Face Recognition For Home Security

D Betteena Sheryl Fernando[1], A B Srivarsha[2], K Pirathisha[3], K Rubiya[4]

[1]Assistant Professor, Department of CSE, Sri Ramakrishna Institute of Technology,Coimbatore, Tamilnadu, India
[2,3,4] UG Scholar, Department of CSE, Sri Ramakrishna Institute of Technology,Coimbatore, Tamilnadu, India

Abstract

Home security is a growing field. Home security matters and people always try to make life easier at the same time. That's why we put up with this project, 3D Face Recognition Door Lock System. Among other things, human face recognition (HFR) is one of the known techniques which can be used for user authentication. 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. 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. It's a prototype that identifies the visitor. A standard Raspberry PI camera captures the image to identify the person. If the visitor at the door is recognized, the door will be unlocked. For unauthorized persons, automatic e-mail notification has been achieved by sending security alert mail to the authorized user email I'd along with sent a SMS. This proposed is more effective, reliable, and this system consumes very less data and power compared to the other existing systems.

KeyWords: *Home security system, Door lock access, Face Recognition, Open CV, Python, Raspberry PI, Haar cascade, LBPH, Security alert*

I. 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. We want to provide high level security to home. Home security has become a solemn issue in the society. Anyone can be harassed in its own house. Older security systems can't tackle some situations like hacking, break down in the system. Unwanted persons like thieves, murderers and some known criminals will try to intrude in the home any time they want. Also we know that the gadgets now days are not that secured and hence can be easily hacked. Even intruders have found their way to take over these gadgets. So to avoid such situations, we have to develop the system in such way that no one should get an intrusion to the system.

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. To develop this we will use a Raspberry Pi microcontroller board for system development, a pi camera module for face recognition and a programmable relay motor to open door lock. We will install appropriate Linux based Raspberry pi operating system on raspberry pi microcontroller board. For the door unlocking system, we will place a relay motor at door latch. This motor will be programmed in such a way that when the system authenticates the person in front of the camera, the motor will rotate to open latch.

We will use image processing technology to authenticate the person to enter in home. For image

processing, we will use pi camera module. Pi camera module is attached to Raspberry pi, and it aids to store various faces in the databases. When someone wants to enter in home, he should stand in front of the camera. Camera will recognize the face and compares with the faces stored in the database.

Tools used are normal and widely applied for current applications and python as the main programming language & Linux based operating system, one can use C, JAVA or Perl also. On being successful, with further optimizations and improvements, the system may be implemented in real time systems requiring user authentication such as attendance systems, ATM security, Network security, In Bank locker, Home automation.

II. EXISTING SYSTEM

The most commonly used system for locking and unlocking the door is a lock and a physical key. The entire process is a mechanical one. If the key is lost, misplaced or stolen, then the entire locking mechanism has to be replaced. This problem with the physical keys intensifies when it comes to big companies where employees are needed to carry several keys for different doors. Apart from the extra burden, all the keys add to become vulnerable to getting lost. An alternative used for physical keys are RFID (Radio-Frequency Identification). There are RFID cards being used as pass keys. The RFID card reader unit is installed near the door. When the card is brought near the reader, it identifies the radio frequency of the card and thus verifies the key. Multiple cards can be paired with the device. But again they are vulnerable to theft or getting lost. It also does not solve the purpose of not carrying a key. Other than the RFID cards some other alternative solutions are used for door access such as digital keypad locks using PIN codes, Barcode locks, Biometrics which uses persons unique characteristics like fingerprint, hand geometry, eye scan , voice to verify their identity for door access. These Solutions are also do not solve the problems. To overcome all such problems we propose a solution using a human face as replacement for existing systems.

III. LIMITATIONS OF EXISTING SYSTEM

The existing system suffers from several limitations such as:

- No Automated door locking system ○ Forgetting Password
- Code Hacking
- Electric Problems
- Unauthorized persons get to know the passwords
- Limit the PIN code length
- If person has injury in his/her biometric features then access may be denied.
- Memory management ○ Cost issues
- Security issues

IV. PROPOSED SYSTEM

In the proposed system, we are using the Raspberry Pi 3 microprocessor for system development. It has the in-built Wi-Fi module so that there is no need of the external one. The aim of our project is to provide a high security system using face recognition on Raspberry Pi board and send an alert to the authorized person via GSM module. This will increase the security of our project.

The proposed work is initially by creating an interface of the camera module, this module is mainly used to capture the live face images of the users, after creating the interface with the camera we have to create a database. This database is used to store the captured photos of the authorized users. The access to the person is granted by comparing the face detected with the images in the database .The raspberry pi camera is used to capture the face images of the person for whom the access is to be validated. The captured current face image is then compared with the available images in the database. Based on the output result of comparison done, the controller makes the decision if the user is a valid authentic user or not. If the user is an authentic user then the access is granted as he is a valid user. If the user is not authentic the access is not granted as he is an invalid user and the GSM module which is interfaced sends a security alert to authorize person while unlocking the locked door. Interface relay as an output module

V. METHODOLOGY

Our project 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. Fig shows the basic block diagram of the Raspberry Pi based face recognition system for door unlocking. Here in the second section we use LBPH (Linear Binary Pattern Histogram)

methodology of face recognition for finding the matches and HAAR CASCADE for face detection.

Camera Module: Camera module is Pi camera interfacing to the raspberry pi module. It is used for captures an image and send captured image to the Raspberry pi module.

Raspberry Pi Module: Raspberry pi B+ module is small computer board. When image taken by the raspberry pi it is compared with stored database face image. At the first time when we capture the image to create a data base raspberry pi module capture the certain number of face images as per the image capturing module to create a data base in the system and this data base is compared with the live captured image. After comparing two images output is positive/negative then it gives commands to GSM module.

GSM Module: GSM module is used to sending a message to the authorities after comparison output is positive or negative. If output is positive then display "Person Matched" message otherwise display "unknown person" and also send email to authorized person mail id. In addition to that send SMS to authorized person mobile

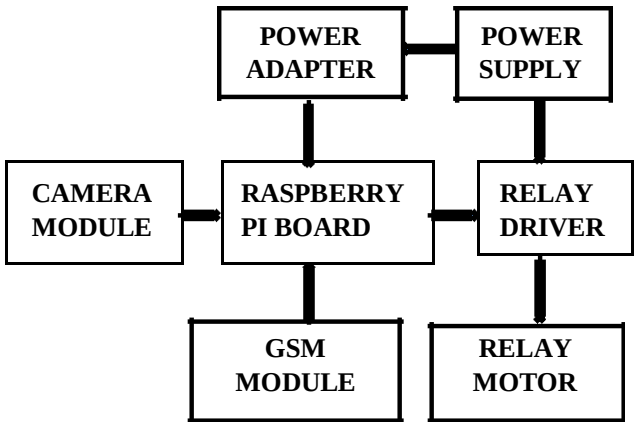


Fig 1: Block diagram of proposed system

VI. SYSTEM ALGORITHM

Haar Cascade Classifier

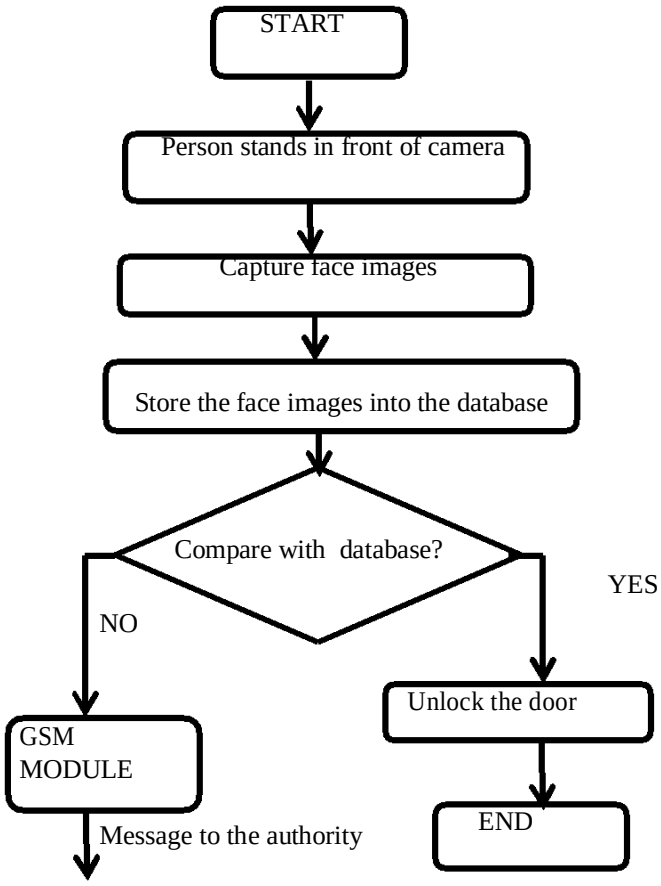
In our system we use Haar cascade algorithm for face detection. Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones which is Machine learning based approach. Initially, the algorithm needs a lot of positive images (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-5 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.

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-equalits 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.

VII. FLOW CHART

Fig 2: Flow - chart of proposed system



VIII. IMPLEMENTATION

The proposed system incorporates both hardware & software implementation. The Hardware implementation consists of the components step down transformer, power supply board, relay motor, relay, raspberry pi, and raspberry pi camera. The coding for the raspberry pi is written in the language of python programming language. The camera works based on the signals from the centralized controller raspberry pi. The access is granted by face detection and recognition by using harr cascade and LBPH (Linear Binary Pattern Histogram) respectively

Hardware Implementation

The Hardware implementation requires the use of the step down transformer that converts the voltage from 230V to 9V-12V. A diode rectifier then equips a full-wave rectified voltage that is first filtered by a simple capacitor filter to produce a dc voltage. Four diodes are connected together to form a bridge rectifier & it is used to convert the analog current to digital current. The resulting DC voltage usually has some ripple or AC voltage variation. A regulator circuit discards the ripples & also remains the same dc value even if the input dc voltage fluctuates, or the load connected to the output dc voltage changes.

The power supply board is designed to supply current to the raspberry pi camera and the relay motor. A voltage of about 5V is given to the relay motor. The power supply for each component is provided. The interface connections are done and the components are connected to each other. The proper connections are ensured to check for the proper working.

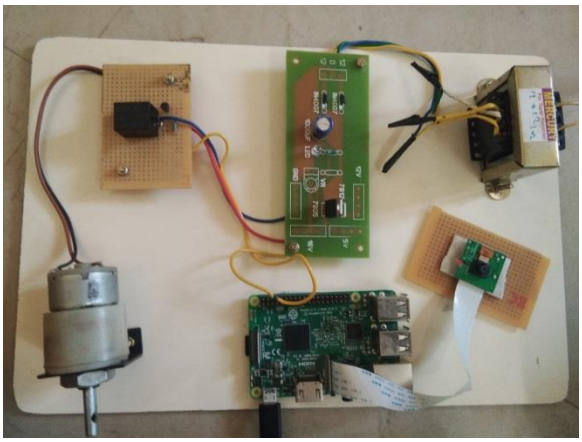


Fig 3: Hardware connection setup

Software Implementation

The software programming is done by using the python version 3.In this version of the python programming language the coding for the functioning of the individual modules in separate files. The codes for the proper working of camera relay motor is written as individual modules and it is loaded into the storage of Raspberry pi. When these codes are executed the desired output is obtained.

IX. ADVANTAGES OF PROPOSED SYSTEM

- By using Raspberry Pi, as a centralized controller for our proposed system, the current developed system becomes more scalable and flexible.
- The system can be modified by adding additional components or replacing the existing components, easily without disturbing the other components which are already available in the system.
- Accuracy in the detection of face is high as we are using the raspberry pi camera for face detection. This has high accuracy as it is high resolution camera.
- As we are using Raspberry Pi as our centralized controller to develop the system, the total system has become low power system.
- New embedded technologies can be easily inserted into this development, due to the use of raspberry pi.
- New connections like cascade connections, parallel connection, series connection to extend the system.
- No lost or found
- No key required
- Security

X. RESULT AND DISCUSSION

Consider the figure 4 which shows the set of python codes which are used for starting the camera , based on these set of lines of code the images are captured, and these captured images are then stored in the user specified path location – the OpenCV database. These set of images are used for the comparison purpose. Based on these images the algorithms execute and the door lock access is provided, if the concerned user is an authentic user.

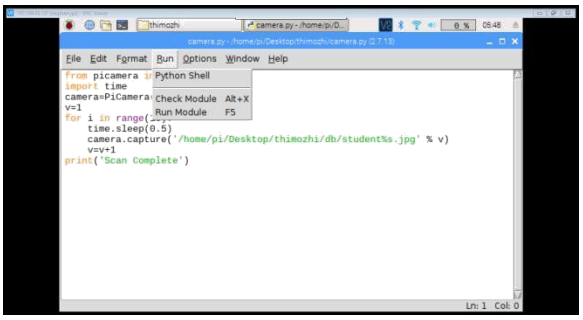


Fig 4: Python code for running the camera

Consider the figure 5 which shows the set of images which are trained already, based on this set of images the access authentication is done

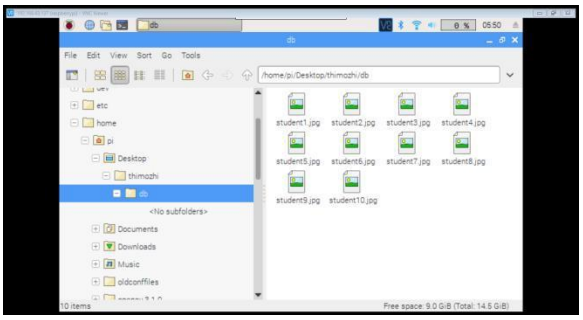


Fig 5: Screenshot of trained data set folder

Consider the figure 6 shows the coding for access grant, based on the set of images from which the access authentication is done

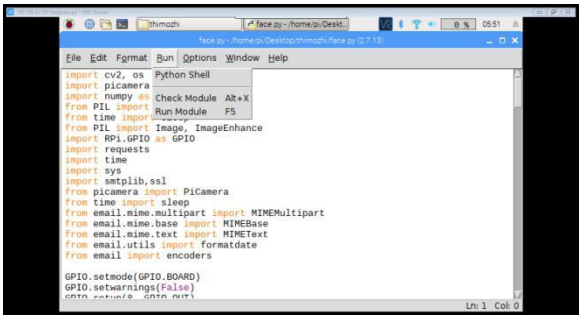


Fig 6: Screenshot of running face.py module

Consider the figure 7 which denotes the scan completion of the authorized user's photos

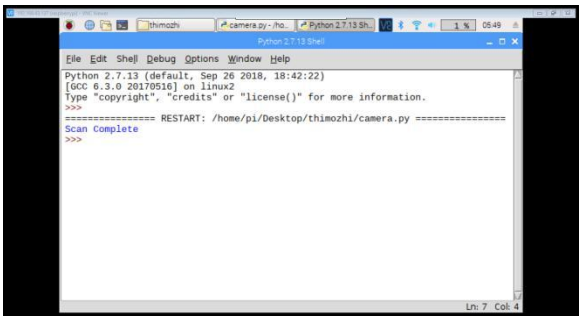


Fig 7: Scan completed

Consider the figure 8 which denotes the access grant of the currently scanned user's photos

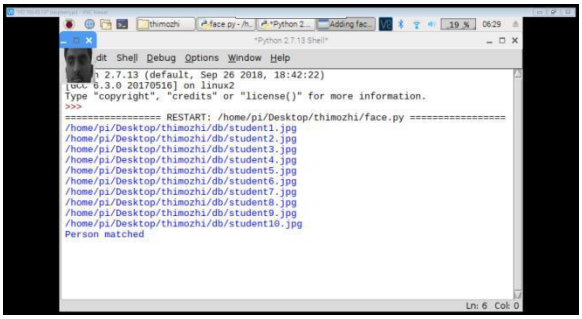


Fig 8: Access grant

Consider the figure 9 which denotes the access grant denial of the currently scanned user's photos

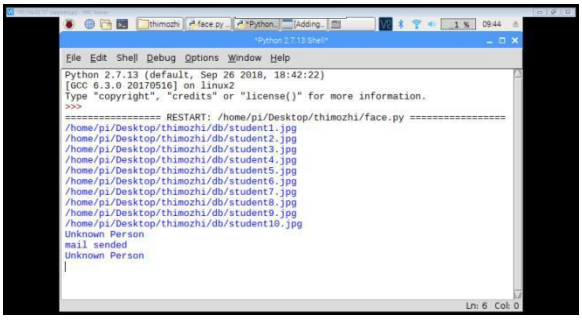


Fig 9: Access grant denied

Consider the figure 10 which denotes the email sent when an unknown person is detected along with their photo.

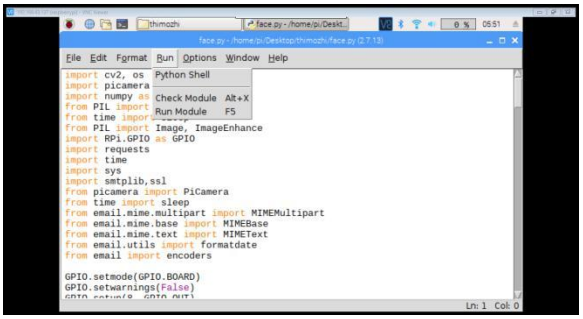


Fig 10: Mail inbox screenshot

XI. CONCLUSION

The design of the face recognition system using Raspberry pi is made with smaller, lighter and lower power consumption, so it is more convenient than the PC-based face recognition system. Because of the open source code, it is free to do software implementation on Linux. The prototype design for real world implementation has been elaborated, in which the output of face recognition algorithm will lock or unlock the magnetic lock placed at the door using relay circuit. We use Principle component analysis algorithm for the face recognition and Haar Cascade for face detection process. Also send a security alert message to the authorized person mail and mobile. The developed project is cheap, fast, and highly secure. This system also provides enough flexibility to suit the requirements of different systems. It is portable and easily upgradable. Face recognition has made this system almost impossible to hack.

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