



FACE RECOGNITION BASED ATTENDANCE MANAGEMENT SYSTEM WITH RASPBERRY PI 2 USING EIGEN FACES ALGORITHM

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ABSTRACT

In recent trends industries, organizations and many companies are using personal identification strategies like finger print identification, RFID for tracking attendance and etc. Among of all these personal identification strategies face recognition is most natural, less time taken and high efficient one. It's has several applications in attendance management systems and security systems. The main strategy involve in this paper is taking attendance in organizations, industries and etc. using face detection and recognition technology. A time period is settled for taking the attendance and after completion of time period attendance will directly stores into storage device mechanically without any human intervention. A message will send to absent student parent mobile using GSM technology. This attendance will be uploaded into web server using Ethernet. This raspberry pi 2 module is used in this system to achieve high speed of operation. Camera is interfaced to one USB port of raspberry pi 2. Eigen faces algorithm is used for face detection and recognition technology. Eigen faces algorithm is less time taken and high effective than other algorithms like viola-jones algorithm etc. the attendance will directly stores in storage device like pen drive that is connected to one of the USB port of raspberry pi 2. This system is most effective, easy and less time taken for tracking attendance in organizations with period wise without any human intervention.

Keywords: raspberry pi 2, Eigen faces algorithm, opencv, GSM, camera, Ethernet.

1. INTRODUCTION

In organizations, industries and many companies are taking the entire attendance using RFID methods [1], registers, Moodle based student ID identification [2] and fingerprint modules [3]. In registers, the entire attendance will be calculated and reports will be gathered at the end. It takes more time for calculation.

RFID technology [4] simplifies programmed wireless using digital passive and active with identifications appropriate readers. In short duration, worth's of diffusion and implementation for an RFID card based fare cluster system can be rather expensive. An RFID based fare cluster system has the potential of seriously violating human's security or privacy. RFID strategies ultimately effects software that allows each person to be analyzed by primary data base. This type of environment will be under attack of hackers. If the RFID reader and receiver are not properly matched then less read rate can occurs.

Biometric time and presence system [5] is one of the most accurate requirement in biometric technology. Fingerprint recognition based attendance management system is a running field today, but recognition of individual fingerprint from a set of enrolled fingerprints is a time taking process. Most fingerprint-based attendance systems store the finger prints of a user in the fingerprint module database. The fingerprint system does not reveal any data about the original fingerprint of the user. This assumption has now been shown to be false; many algorithms [6] have been stated that can restore fingerprint images from minutiae templates. These biometric systems, RFID systems and Moodle based student ID identification systems are personal identification systems used for attendance management systems and many security

systems. In ensuing days for any systems security, privacy and accuracy are mainly calculating parameters but these systems are violating security and inaccurate. So, it is important to design a system with highly secured and accurate.

This face recognition [7] based attendance management system with raspberry pi 2 using Eigen faces algorithm is high secured, high efficient and accurate. The module espies the images of student's face captured by the camera, which have been catalogued manually with their names and ID codes in the system database. Face detection data and face recognition data are stored into the system database. Using the stored database, all the details like date, time and present or absentee is calculated and message will be sent to absentee student parents using GSM technology. Let us Assume that a person framed in any random captures not an attendee at the Renaissance Fair, the system can be assumed that the face is not in color space like white red green or any unnatural color. With the assumption of a typical captured scenario, it would be clear to take an advantage of face-color correlations to limit our face search to areas of an image that have at least the correct color components. To achieving this goal, we looked forward at three color spaces HSV spaces, YCrCb spaces and RGB space. RGB (red, green, and blue) is the frequently used basis for color characterizations. Using this color characterizations system will understand difference from human and non-human faces. The background of the image also one of main effect [8] using this image based systems. If the intensity of the background light is high system accuracy decreases. So, it is important to place the system in correct area. The system identifies the images of student's face, which have been stored manually with their names and ID



codes in the database. This system is mainly useful for organizations to take period wise attendance also by setting the time period. An application is created to capture the images, storing ID numbers, starting recognition process, time period and file generation with attendance details.

This paper explains about methodology, system overview, implementation and conclusion of the system.

2. METHODOLOGY

This section describes about software algorithm, openCV, Raspberry pi 2 and components used.

2.1 Eigen faces algorithm

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. This method works on the idea of decomposing face images into a small set of characteristic images called as Eigen faces. Recognition of these images are done by projecting a new face onto a low dimensional linear "face space" stated by the Eigen faces, proceed by calculating the area between the resultant position in the face space and those of known face classes. This Eigen faces algorithm contain face recognition and detection algorithms.

2.2 Face recognition

Using Eigen faces algorithm face recognition done by following steps.

Step 1: obtain the face images, named like $I_1, I_2, I_3, \dots, I_m$. Arrange these images in the form of $N \times N$ matrix. The faces must be centered and in same size. This is high dimensional image; convert into low dimensional image by converting vector into $N \times 1$ vector. Γ is an $N \times 1$ vector, corresponding to an $N \times N$ face image I .

Step 2: compute the average face vector Ψ , by this we will find out mean of the all images.

$$\Psi = \frac{1}{M} \sum_{i=1}^M \Gamma_i$$

Step 3: Subtract the average face vector that is mean from $N \times 1$ vector, this is difference between original image and mean image.

$$\phi_i = \Gamma_i - \Psi$$

Step 4: compute the covariance matrix C

$$= \frac{1}{M} \sum_{n=1}^M \Phi_n \Phi_n^T = A A^T$$

Where $A = [\Phi_1 \Phi_2 \dots \Phi_M]$

Step 5: compute the Eigen vectors of the covariance matrix, by this Eigen face we will recognizes the face. It compare the face captured by camera with all the Eigen faces when face recognize operation is working and find out the nearest matched image.

2.3 Raspberry PI 2

The raspberry pi 2 is a small credit-card sized computer that plugs into monitor, keyboard or touch display. The Raspberry pi 2 model B is used in this project

and it gives six times the processing speed of other previous models. The raspberry pi 2 model B has Broadcom BCM2836 processor. BCM2836 is high powered ARM cortex-A7 based quad-core processor and runs at frequency of 900MHz with memory capacity to 1Gbyte. It has 40 pin GPIO Header for interfacing the external devices to communicate with processor. The communication media's are like I2C, CAN, SPI and in this project GSM is used by direct connection with TRX and RXI pins in GPIO. It has quad USB ports, 10/100 BaseT Ethernet socket, DSI Display connector, Micro SD card slot, 5v Micro USB, HDMI port, CSI camera connector and 4-pole 3.5mm jack All of these are shown in Figure-1.

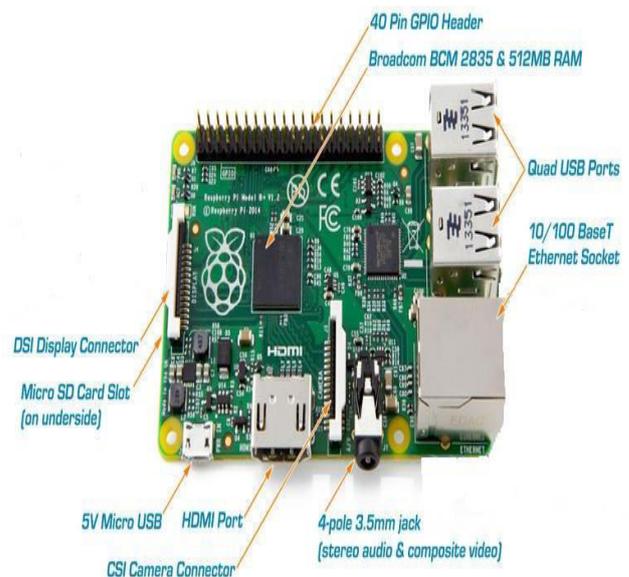


Figure-1. Raspberry pi 2.

This raspberry pi 2 works on the basis of raspbian OS. Different types of raspberry pi are work on different operating systems. Raspbian is an open source operating system based on Debian optimize for the Raspberry Pi hardware. This raspberry pi 2 contain an openCV based image processing library. This library is used for performing the operations on the images while performing face recognition and detection.

Qt Creator is used in this project to create the application. Qt creator is uses C++, JavaScript and QML integrated development platform and which is part of the SDK for the Qt GUI Application development. It contains a visual debugger and forms designer. It has editor's features include pattern symbols highlighting and completion automatically. Qt Creator uses different compilers for different operating systems. For Linux C++ compiler from the GNU Compiler is used and On Windows it can use MinGW or MSVC with the default install.

2.4 Opencv

OpenCV 'open source computer vision library' is an open source image processing library created by Intel



and maintained by Willow garage available for C, C++, and Python. OpenCV is need a compiler like DevC++, code blocks, visual C++. In this paper uses C++ language and DevC++ compiler. In OpenCV there are four modules. Mainly used are CV: main OpenCV functions, image processing algorithms, vision algorithms and highgui: GUI functions, Image and Video I/O.

Using this OpenCV, we will load images captured by camera. These images are in three formats binary image, gray scale image and colored image. The colored image contain R G B with pixel values containing 0-255. It has depth of the image with 8 bits and 3 channels. For loading the image using OpenCV, the following program is used

```
#include "cv.h" // It includes main OpenCV header files//
#include "highgui.h" // header file for GUI function's//
Int main () // main function start here//
{
  IplImage * input; //declaration of variable 'input' by
  command IplImage//
  input = cvLoadImage ("sarath.jpg", 1); // loads the image
  by a cvLoadImage command //
  cvNamedWindow("Output",1);//creates a window to
  display image by cvNamedWindow command//
  cvShowImage ("Output", input); //displays the image//
  cvWaitKey (0); // waits until the key is pressed//
}
For clear the memory for image and destroy the created
window, functions used are
cvDestroyWindow("Output");// destroy the window//
cvReleaseImage(&input); //release the memory for the
image//
```

2.5 GSM

GSM (Global System for Mobile communications) is a digital cellular technology used for transition of mobile voice and data services. Three digital wireless telephone technologies (TDMA, GSM, and CDMA) are available. In this GSM uses a Time Division Multiple Access (TDMA) and operates at two frequency bands i.e. 900 MHz or 1,800 MHz frequency band.

The data transmission using GSM done with the speed up to 9.6 Kbit/s and transmission SMS (Short Message Service) with same speed. GSM contain two links for transmission of data like uplink and downlink. GSM-900 uses 890-915 MHz to send data from the mobile station to the base station (uplink) and 935-960 MHz for the other direction (downlink). It contain 124 RF channels with 200 kHz of spacing and 45 MHz of Duplex spacing is used.

GSM connected to raspberry pi 2 directly through transmission and receiving pins (TXI, RXI) with common ground. GSM TXI pin connected to raspberry pi 2 RXI pin and vice versa. The interfacing of GSM with Raspberry pi 2 shown in Figure-2.

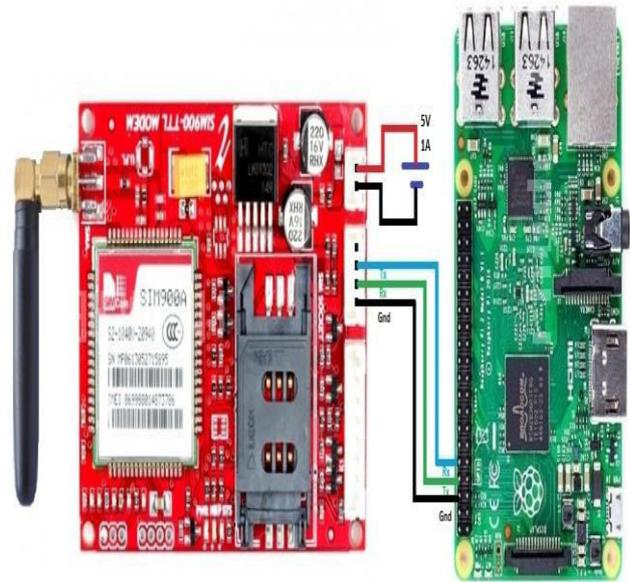


Figure-2. GSM modem interfacing with raspberry pi 2.

3. SYSTEM OVERVIEW

The block diagram of the entire system is shown in the Figure-3. The block diagram explains the overall requirement of the paper. A camera interfaced to raspberry pi 2 is placed entrance of class, each person enters in the class was viewed in the camera. Total student faces, roll number, names are stored in data base of raspberry pi 2 and it contain 1GB of memory for storing this data and application. Each person enters into class is observed by the camera and captures the image like all the students faces are visible. Raspberry pi 2 contain internal timers and set time period for attendance to be taken. Start time period when recognition process start. Face detection and recognition is done for the image captured by camera using Eigen faces algorithm. An application is developed for showing time period, roll number and recognition of student face process by using Qt creator. After completion of time period, a file generated with student details like roll number, date, time, present or absent. The file stored in external memory device like pen drive. Raspberry pi 2 contain An Ethernet port is used to post the attendance in server and connected by the LAN. An USB PORT is used to connect the camera and external storage device. The message send to absent student parent mobile numbers using GSM. The GSM uses ATattention commands to send the message.

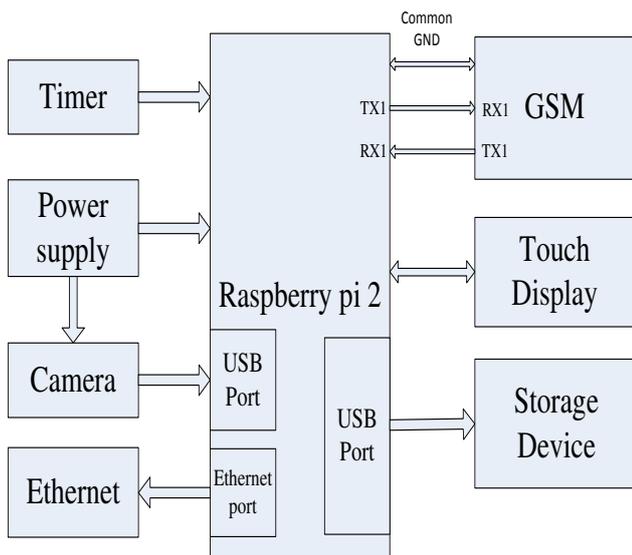


Figure-3. Block diagram of the entire system.

The flow chart describes about the operation of the system shows in Figure-4.

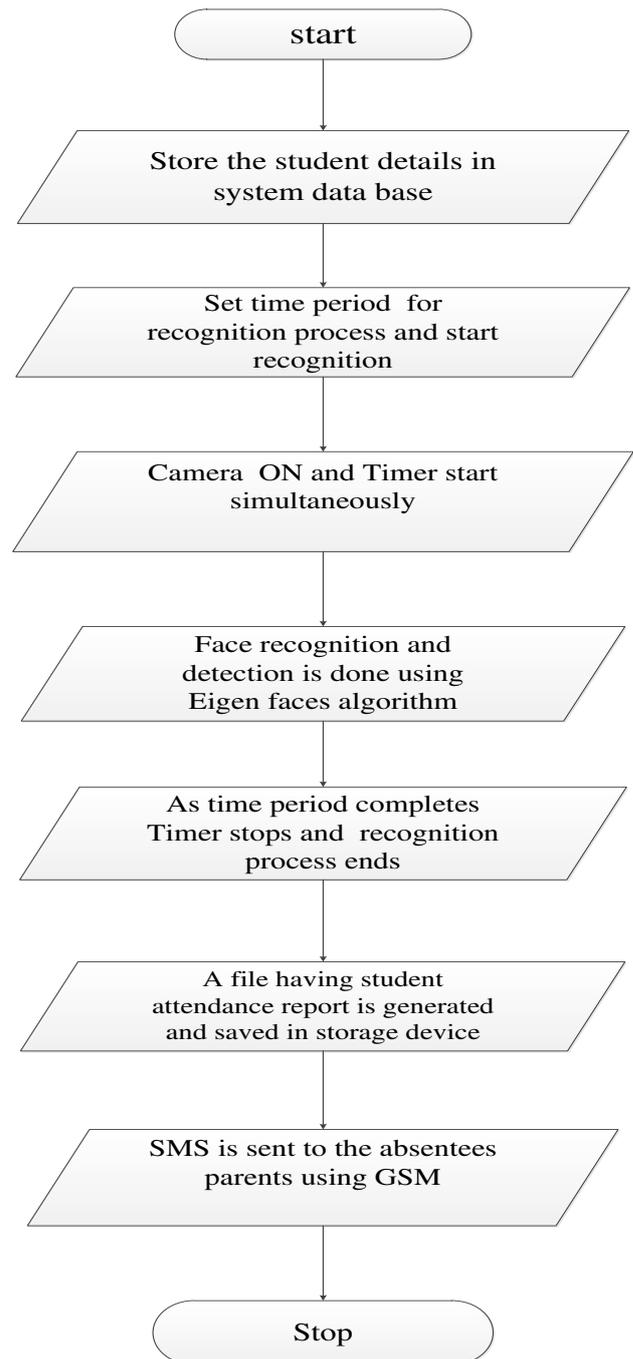


Figure-4. Flow chart of the system.

4. IMPLEMENTATION OF THE SYSTEM

The student images stored in the data base of raspberry pi 2 are shown in Figure-5. The implementation of the system is shown in Figure-6. This system explains interfacing of all the modules to the raspberry pi 2. The output of the system is designed by QT creator is shown in Figure-7. This contain options like train, rec, roll no, capture and bottom it contain time. Train options are used for loading images of the students into database. Rec is for start face recognition process. Your ID option gives Roll numbers to the each student. Capture is used when train the images. Bottom Timer will shows the time up to 600



seconds. The GSM uses AT commands for sending message are listed below:

AT+CMGS-send message
 AT+CMSS-send message from storage
 AT+CMGW--write message to memory
 AT+CMGD--- to delete message



Figure-5. Images stored in data base of raspberry pi 2.

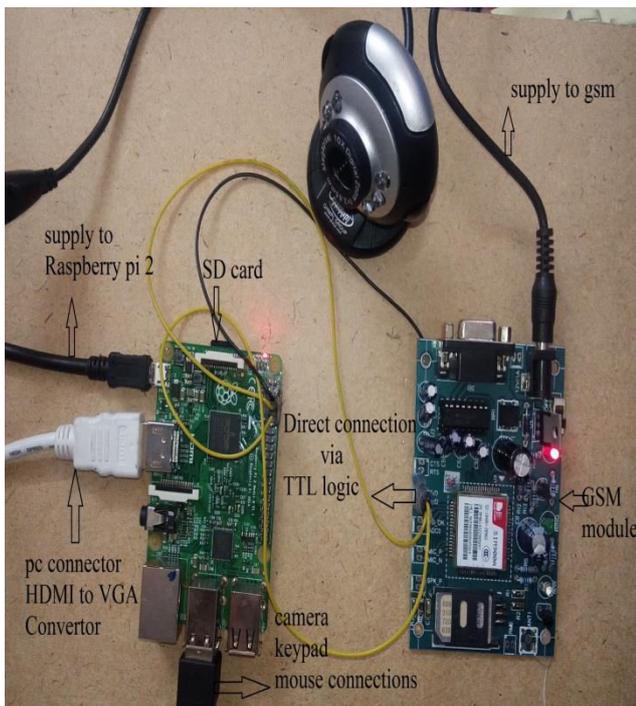


Figure-6. Implementation of the system.

After completion of time period attendance will stored in storage device like

*****02:04:2016 09-00-34*****

Roll number: 1 Name: Sarath Chandu Present
 Roll number: 2 Name: Sumadeep Present
 Roll number: 3 Name: Siva Absent

Message will send to Siva parent's mobile number using GSM like

Roll number: 3 Name: Siva Absent

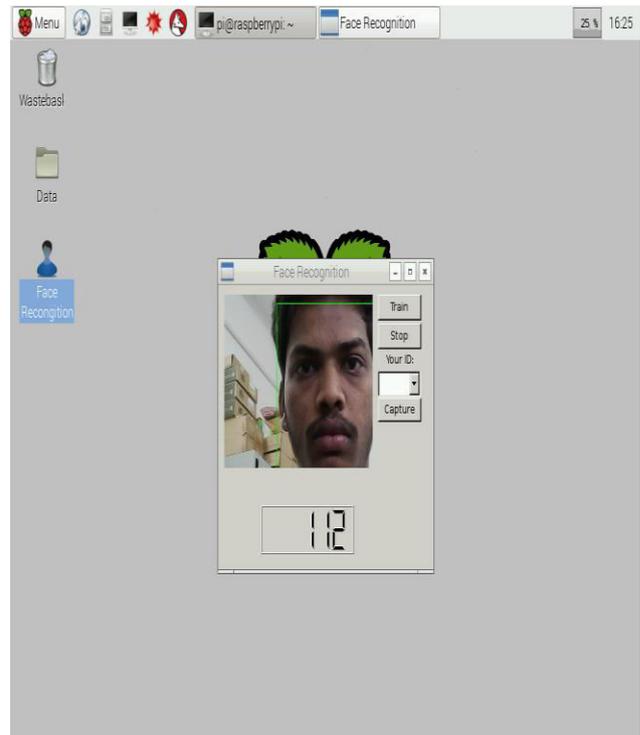


Figure-7. Output of the system.

5. CONCLUSIONS

This face recognition based attendance management system provides accurate attendance information of the students in easy way and upload the attendance into server using Ethernet cable. This system is convenient to user, easy to use and gives better security. These systems develop outputs with 88 percent of accuracy. When number of student faces increases the accuracy will decreases slightly. This system gives the student details as output to a storage device and send message to absent student parent mobile number.

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