

AUTOMATED DOOR ACCESS CONTROL SYSTEM USING FACE RECOGNITION

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Abstract - Authentication is one of the significant issues in the era of the information system. Among other things, human face recognition (HFR) is one of the known techniques which can be used for user authentication. As an important branch of biometric verification, HFR has been widely used in many applications, such as video monitoring/surveillance system, human-computer interaction. This project proposes a method for automatic door access system using face recognition technique by using python programming and from OpenCV library Haar cascade method. Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones. This is the standalone security device has been developed by using Raspberry Pi electronic development board and operated on Battery power supply, wireless internet connectivity by using USB modem. Automatic e-mail notification has been achieved by sending security alert mail to the user e-mail id. This proposed is more effective, reliable, and this system consumes very less data and power compared to the other existing systems.

Key Words: OpenCV, Database, Recognition, Detection, Raspberry Pi, LBPH.

1. INTRODUCTION

In today's world of connectivity and smart devices there is an urgent need to modify our existing day to day objects and make them smart, also it is not the era when we can blindly trust the old and conventional security measures, specifically speaking is our door locks. To change and modernize any object we need to eliminate its existing drawbacks and add extra functionality. Face detection is more challenging because of some unstable characteristics, for example, glasses and beard will impact the detecting effectiveness. Moreover, different kinds and angles of lighting will make detecting face generate uneven brightness on the face, which will have an influence on the detection process. An intensive study of OpenCV platform and its inbuilt libraries has been conducted to generate a code, which does correct and reliable facial recognition with new and efficient use of hardware. This proposed system also acts as a home security system for both Person detection and provide security for door access control by using facial recognition for the home environment. The human body is identified as an intruder within a home environment achieved by capturing live video from web camera and processing will be done on captured

video frames. The web camera to capture the series of images as soon as the person press switch. The advantage of this system is for accessing the door is that face detection and recognition are performed by using face detection technique and the entire face recognition is completed by pressing single and tiny push button switch. Face recognition includes feature extraction from the facial image, recognition or classification and feature reduction. As the world is progressing people are scared about the safety of their possessions, information and themselves. With the model of Smart Door, a profound impact is expected in the security industry and it is somewhat anticipated as the time has come to make all daily life objects interconnected and interactive. This model will be a major contribution to the field of Home Security.

2. SYSTEM ARCHITECTURE

The Architecture of the proposed system is the design diagram which depicts the scope of the project with the whole system design. In architecture diagram, it highlights the modules with its various functions as a process. It aims to convey the internal design of the proposed system the following Fig-2.1 shows the entire architecture of the proposed system.

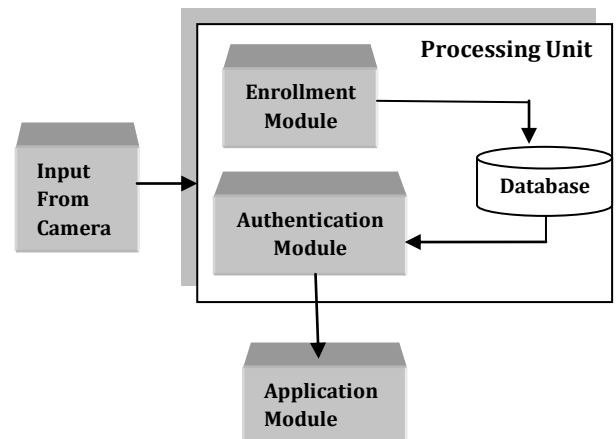


Fig-2.1: System Architecture

2.1 Input Unit

In input unit, the Facial images for Face Recognition and Video frames for person detection are captured from camera input devices respectively i.e. from Raspberry Pi Camera or Web camera.

2.2 Processing Unit

The data which is collected from Input unit that is captured Image and Video frames input is fed into the processing unit in which the processing or calculations are performed on the proposed person detection and door lock system module, Here the processing unit is nothing but a Raspberry Pi board, along with code scripts of the implemented modules.

2.2.1 Enrollment Module

In this enrollment module, the data which collected from input camera means person face image is stored in the database. Before storing the image it will use feature extraction means it is converted in Haar Feature-based Cascade Classifiers.

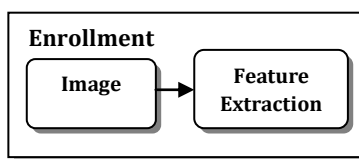


Fig-2.2.1(a): Enrollment Module

2.2.2 Authentication Module

In this module, we recognize and detect the input images. This module is connected to the outer side of the door, where the captured image converted into Haar Feature-based Cascade Classifiers. And matching this feature extraction image with the database.

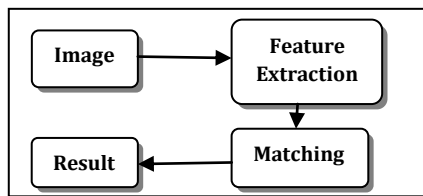


Fig-2.2.1(b): Authentication Module

2.3 Application Module

The Application specific unit which consists of Door lock circuitry, it is associated with Door lock system module of authentication module and it starts functioning according to results of the module to perform door lock open/close operation based on Face Recognition.

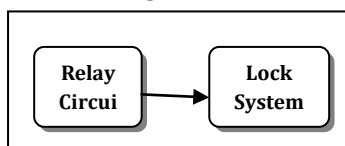


Fig-2.3: Application Module

3. SYSTEM IMPLEMENTATION

There are two parts in this section. The first is the implementation of Door lock access by using Face Recognition and the second is the implementation of person detection along with auto alert sending.

3.1 Implementation of Door Lock Access by using Face Recognition

This project work proposes an idea of for face reorganization concept for accessing the door lock system and it implemented with the help of OpenCV, which is a popular computer vision library. Face recognition is an important application of image processing owing to its use in many fields. An effective face recognition system based on OpenCV is developed in the project. Face recognition has been the best choice for the problem of biometrics and it has a various type of applications in our present life. An efficient face recognition system can be of great help in forensic sciences, identification for law enforcement, authentication for banking and security system, and giving preferential access to authorized users i.e. access control for secured areas etc. A real-time door lock access system by face recognition system. The algorithm used here is Local Binary Patterns Histograms (LBPH), based on Haar Feature-based Cascade Classifiers is presented in the project. The technique used here we will work with face detection. Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. Then we need to extract features from it. For this, Haar features shown in the below Fig-3.1 are used. They are just like our convolution kernel. Each feature is a single value obtained by subtracting the sum of pixels under the white rectangle from the sum of pixels under the black rectangle.

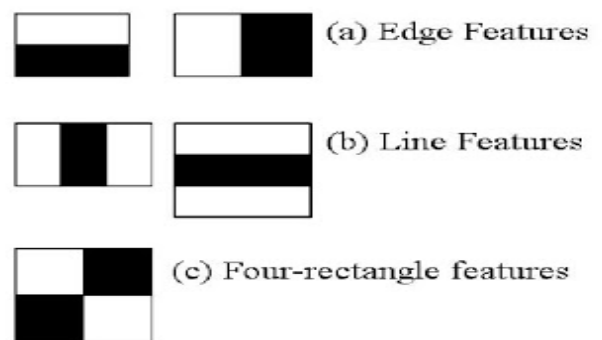
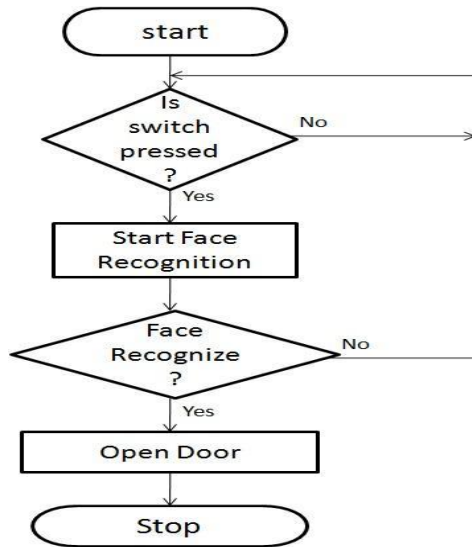


Fig-3.1: Haar Features

3.2 Implementation of Person Detection along with Auto Alert Sending.

The proposed home security system is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. A procedural view of how this person detection works is shown in below flowchart.



In the above Figure, we see the procedural view person detection process. In this system first in authentication module is having small switch button, when the person presses the switch button then the implemented code is the call. Then by using the camera the system capture the image sequence and compare this images with the database. If the image is a match then in application module get the signal to unlock the door. After unlocking the door the SMTP is to send alert to an authorized personnel.

4. SYSTEM DESCRIPTION

4.1 Internal Module:

The following block diagram shows the internal module of door unlocking system. Which is have the Raspberry Pi board, motor driving circuit, motor & camera.

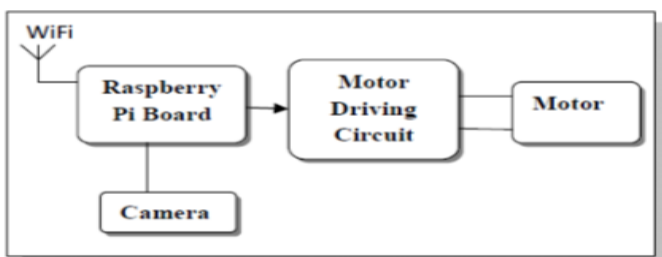


Fig-4.1: Internal Module

Raspberry Pi 3 Model B are used in it. The commands are sent to a driver circuit for processing the required action and the motor is being driven in either clockwise or anticlockwise as per requirement for locking or unlocking the door.

I]Software and Techniques for Face Recognition:

This System is used Python 3.5+ software and python programming. With OpenCV (Open Source Computer Vision)

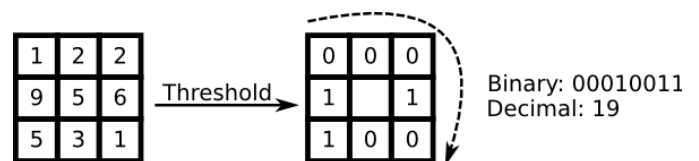
is a library of programming functions mainly aimed at real-time computer vision.

- Haar Cascade Classifier

Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.

- Local Binary Patterns Histograms Technique

The Local Binary Patterns methodology has its roots in 2D texture analysis. The basic idea of Local Binary Patterns is to summarize the local structure in an image by comparing each pixel with its neighborhood. Take a pixel as center and threshold its neighbors against. If the intensity of the center pixel is greater-equal its neighbor, then denote it with 1 and 0 if not. You'll end up with a binary number for each pixel, just like 11001111. So with 8 surrounding pixels, you'll end up with 2^8 possible combinations, called *Local Binary Patterns* or sometimes referred to as *LBP codes*. The first LBP operator described in literature actually used a fixed 3 x 3 neighborhood just like this.



4.2 External Door module:

The following block diagram shows the external module of door unlocking system. Which is have the switch, Led by indication & camera. In this module when the person presses the switch, then the code will run from the virtual environment of the raspberry pi board. Then the camera is started, and from camera capture, the images and it will process in raspberry pi. After matching and verifying the images the Led will glow it means the door is open.

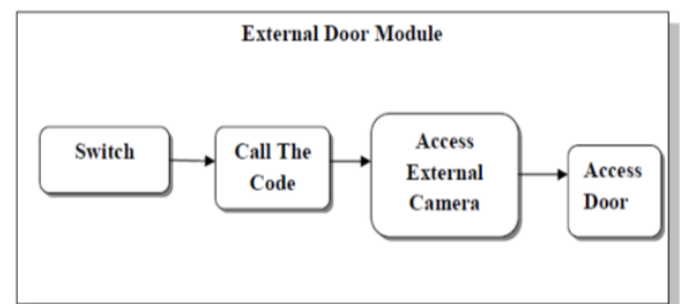


Fig-4.2: External Module

5. SYSTEM ANALYSIS

Testing procedure:

Install OpenCV and Python

1. Write the code for detecting and recognition of image through the camera.

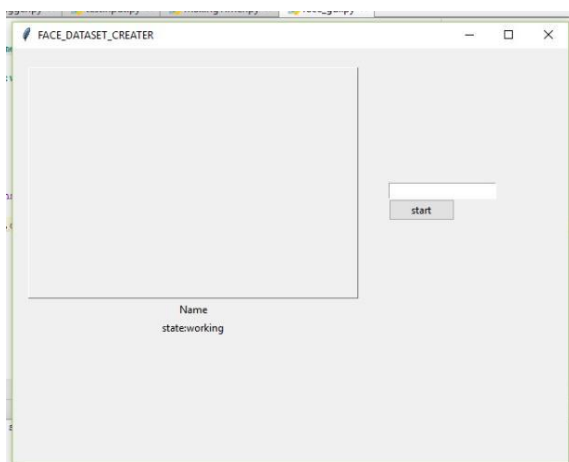
2. Then start the training code, and the camera will open up, Accuracy depends on the number of data sets as well as the quality and lighting conditions.

3. Take pictures of the person for face recognition after running create_database.py script. It automatically creates Train folder in Database folder containing the face to be recognized. You can change the name from Train to the person's name. The result in the creation of the real-time database is recorded. The real-time database is created by using python. While executing it 100 images of each subject. Likewise, databases should be created a dictionary and it creates each image size of variable pixels of height and width. While creating the database, the face images must have different expressions, which is why a 0.38-second delay is given in the code for creating the dataset. In this example, we take about 45 pictures/images and extract the face, convert it into greyscale and save it to the database folder with its name.

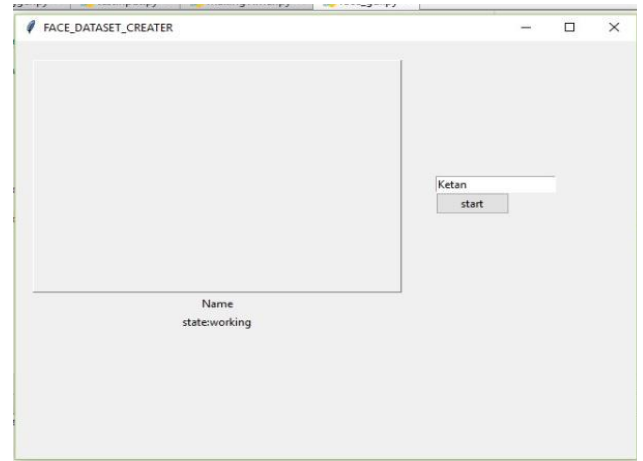
4. After program execution, the database is created and then run face recognition program. And the database is accessed by the program and it will match the live stream video image with it.

The proposed system works are as follows:

- Interface the camera to capture live face images.
- Create a database of an authorized person by using Graphical user interface shown in below image.



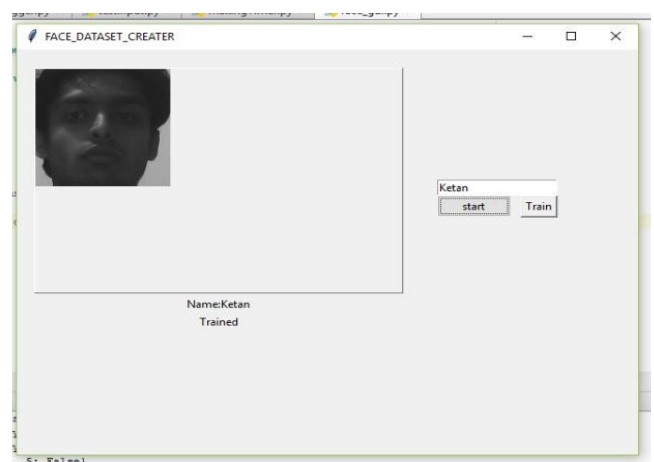
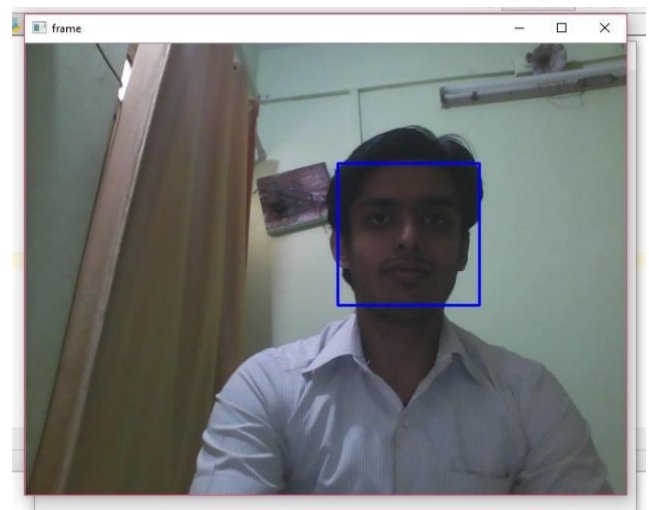
- Write name in the blank block in GUI model to store the person image on their name in the database. And then click on start.



- After click on start one video frame window will open. It captures the images and creates the database.

- After completing capturing the images click on Train.

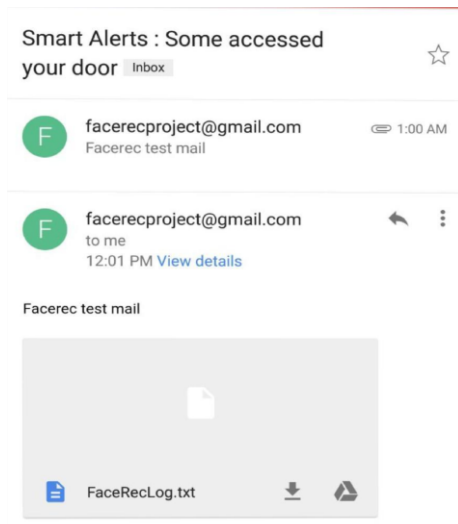
(Above two process images are following shown respectively.)



- After click on start one video frame window will open. It captures the images and creates the database.



- When the face is recognized then by using Simple Mail Transfer Protocol(SMTP) to send alert to an authorized person while unlocking the locked door in the form of an email.



6. CONCLUSION

In this proposed system door access system by using face recognition and along with the e-Mail alert system has been presented. This system has been used with home door lock access control based on face recognition method by verifying enrolled facial images. Concern persons will be informed successfully about the person detection via e-mail alert generations along with details attached. Face recognition is one of the several techniques for recognizing people. There are several methods that can be used for that purpose. Some of the most common are using PCA or eigenfaces. Though there are other new techniques more simple to understand the use and implement but also with very good performance. The Haar Cascades algorithm is one of those algorithms. As we show Haar Cascades has very good performance and is very accurate.

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