two different parts. The first part is for capturing and creating a database by storing the image. And the second one is to compare the image with the stored images in the database. The processing

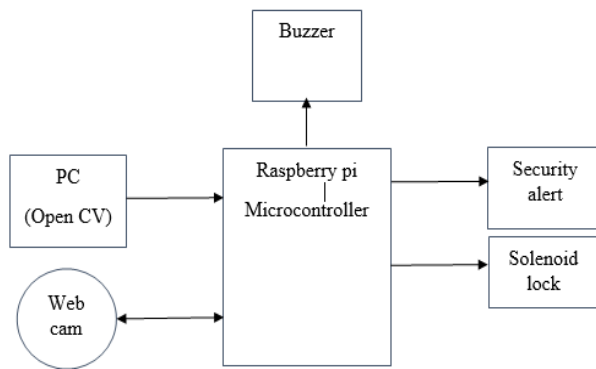


Figure 2.1

Unit of the system is raspberry pi. Why only raspberry pi? A raspberry pi is a general purpose computer with the ability to run multiple programs. It is lighter, smaller, efficient and lower power consumption. It supports full HD video, multiple USB ports and also very low cost.

GSM (global system for mobile communications) is used for the need of sending SMS (short message service) alert. It Uses narrow band TDMA (time division Multiple access). Security and confidentiality the GSM offers increase defense against eavesdropping.

The implementation of face recognition technology includes the following stages. They are image acquisition, image processing, distinctive characteristic location, template creation and template matching. There are various algorithms for face recognition one of them is PCA (principle component analysis) which is a global feature (holistic) appearance based algorithm.

PCA method is a technique which reduces the parameter of the images, the system can detect and recognize an image within few seconds. This speeds up the computational time. PCA uses Eigen faces and Euclidean distance for matching the correct face from the database. PCA in the form of mathematical approach is defined as

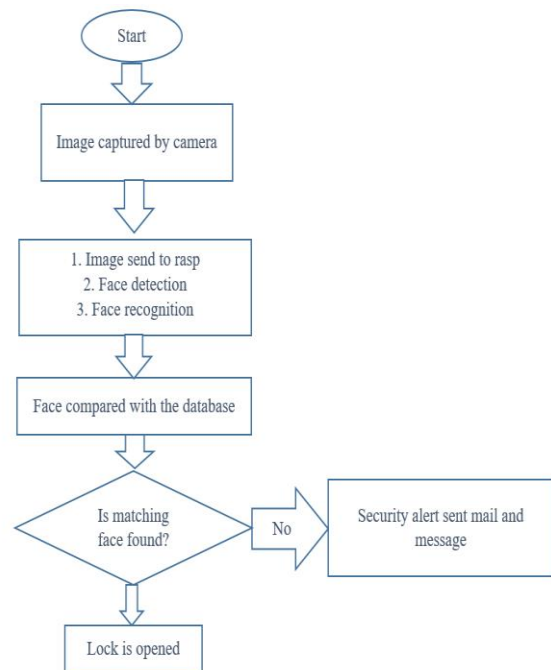
- The database is rearranged in the form of matrix where each column represents an image

- With Eigen values and Eigen vectors covariance matrix is computed
- Feature vector for each image is then computed. The feature vector represents the signature of the image. Signature matrix for whole database is then computed
- Euclidian distance of the image is completed with all the signatures in the database
- Image is identified as the one which gives least distance with the signature of the image to recognize

Euclidean distance is used to compare profiles of respondents across variables. This analysis is also used for image compression, signal processing, image processing and statistics.

System implementation flowchart

Procedural view of how person face recognition works as shown in below flowchart



Initially database is created which contains pictures of person who are allowed by the admin. Now when the module is executed the image window appears then for capturing face press's' from keyboard then the captured face is compared with the database, if the matching is found then the lock/door is opened or else security alert is sent to admin.

III. SYSTEM ANALYSIS

Procedure

1. Initiate raspberry pi and install open CV and python

Sudo apt-get install python-opencv

Sudo apt-get install python-sklearn

Sklearn contains system specific parameters

2. Open python shell and write a code for face detection and recognition

3. Two scripts are created createface.py and main.py

4. Createface.py is for creating the databas4. Initially person's face with different expressions is captured and stored in the database. Each person's face should have separate folder.

5. Now after executing main.py, the camera window appears and ready to capture the image. Now if a person comes in front of camera the person's face is captured and compared with the faces in the database

6. If the match is found, then the lock is opened holds for few seconds and closes and if the match is not found the buzzer gives the indication that the person is unmatched and mail and SMS are sent to admin

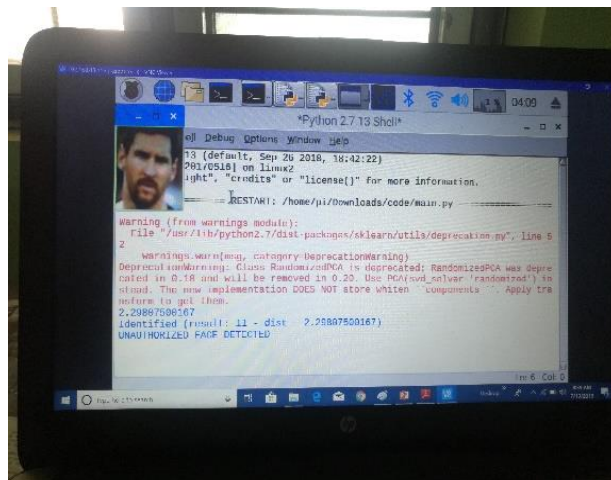
Implementation

- Hardware setup

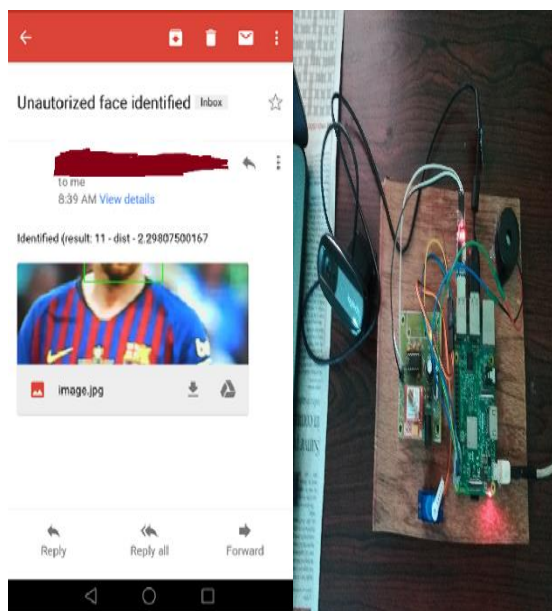
Laptop is configured with raspberry pi and GSM module



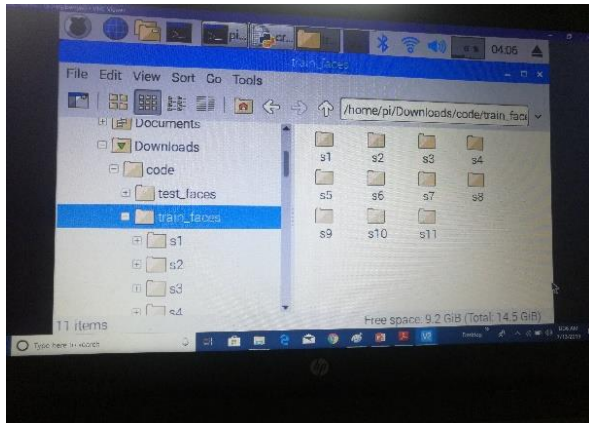
- An untrained person comes in front of the camera, then face is unauthorized and lock does not open



Warnings are appeared as the python used is not an upgraded version. But warnings are not worth noted.

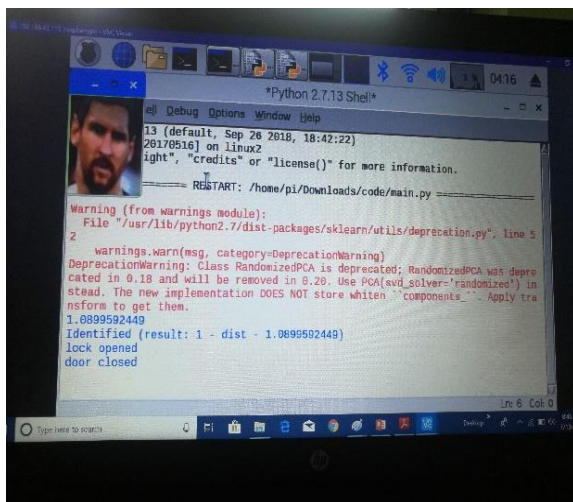
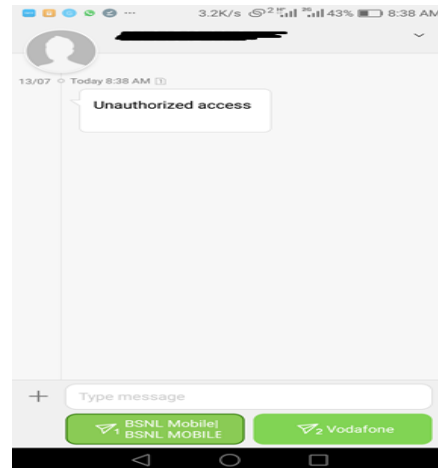


- The person's face is trained with multiple expressions and 10 images of the face are saved into a unique folder. Every face should have one unique folder



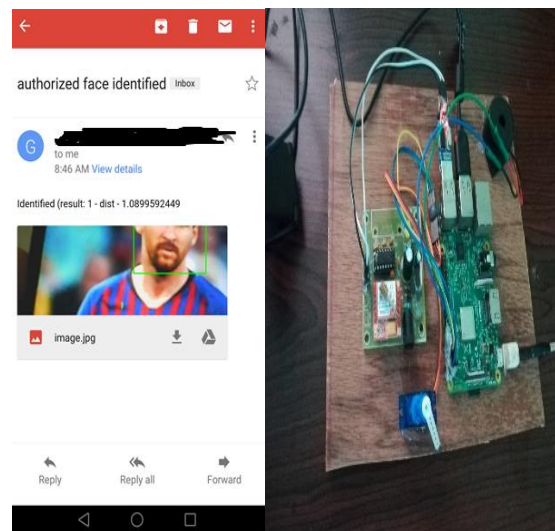
- Now the person's face is trained and if the program is executed as the face is matched the lock turns 90 degree either in clockwise or anticlockwise

- As GSM module is present, SMS alert is sent to admin



IV. CONCLUSION

Face recognition is done in open CV image processing tool using python programming. Raspberry pi is used to control the lock access system depending on the incoming data sent from the PC. Lock is opened immediately after confirming that the person is authenticated. The lock holds for 5s keeping the lock open. After 5s, the lock is closed automatically. This time can also be changed according to admins requirement. For face recognition, principle component analysis method is used to extract the important features of facial images. Since PCA method reduces the dimension of the dataset, this system can recognize an image within few seconds.



V. FUTURE WORK

- There are various ways to start up the script/capturing on its own. One of the way is configuring sensors that can start the script after sensing a person near to them.
- Using other face recognition algorithms such as fisher faces which are robust to varied lighting.
- We can also use advanced methods like deep learning and neural networks for face recognition.
- For making the system friendly we can deploy the speaking assistant.

- Number of people entering the door can be counted.

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