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Implementation of Smart Attendance System Using Raspberry Pi

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ABSTRACT

Being one of the most successful applications of the image processing, face detection and recognition has a vital role in technical field especially in the field of security purpose. Human face detection and recognition is an important field for verification purpose especially in the case of attendance system. Maintaining the attendance is very important in all the institutes for checking the presence of students. Every institute has its own method in this regard. Some are taking attendance manually using the traditional pen and paper or file based approach. This system is developed for deploying an easy and a secure way of taking down attendance. The system first captures an image of all the students and stores the information into database. The system then stores the image by mapping it into a face coordinate structure. Next time whenever the registered student enters the premises the system recognizes the student and marks his attendance along with the time. In this project, we come up with a new hardware system for human face detection which makes use of Raspberry Pi. It is a credit-card sized computer with the components mounted on a credit card sized motherboard, running a dedicated version of Linux. It plugs into TV and a keyboard. It is a capable little computer which can be used in electronic devices and for much functionality that a desktop computer can perform. It comes at a very low price

Keywords: Raspberry pi, Face Detection, Face Recognition, Attendance System, Linux (Python)

I. INTRODUCTION

Organizations of all sizes use attendance systems to record when student or employees start and stop work and the department where the work is performed. Some organizations also keep detailed records of attendance issues such as who calls in sick and who comes in late. An attendance system provides many benefits to organizations. Traditional approach for attendance is professor calls student name & record attendance. It takes some time to record attendance. Suppose duration of class of one subject is about 50 minutes & to record attendance takes 5 to 10 minutes. For each lecture this is wastage of time. To avoid these losses, we are about to use automatic process which is based on raspberry pi. In this novel approach, we are using face detection & face recognition system. This face detection differentiates faces from non-faces and is therefore essential for accurate attendance. The other strategy involves face recognition for marking the student's attendance. The Raspberry pi module is used for face detection & recognition. The camera will be connected to the Raspberry pi module. The database is collected. The database includes name of the person, their images . One of the unique features of our brain is that it can think only in images not in words. Once you may forget to keep your Car's key but you will never forget to bring a face with you.

God has given everyone a unique face. Face is the most important part of our body, so that it can reflect many emotions of a person. There are traditional ways are being utilized even today but with vast resources wanted to be more secured. There are two types of biometric as physiological characteristics (face, fingerprint, finger geometry, hand geometry, palm, iris, ear and voice) and behavioral characteristics (gait, signature and keystroke dynamics). Sometimes your behavioral traits may change because of illness, fear, hunger etc. Face detection and recognition system is more expensive, exact, easy to understand and non intrusive process as compare to other biometrics. The system will fall into two categories as face detection (1:1) and face recognition (1:N). In the face detection we have to classify between face versus non face region while in recognition process we have to compare that single face image with multiple images from the input image.

While capturing an images from a webcam we have to come across some problems like pose (position of camera), presence of structural components (spectacles and beard), facial expression, occlusion (obstructed by someone), image orientation (variation in rotation), imaging condition (lightning and camera characteristics) etc.

A Face Detection and Face recognition System is a system which automatically identifies and/or verifies the identity of a person from digital images or a video frame from a video source. A general statement of the face recognition problem (in computer vision) can be formulated as follows: Given still or video images of a scene, identify or verify one or more persons in the scene using a stored database of faces.

II. LITERATURE REVIEW

Two researchers Visar Shehu and Agni Dika proposed in [1] a system which introduces an attendance marking system, which integrates computer vision and face recognition algorithms into the process of attendance management. The system is implemented using a non-intrusive digital camera installed on a classroom, which scans the room, detects and extracts all faces from the acquired images. After faces have been extracted, they are compared with an existing database of student images and upon successful recognition a student attendance list is generated and saved on a database. This paper addresses problems such as real time face detection on environments with multiple objects, face recognition algorithms as well as social and pedagogical issues with the applied techniques.

In [2] PAN Xiang described work process of a system: When a person wants to enter the access control system, he used the RFID card to swiping card by non-touch way. The system reads the information in the card and meanwhile the video camera is started to take photos of the person. Then the face can be detected in a short time. The identity information in the card is compared to the information from the database and the corresponding face data will be obtained. If the identity information and the face data are all matched to the information from the database, the person will be passed. Else he can't enter. The manager can do the manage work such as query the records.

In [3] Mr. Jawale described a technique based on ear is also introduced that is a photo of the subject's ear is taken and fed into the computer. Edge detection is carried out on this picture. From this detected edge, is separated a reference line with respect to which other features are identified. These extracted features are stored in a database in the form of a vector, each vector corresponding to a particular image in the database. The feature vector of the test image obtained is compared with those in the vector database, For creating and maintaining database for records of individuals and feature vectors, which are used for the purpose of comparison and decision making, linking of MATLAB and some data base using ODBC Drivers is carried out according to which a match is calculated.

This match is compared with a predecided threshold value, which decides the identity of the person.

The [4] Jian Xiao, Gugang Gao, Chen Hu, Haidong Feng proposed a framework for fast embedded face detection system based on three modules. One fast face detection method based on optimized AdaBoost algorithm with high speed and high detection rate, one SOC hardware framework to speed up detection operations and one software distribution strategy to optimize the memory sub-system.

The [6] describes a Real Time System developed for Multi-face detection. As most of the system are based on software algorithms. This proposed system is based on hardware design to enhance the processing time. The different stages of this hardware design includes skin color detection, morphology, Fast connected-component labeling algorithm, Implementation of the Fast connected-component labeling algorithm, Lip feature extraction, Horizontal edge detection.

III. PROPOSED WORK

3.1 SYSTEM DESIGN

The aim of our dissertation is to provide a attendances system using face detection and recognition on Raspberry Pi board and send an alert message to the authorized person via mobile device or internet server This will increase the security of our Dissertation. Whatever the system that we have to implement it should work in real time with low false detection rate. Figure. 1 shows the block diagram for real time face detection and recognition system that will contain various hardware and software components.

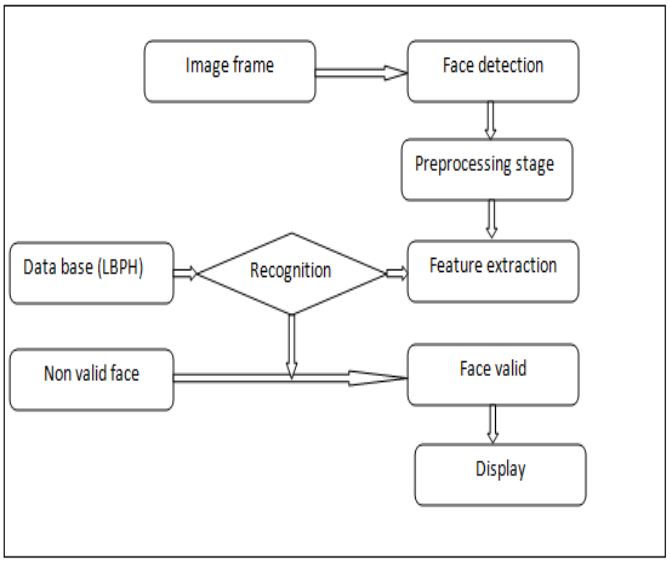

Figure 3.1: Proposed work diagram of Face Detection and Recognition

The proposed work follows:

The first part was booting the Raspberry Pi board by installing the Operating system Raspbian OS and installing the essential libraries and packages.

1) Interfacing of camera module with raspberry pi B3 model. Capture face image using USB Webcam i.e. image acquisition take place
2) Create a database of authorized person using face detection process. After created database save into folder.
3) Capture current face, compare with data base image. Using face detection and face recognition process. Algorithms are used for face detection and recognition.
4) If any person is not present then message will be send to absent person.

3.2 SYSTEM ARCHITECTURE

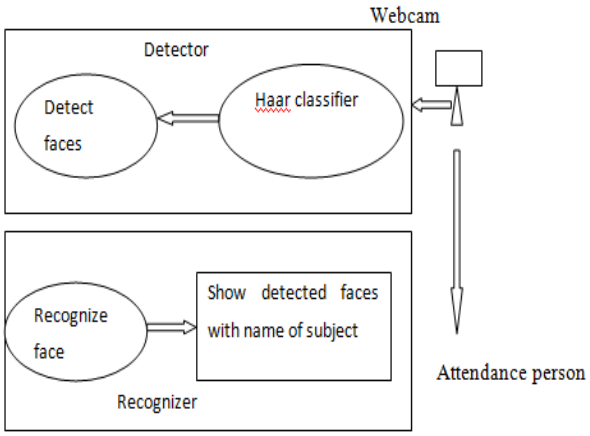

Figure 3.2: Architectural block diagram of Implementation of human face detection and recognition system for attendances

WORKING

Above figure show the basic block diagram our dissertation system can be operated in two different sections, i.e. one for capturing and creating a data base and the other section is to capture the image and which is used for identifying or comparing the images in the database for attendances mechanism.

3.2.1 USB Webcam

The imaging module in the proposed system is realized using a USB webcam.USB Webcam connects to the raspberry pi b3 module. Its resolution is 8megapixel and still picture resolution 640x480, Max image transfer rate 1080p: 30fps. USB Webcam module is used for captures an image and send captured image to the Raspberry pi module. At the first time camera module captures images to create a database of the authorized person as a train faces then secondly take a test face or live captured image to compare with train faces (Data base).

Figure 3.3: USB Webcam

3.2.2 Raspberry pi B3 Module

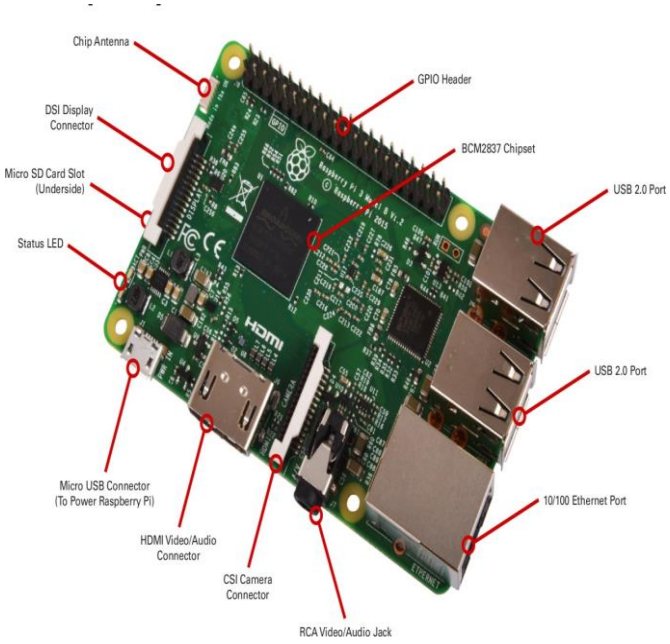

Fig3.4: Raspberry pi B3 Model

The Raspberry Pi 3 is the third generation Raspberry Pi. The Raspberry Pi 3 uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cacheThe Raspberry Pi is a low cost, credit card sized single board computer developed by raspberry pi foundation. Raspberry pi is controlled by a modified version of Debian Linux optimized for the ARM architecture. The Raspbian OS distribution of Debian is designed to provide embedded software programmers with a familiar and fully functional interface to custom hardware development. Raspberry pi consist of OPEN

CV library in which we can write algorithm in JAVA, Python..

Raspberry pi B3 module is small computer board. Webcam interface with raspberry pi model this capture face image fed to the raspberry pi model. Raspberry pi contain SD card i.e. memory card face image of database authorized person stored on this. W captures face image compare with database image. Face not recognized with database then send message to person mobile.

IV. IMPLEMENTATION

Below figure shows that the flowchart of implementation of Human face detection and recognition system using raspberry pi

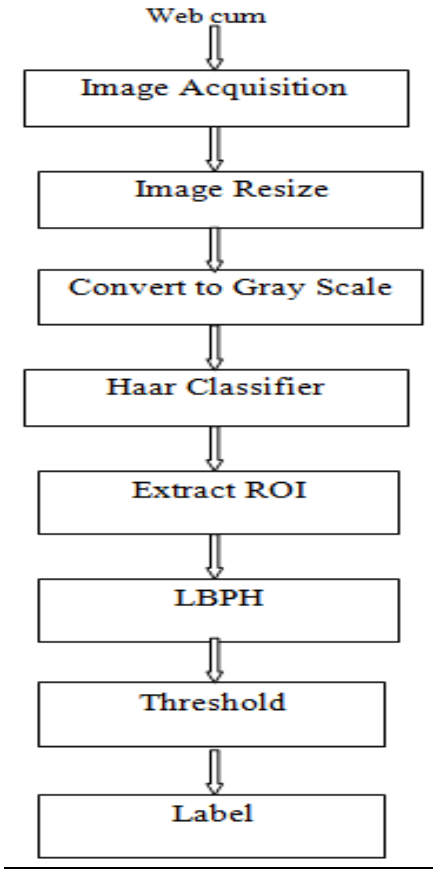

Figure 4.1 Flow chart of Implementation of Human Face Detection and recognition System for attendances system using Raspberry pi

Following is implementation process of dissertation

Step 1: Setting up Raspberry PI

SD card into the SD card slot on the Raspberry Pi, which will only fit one way. Next, plug the USB keyboard and USB mouse into the USB slots on the Raspberry Pi. Make sure that the monitor or TV is turned on, and that the right input is selected. Then Connect the HDMI cable from your Raspberry Pi to the monitor or TV. If the Raspberry Pi is needed to be connected to the internet, plug an Ethernet cable into the Ethernet port next to the USB ports. When all the required cables and SD card are plugged then, plug in the micro USB power supply. First of all the Linux OS is installed into the Raspberry Pi board via Micro SD card and appropriate code is written in Python language for the object detection using the Open CV libraries and is dumped in the board. The USB Camera is interfaced; the GPIO pins are programmed using commands in Linux and Python in this stage. The camera is interfaced to the Pi via the USB port and the door lock module is interfaced via the GPIO pins on the Pi.

Step 2: Image Acquisition

Webcam connect to the raspberry pi kit. When person standing in front of camera then webcam capture face image of that person. Resize the captured face image.

Step 3: Pre-processing

The data which is collected from Input unit that is captured Image and Video frames input is fed into the processing unit in the processing unit. Here the processing unit is nothing but a Raspberry Pi board. Along with code scripts of the implemented modules.

Step 4: Face detection

In face detection process haar cascade algorithms are used for face detection.

- First capture face image by using webcam then resize the image.
- Haar-like features are digital image features used in object 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. In this face detection process, captured colour face image is converted into black and white image i.e. gray scale image. It reduce the number of pixel for simplification of detection. Then selection of ROI take place i.e. face detection process is done.

Step 5: Create Data base of Authorized Person

In Face detection process first create database of authorized person**.** The captured face of current poses creates a data base of the authorized person and stores this. At the next time camera module will capture the current live face of the person. All this process is done in Raspberry pi module. Create our own database. The images stored in a folder, storing database images and store it as a train faces in the test 1 folder.

Step 6: Face Recognition

The most important step of our dissertation is face recognition. In Face recognition process LBPH algorithms are used.

- The image is divided into small connected regions called cells, and for the pixels within each cell, a histogram of gradient directions is compiled.
- For improved accuracy, the local histograms can be normalized by calculating a measure of the intensity across a larger region of the image, called a block, and then using this value to normalize all cells within the block.
- The final step in object recognition using Local binary pattern(LBP) algorithm.

Step 7: Output

When captured face match with database face image i.e. face recognized successfully. When person are absent then send absent message to person.

V. RESULT

Five basic face recognition techniques are compared for different algorithms based on recognition rates (percentage) and elapsed time is shown in table 5.1. The common training data set and test data set is used for comparison in all four used techniques. In this work, basically the comparison of various algorithms as stated above i. e; PCA, KPCA, LDA , LEM and LBP is done on the basis of recognition time used in face recognition procedure.

Table No 5.1: Comparison of various methods on the basis of recognition rate and recognition time

Sr No.	Methods	Recognition Time (sec)	Recognition Rate(%)
1.	PCA	24.13	98.99
2.	KPCA	20.33	94.99
3.	LDA	33.80	97.99
4.	LBP	7.5	95.05

After executing all the step of implementation as discussed above we get following results as shown in figures given below:

5.1 database generation

In our project the main task is to create a database of students enrolled in a class and then to campare these images with the live captured images. These captured images help in identifying the known or unknown person.The face images get stored in a default folder.

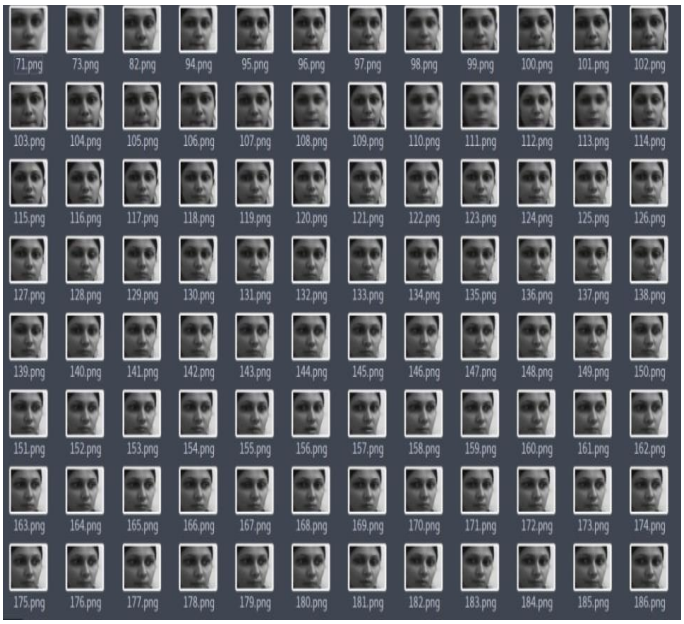

Figure 5.1: Created database

Fig.5.1 shows that database of enrolled student is successfully generated and stored in default folder,

5.2 Face detection of enrolled student

Now live captured image is taken as a test face shown in figure 5.2 to identify whether the student is enrolled or not.

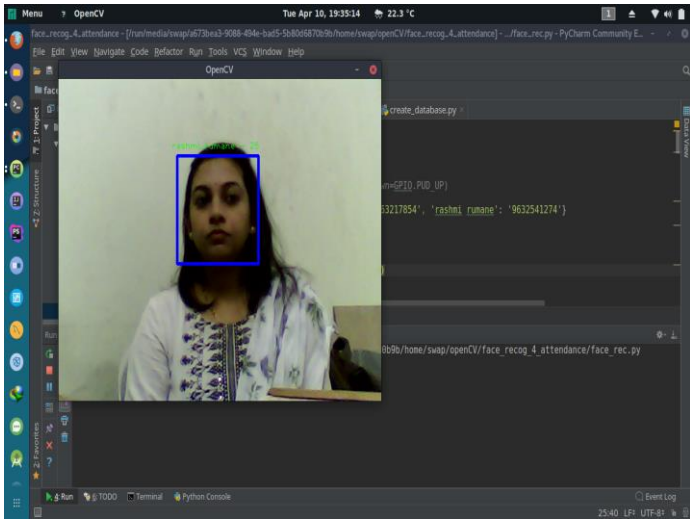

Fig 5.2: face detection after entering a classroom

Fig 5.2 shows that captured imaged is detected and it is available in the database and hence face is indicated by blue coloured rectangle and also shows name of the known person, therefore attendance of present student is automatically marked.

5.3 face detection of unknown student

Figure.5.3 shows that the captured image is of unknown person. Because we have created an enrolled students database in the system and this captured image is unknown to the system after comparing with the database and hence indicated by red colored rectangle.

Hence attendance can not be marked.

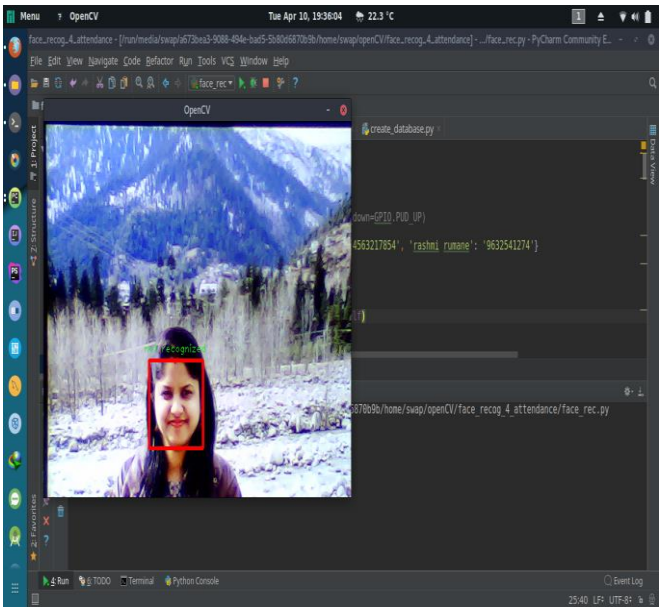

Fig 5.3:image captured of unknown person

5.4 Email to the head authority

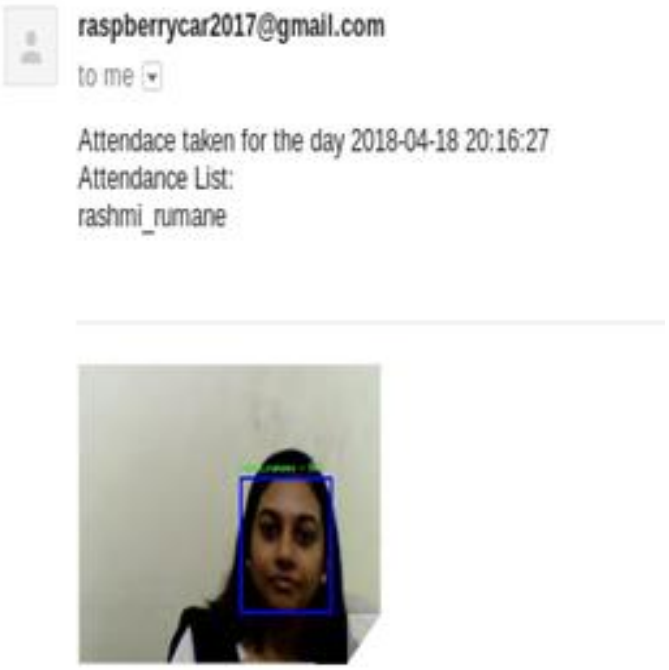

Fig 5.4: Email sent to the head authority

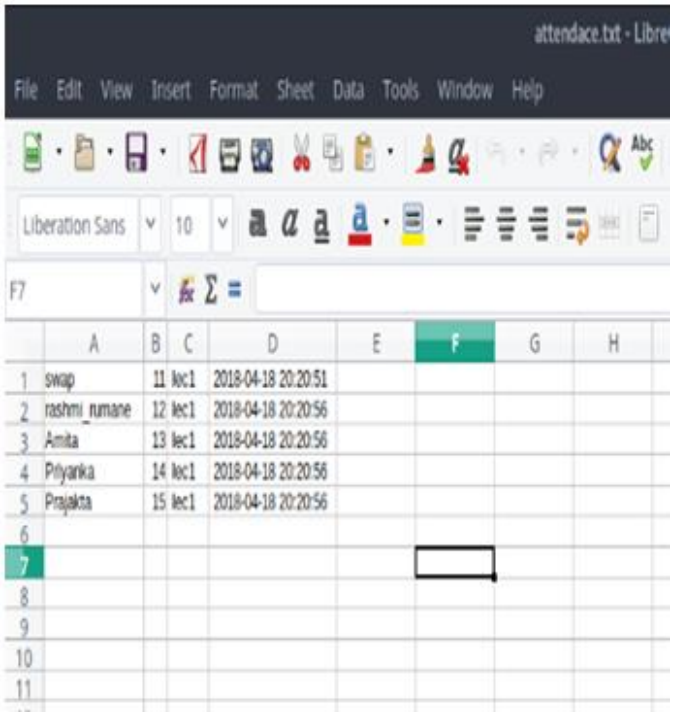

Fig 5.5: attendance sheet of present students

Fig 5.4 shows that attendance of present students during the lecture is recorded and sent to the authority along with the detected image and name.

5.5 Attendance sheet

After completion of the lecture, attendance sheet is generated and stored in default folder.

This attendance sheet consists of name of student, roll number, date and time.

Fig 5.5 shows attendance sheet of students present for the lecture along with roll number and time.

VI. CONCLUSION

We have to study face detection and recognition system on Raspberry Pi module. Face detection and recognition is currently a very active research area. Some of the more algorithms are still too computationally cheap to be applicable for real time processing. Other processors are costlier than Raspberry Pi along with large memory, accuracy and speed. Using Python and Open CV in Raspberry Pi, made our project flexible. But in future it can be used in Orange Pi and Banana Pi board. This has more RAM.

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