Impact Factor (SJIF): 4.542

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 4, Issue 5, May-2017

Implementation of Human Face Detection & Recognition System on Raspberry Pi

Mayuri D. Dahake[1], N. N. Mandaogade[2]

[1]*ME Student, Department of Electronics & Telecommunication Engineering, G.H. Raisoni College of Engineering & Management, Amravati, Maharashtra, India*

[2]*Professor, Department of Electronics & Telecommunication Engineering, G.H. Raisoni College of Engineering & Management, Amravati, Maharashtra, India*

Abstract —Face detection is concerned with finding whether or not there are any faces in a given image and if present, returns the image location and content of each face. Security and surveillance are the two important aspects of human being. In this dissertation, we propose face detection and recognition system that will be capable of processing images very fast while acquiring very high true positive face detection rate. This dissertation describes a simple and easy hardware implementation of face detection system using Raspberry Pi. The system is programmed using Python programming language. Both real time face detection and face detection from specific images, i.e. Object Recognition is carried out and the proposed system is tested across various standard face databases, with and without noise and blurring effects. Efficiency of the system is analysed by calculating the Face detection rate for each of the database. The results reveal that the proposed system can be used for face detection even from poor quality images and shows excellent performance efficiency. Thus with the help of this system, time will be saved. With the help of this system, it is so convenient to record attendance. We can take attendance on any time.

Keywords- Linux, Python, Open CV, Raspberry Pi, LBPH.

I. INTRODUCTION

1.1 OVERVIEW

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. The basic flow of face recognition is shown below in fig

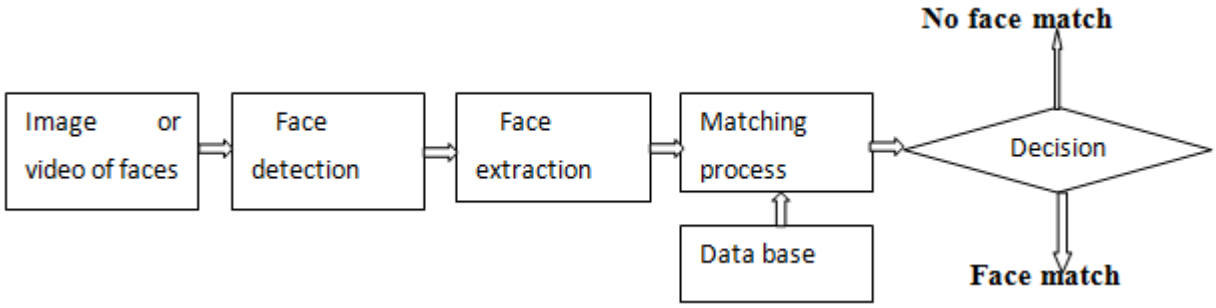


Figure 1.1. The basic flow of face detection and face recognition system

In above figure, which clear that the basic flow of the face detection and face recognition system. The image is captured by camera. The embedded system detects the face and extracts its features. After the extraction, system matches the captured images with data base images. In the decision box the result of the matching is decided which is face match or the no face match.

Face detection and face recognition can be used in various real world application fields.

1.1.1 Face Detection

Face detection describes the process of locating one or many human-like faces in an image sequence. For a fast detection of faces the haar-like feature algorithm can be used.

Fig 1.2 Haar-like features

1.1.2 Face Recognition and Attendance

After the face detection step , the next is face recognition. This can be achieved by cropping the first detected face from the image and compare it with the database. This is called the selection of region of interest. In this way faces of person are verified one by one with the face database using the different algorithms like Fisher faces or Local Binary Patterns Histograms (LBPH) can be used.

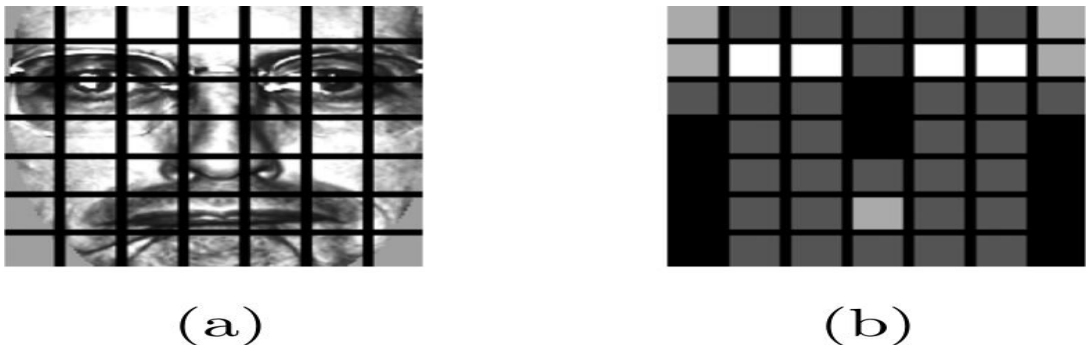


Fig 1.3 LBPH analysis

1.2 OBJECTIVE

The objective of our dissertation to achieve high level face detection and recognition attendances system using raspberry pi model. In the present age raspberry pi has entered a golden area of rapid growth. To overcome problem of previous

attendances system proposed system is designed which would control the attendances through face without any complexity. The main objective of dissertation is to make real time system with low power consumption, low cost with high level security. In this project implementing real time application using Raspberry Pi and image processing detection and recognition system of face. Then used linux software, python and open CV, Haar classifier and LBPH.

II. LITERATURE REVIEW

From the rigorous review of related work and published we found that many researchers had done work in raspberry pi based image processing. From different papers of raspberry pi gives idea about project implementation of raspberry pi based face detection and recognition. The performance, random speed, etc. other parameters are based with respect to the hardware design of Raspberry pi 1 Model B and Raspberry Pi model B+. Also Raspberry pi is known for its versatility and inexpensiveness with respect to display modules. As time passes public utilizes the Raspberry Pi Model B 3 as the central module and extract the results.

In their paper, G. S. Shamanth and A.K. Kashyap presented internet of things has initiated tremendous growth in internet and products that are connected to internet. Internet of things components are cost effective, small in size computational power for application oriented components can be used in surveillance system by using open CV and python .stored faces in cloud can be recognized .in this system describes a simple and easy hardware implementation of face detection system using Raspberry Pi. The system is programmed using Python programming language. Both real time face detection and face detection from specific images, i.e. Object Detection, is carried out and the proposed system stored the faces detected. Here pyroelectric infrared (PIR) sensors are used. It is a simple circuit. It is simple to implement, small size portable stand-alone device. PIR motion sensor and camera modules are also cost effective and can be used for surveillance systems. Detected faces can be stored in cloud and can be used for recognizing the faces. [1].

S. C. Gaddam, N. V. K. Ramesh and H. Dhanekula proposed face recognition based attendances. The main strategy of this paper is taking attendance in organization etc. for this time period are set after completion of time period .attendance are directly stored this raspberry pi 2 module used. For high speed operation eigen face algorithm used but when a number of students faces increases the accuracy will decreases Eigen face approach is one of the face recognition method with accurate recognition technique. Face recognition technology has been an area of research with numerous applications. The Raspberry pi 2 model B is used in this desertation and it gives six times the processing speed of other previous models The GSM uses Attention commands to send the message. This system is convenient to user, easy to use and gives better security When number of student faces increases the accuracy will decreases slightly [2].

Tony Di Cola. "Raspberry Pi Face Recognition in Treasure Box" According to this paper Tony Di Cola dissertation "Raspberry Pi Face Recognition in Treasure Box" is a great example of how to Use the Raspberry Pi and Pi camera with open CV algorithms. By compiling the latest version Of Open CV, it can get access to the latest and most interesting computer vision algorithms like face recognition. Also he used a Solenoid double action lock which is lock/unlock using Key after power off.

Medak Teena Ravalli, Prof. Rangasaikomaragiri "Image Processing Platform on Raspberry Pi for Face Recognition" According to this paper present that a low cost alternative for DSP kits for image algorithm are used for image processing. Their system has been designed on the criteria of resources optimization, low power consumption and improved operation speed.

R.Pahrne and A.Shep ,A. A. Chaudhuri presented this paper solve the problem of high image processing speed. The two view points are face descriptor tool for face recognition and feature extraction by using computer vision, raspberry PI used to create the data base .database can be used to match the input and then shown output of the screen. Face descriptor tool used for face recognition with three aspects as detect a face to track, identify facial feature to track and track the face.Yale database uses. If create database which does not require any facial expression, so reduces complexity [3].

Richard Mo and A.Shaout presented A portable real time facial recognition system that is able to play personalized music based on the identified person's preferences was developed. The system called portable facial recognition JUKEBOX using fisher faces. Raspberry pi was used as the hardware .when implemented on a raspberry pi, the system is able to facial recognition .this paper presents a cost effective solution that is cross platform Linux OS and windows. Facial Recognition Jukebox can also be used to distinguish between different moods (emotion) of a person based on facial expression and play a different song accordingly. The system is implemented on the Raspberry Pi Model B hardware platform and uses OpenCV and Simple DirectMedia Layer libraries for computer vision and media play respectively. Future work of this project would be to future increases the precision of the system by improving algorithm to be more robust to other environments [4].

Subhani Shaik and A. A. Micheal presented Social platform and social media age and gender classification has become applicable to an application .In this paper use in convolutional neural systems and the end use in direct convolutional neural system which used in measure of learning data is limited. CNN can be utilized to give enhanced age and gender arrangement results.[5].

III. METHODOLOGY

3.1 Proposed Work

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.

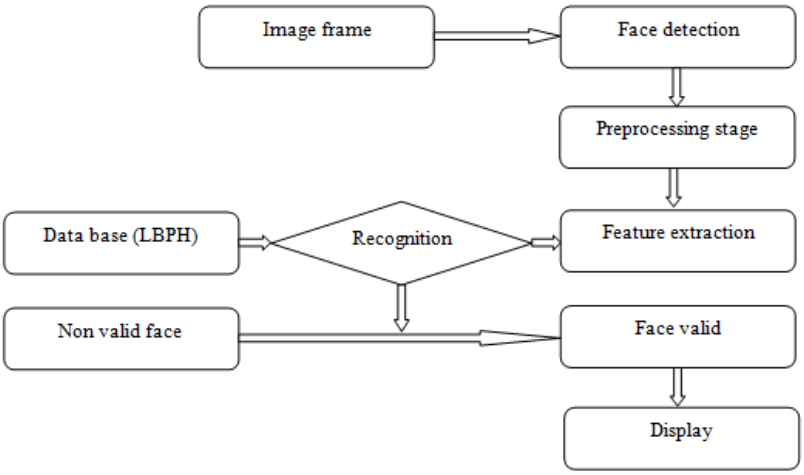


Figure 3.1: Proposed work diagram of Face Detection and Recognition

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 Design & Architecture

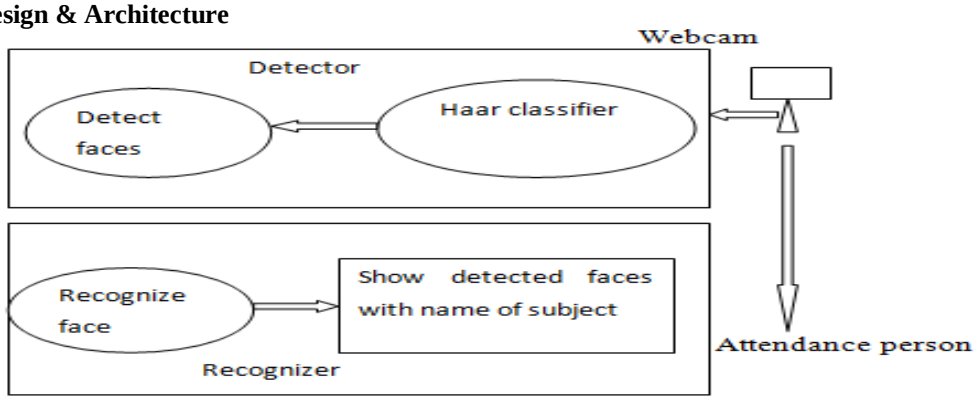


Figure 3.2: Architectural block diagram of Implementation of human face detection and recognition system for attendances

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.

IV. IMPLEMENTATION

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

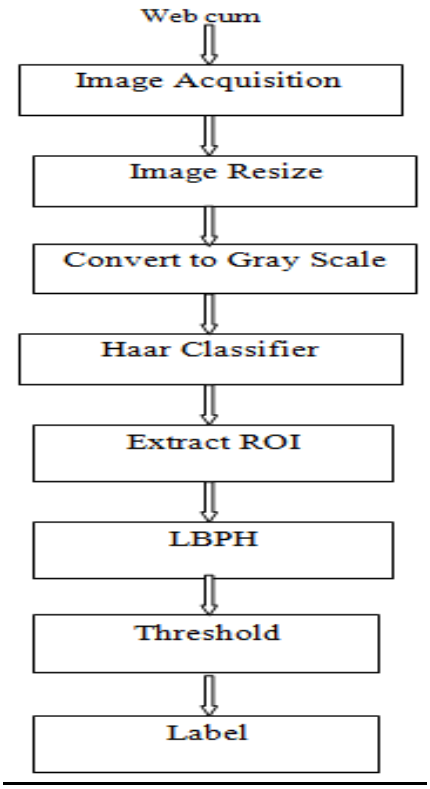


Figure 4.1 Flow chart of Implementation of Human Face Detection and recognition System for attendances system using Raspberry pi

Following is implementation process of dissertation

Step1: 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.

Step2: 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.

Step3: Preprocessing

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.

Step4: 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 histogram of oriented gradient descriptors is to feed the SVM classifier descriptors into some recognition system based on supervised. The support vector machine (SVM) classifier is a binary classifier which looks for an optimal hyper plane as a decision function. Once trained on images containing some particular object, the SVM classifier can make decisions regarding the presence of an object, such as a human, in additional test image.
- The final step in object recognition using Local binary pattern(LBP) algorithm.

Step5: Output
When captured face match with database face image i.e. face recognized successfully. When face not recognized i.e. unauthorized person then send message to the absent person.

V. EXPERIMENTAL RESULT

Four basic face recognition techniques are compared for different algorithms based on recognition rates (percentage) and elapsed time. 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 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

5.1 Created database:
In our Raspberry pi based face detection and recognition system the main task is to creat a database of authorised persons to campare these images with the live captured images. These captured image identify the known or unknown person, So here we creat a 6 number of images as a train faces and stored in the following path is written for the database in the hierarchy order..
dir="/home/pi/Desktop/Work/test1/train faces/s"+str(i)+"/"
The face images need to be stored in a folder. The fig shows that the database of authorized person

The face images need to be stored in a folder hierarchy are shown in following example.s1, s2, s3 are the database folders and 1.pgm, 2.pgm,……., 6.pgm are the created face database images stored in these folders. The figure.6.1 shows that the database of authorized person.

Figure 5.1: Created database

5.2 Authorized persons Captured images:

As per our task we create a database of authorized or known person. Now we take a live captured image as a test face shown in figure 6.2 to identify the person to authorize or not. We capture a one image on the following path,dir="/home/pi/Desktop/Work/test1/test_faces/".

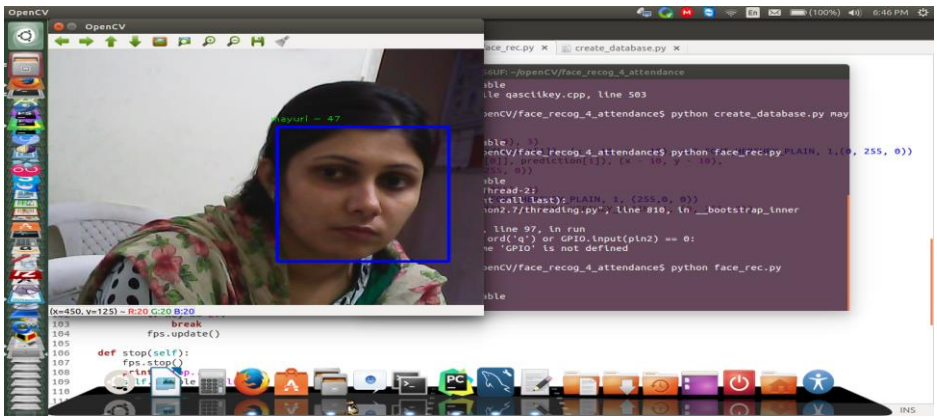


Figure 5.2: Authorized persons Captured image

5.3 Unknown persons Captured image:

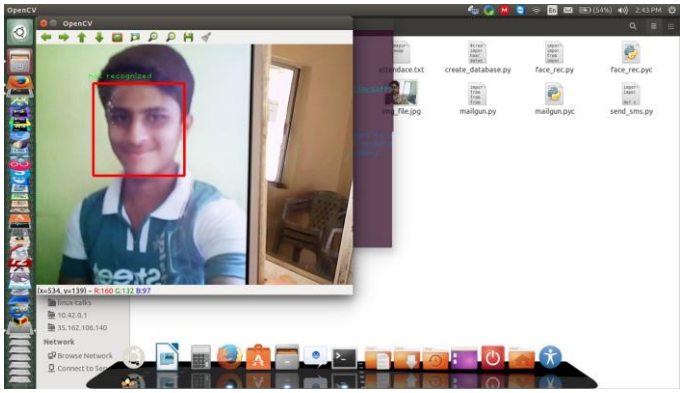


Figure 5.3: Unknown persons Captured image

Figure.6.3 shows that the captured image is unauthorized or unknown persons. Because of we create an authorized persons database in the system and this captured image is unknown to the system after comparing database and live captured image or test face. This captured test face image is stored at the following path,

dir="/home/pi/Desktop/Work/test1/test faces/"

5.4 Multiple persons Captured image:

If multiple faces present in front of camera .for that time they only detected present data base faces.

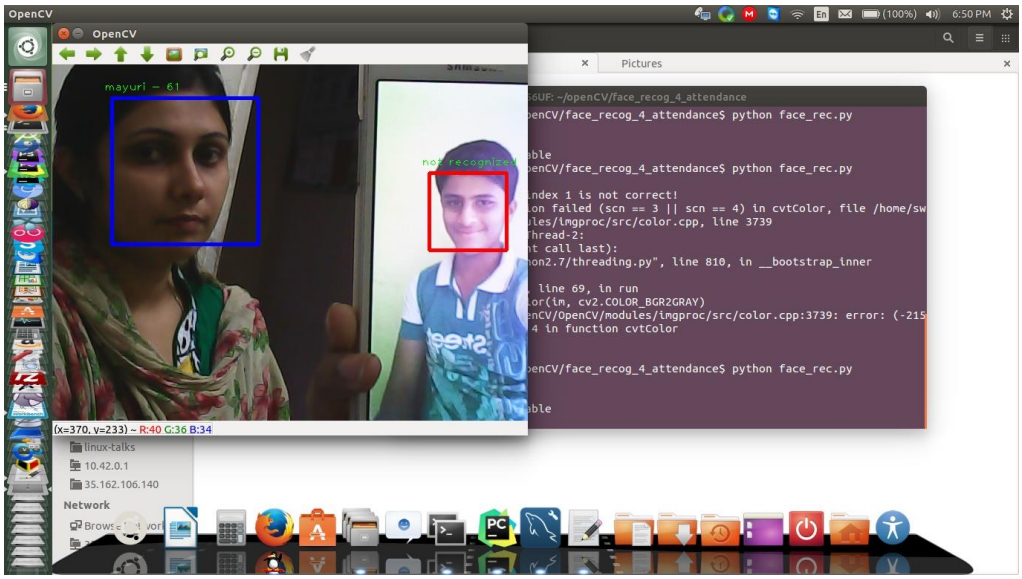


Fig 5.4: Multiple persons Captured image

5.5 Message to the authorized (absent) person:

When authorized person are absent during the attendance send message to mobile of authorized person.

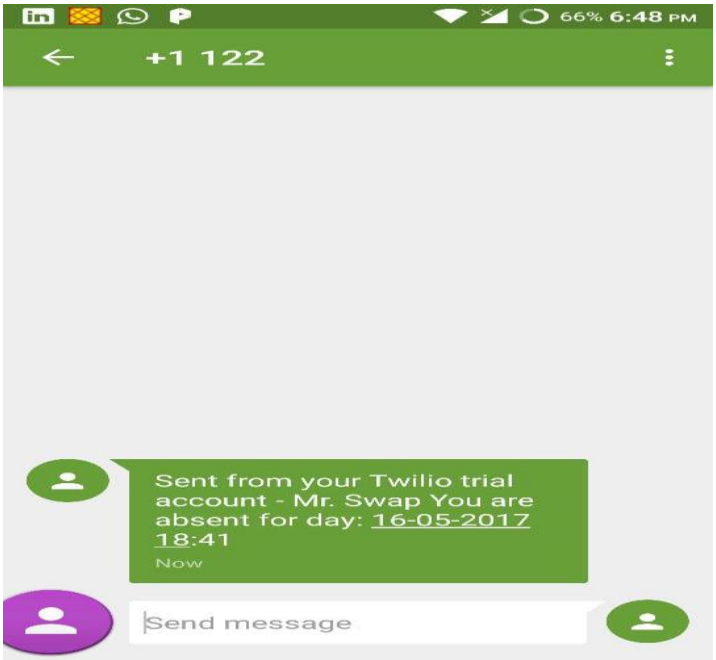
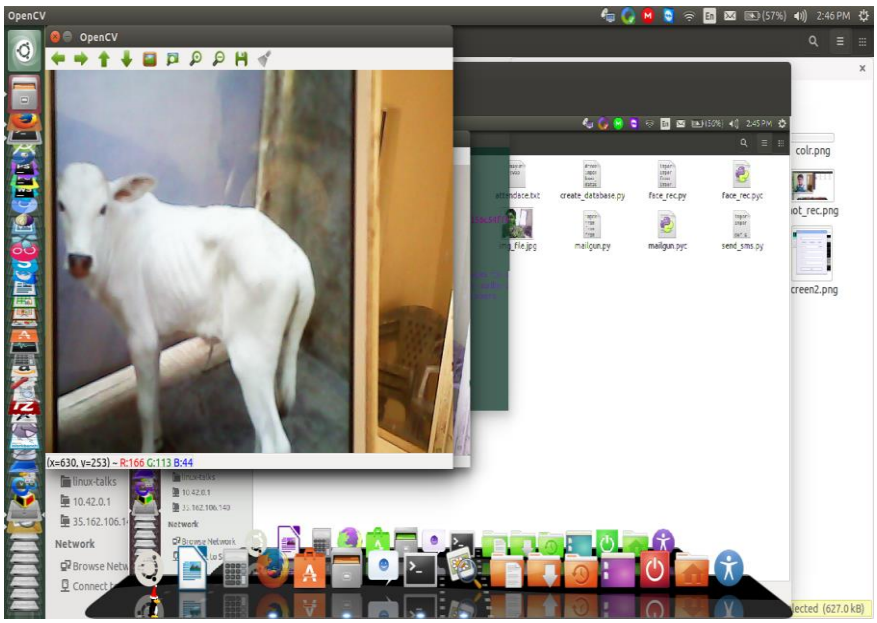


Figure 5.5: Message to the authorized (absent) person

5.6 If persons not present for that time Captured image:



VI. CONCLUSION AND FUTURESCOPE

The design of the attendance by face detection and recognition using Raspberry pi can make the smaller, lighter and with lower power consumption, so it is more convenient than the PC-based face recognition system. Because of the open source code, it is freer to do software development on Linux. We use haar cascade algorithm for the face detection and LBPH algorithm for face recognition process. Also send a security alert email to the authorized person. A face detection system using Raspberry Pi developed. The system programmed using Python programming language. Both Real time face detection and face detection from specific images, i.e. object recognition, was carried out. The efficiency of the system was analyzed in terms of face detection rate. The analysis revealed that the present system shows excellent performance efficiency and can be used for face detection even from poor quality images. This dissertation gives a attendance with high efficiency using raspberry pi model. 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 dissertation flexible.

Using raspberry pi the current dissertation can be modified by an Infrared camera interfacing it can be used in attendance system of the class, Also some profound applications can be implemented using interfacing of Raspberry pi and Arduino UNO board like sensor application of smartcard swapping, finger detection, alcohol detection, agriculture humidity sensing, Temperature sensing using web server, and many more. But in future ,it can be used in Orange Pi and Banana Pi board which has more RAM as compared to Raspberry .

REFERENCES

[1] M. Molina Shamanth G S ashwin Kashyap ‘‘face detection using Raspberry pi and python,’’ *.NCPD 2016 July 2016.*

[2] S. C. Gaddam, N. V. K. Ramesh and Hema Dhanekula,’’ Face Recognition Based Attendance Management System with Raspberry PI 2 using Eigen Faces Algorithm, *’’ARPN journal vol -11, NO.13, july 2016.*

[3] Raspberry Pi Face Recognition Treasure Box Created by Tony Di Cola.

[4] MedakTeenaRavali, Prof. RangasaiKomaragiri “Image Processing Platform On Raspberry Pi For Face Recognition” *Global Journal of Advanced Technologies, ISSN 2277-6370 Vol3, Issue4- 2014.*

[5] R.Pahune ,A.A.Chaudhuri,”Face Detection System for Security Purpose Using Raspberry PI,”*ICEIS-2016.*

[6] Richard Mo Adnan Shaout, ’’Portable Facial Recognition Jukebox using Fisher Faces, *’’IJACSA Vol.7, No.3, 2016.*

[7] Subhanishaik, Antomicheal,''Automatic Age and Gender Recognition in Human face Image Data Set Using Convolutional Neural Network System,*''IJARCSMS Vol 4, issue 2, Feb 2016 .ISSN:2321-7782.*

[8] Danwei, ''Distributed Compressive Sensing Based Near Infrared and Visible Images Fusion for Face Recognition,*'' IJSP, IPPR vol.9, No.4 (2016), pp.281-292.*

[9] Unsoojang and Eui Chul lee, ''Performance Analysis of Pixel Based Face Recognition Method, *''IJBSBT Vol.8, No. 2(2016), PP.197-206.*

[10] Li yongqiang and panjin, ''one sample image Recognition algorithm based on improved sub-pattern principle component analysis, *''IJSP,IPPR vol.8,NO.9(2015),PP.77-84.*

[11] Maryam Moghaddam, Saeed Meshgini,"Automatic face Recognition via Local Directional Patterns," *journal of Artificial Intelligence in Electrical Engineering, vol.4, NO.15, DEC 2015.*

[12] Navin Prakash, Dr. Y. singh, ''Support vector Machines for Face Recognition *''IRJET Vol: 02 issue: 08|Nov-2015.*

[13] JunLee, Jeong-Sik Park, Gil-Jin Jang and Yong-Hoseo,'' Efficient Head Pose Determination and its Application to face Recognition on Multi-Pose face DB,*''IJMUE Vol.11.No2 (2016).*

[14] G. Senthilkumar, K. Gopalakrishnan, V.S.Kumar,'' Embedded Image Capturing System Using Raspberry PI System,'' *IJETTCS Volume 3, Issue 2, March-April 2014.*

[15] Gheorghita Ghinea ,Rajkumar Kannan and Suresh Kannaiyan, "Gradient orientation-based PCA Subspace for Novel Face Recognition "*in IEEE Access, Vol 2,2169-3536 2014.*

[16] Mounika B.R Reddy N. Jand Reddy V.B.D,''A Neural Network Based Face Detection Using Gabor Filter Response, *''IJNN ISSN:2249 -2763 &ESSN: 2249-2771, volume 2 ,Issue 1, 2012 ,PP.-06-09.*

[17] Tudor Barbu,''Gabor Filter –Based Face Recognition Technique, *''Processing of the Domain Academy, Series A, Vol 11, No 31 2010,PP.277-283.*

[18] H.R.Kanan and K.Faez,''Adaptively Weighted Sub –Gabor Array for Single Model –based human face Recognition''. *IJECE DEC 2010.*

[19] Sumo .M.O, Rashmi .H.N, S.B.Seshadri.'' Stand Alone Face Recognition System Using Principle Component Analysis,'' *IJETCAS.*

[20] K.Srinivas and Konda Suresh ,'' Detection and Tracking of Human faces with an Active camera, *''IJMETMR ISSN No :2348-4845*

[21] Rajashree Tripathy, R N Daschoudhury,'' Real Time Face Detection And Tracking using Haar Classifier on SOC,*''IJECSE ISSN.2277-1956.*

[22] P. Viola And M. Jones,'' Robust Real –Time Object Detection, *''international Journal of Computer Vision, 57(2):137-154, 2002.*

[23] Pawana Sharma, Sachin Sharma, ''Face Recognition and Detection Using Hausdorff Distance, Surf and SVM, *''VOL Issue No.3.*

[24] Pankaj Bhusari, V.Raut ,"Real Time face Detection & Recognition system ," *IJCST Vol.5,Jan-March 2014.*

[25] Y.Januzaj, A.Luma ,V.Ramaj,"Real Time Access Control Based on Face Recognition "*ICNSCS-15 June 10-11,2015.*

[26] P.I.Wilson and DR.J.Fer nandez ,"facial feature Detection using Haar classifier".

[27] Ajinkya Patil, Mrudang Shukla," Implementation Of Classroom Attendance System Based On Face Recognition In Class''**,***IJAET July 2014 ISSN: 22311963*

[28] S.Kaushik,R.B.Dubey &A.Madan," Study Of Face Recognition Techniques",IJACR Vol.4 No-4 Issue-17 DEC-2014.