

Door Automation using Face Recognition

Arathi P¹ Sai Manasa P S² Sushma N³ Sahana K⁴ Pallavi⁵

¹Assistant Professor ^{2,3,4,5}Student

^{1,2,3,4,5}Department of Computer Science and Engineering

^{1,2,3,4,5}Dr AIT, Bangalore, India

Abstract— In this project, a smart home security system by using Haar cascade face detection algorithm is proposed to enhance the security level of the entry system. Face recognition is an interesting but challenging in machine learning field and impacts important applications in many areas such as remote sensing, machine/robot vision, pattern recognition, medical field, banking and security system access, and authentication in personal electronics gadget. In this research paper, we proposed the door lock security system using image processing instead of the traditional key and digital lock system. The image processing mainly consists of three parts, namely face representation, feature extraction and identification of face. Face representation represents how to model a face with Haar cascade algorithms of detection and recognition. The important and distinctive features of the face are extracted in the feature extraction phase. In the identification of the face, the new face image is compared with the images which are already extracted and saved on the database. Face detection and recognition methods were applied to allow the authorized dwellers and the guest and prevent the unwanted person to enter inside the house.

Keywords: Face Detection, Haar Cascade Algorithm, Machine Learning, Feature Extraction, Door Automation System

I. INTRODUCTION

In this world of connectivity and smart devices, there is an essential need to adapt our existing day to day objects and make them smart, also it is not the era where 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.

Home security is needed for the development of society as a whole, which in turn will help make our cities smart, so the concept of facial recognition to gain access of the house is an idea which is used to make our place of living more secure. A facial recognition system is a system that captures facial images and verifies the identity of a person using a digital camera. Human is identified by their unique facial characteristics. In the face recognition approach, a given face is compared with the faces stored in the database in order to identify the person. In the field of biometrics, facial recognition technology is one of the fastest growing fields.

An extensive study of the OpenCV platform and its inbuilt functions has been conducted to generate a code, which does correct and reliable facial recognition with new and efficient use of hardware. Face detection is more challenging because of some instable features, for example, eye glasses and beard will impact the detecting efficiency. Moreover, different angles of lighting will make detecting face to generate irregular brightness on the face, which will

have an influence on the detection process. This proposed system acts as a home security system for both Person identification and provides security for door access control by using facial recognition for the home atmosphere. The camera is used to capture the image of a person as soon as he stands near the door.

The advantage of the proposed system is to access the door by face detection, where face detection and recognition are performed by using face detection algorithms and the entire face recognition is completed when the captured image is compared with the stored database. Face recognition includes feature extraction from the facial image, recognition or classification and has reduction.

As the progressing people are scared about the safety of their information and themselves. With the model of Door Automation, a profound impact is expected in the security industry and also to make all daily life objects interconnected and interactive. This paper will be the main contribution to the field of Home Security.

II. RELATED WORK

In today's fast-paced and ever-changing world security is one of the basic needs of our lives. The use of technology in the field of security plays an important role in increasing security as well as reducing the manpower efforts.

Y. Januzaj. et al. [1] proposed real-time access control for face recognition using, Raspberry Pi instead of GSM services and relay. The limitation of the work was it couldn't control the background light situation and ambient light conditions.

H.Lwin.et al.[2] has proposed a door lock access system which consists of three subsystems: to be specific face recognition, face detection, and automated door access control. Face recognition is actualized by using the PCA (Principal Component Analysis). The door will open itself for the known person in command of the microcontroller and caution will ring for the unknown person. The demerit of this system is input images are taken through a web camera continuously until the 'stop camera' button is pressed. Somebody is required at the location to check the unauthorized person's images or status of the system and take further appropriate action. Personal computer (PC) is associated with the microcontroller, The entire system will not work if PC is crashed or Non-Function.

G.senthilkumar.et.al. [4] proposed work on Embedded Image Capturing System Using Raspberry Pi. In this work, they captured the image and compared it with the database but the limitation was the system couldn't work properly in the ambient light condition.

M. Carikci et al. [5] proposed a work on A Face Recognition System based on the Eigenface method in which they used the Eigen method for face recognition and Euclidean distance method to compare the image of the

person concerned with the images in the database. It was a very efficient and fast method and also gave high accuracy.

S. Jogdand.et.al [6] proposed a work on Implementation of Automated Door Accessing System with Face Design and Recognition in which they used Viola-Jones method for face detection and PCA (Principal Component Analysis) for the comparison of images. The limitation of this work was that it is not robust and the efficiency is less.

U. Sowmiya.et al [7]. Developed to connect any door with the internet. In this system user also implemented a PIR sensor and camera. PIR sensor used for detecting a person and camera used for capturing the video of the person who comes at the door. The video was sent through a 3g dongle to the authorized person. They had also discussed some advantages of this system. They had concluded the use of this system in banks, hospitals, etc. But their proposed model didn't provide the facility of sending messages to authorized people.

III. PROPOSED SYSTEM

The purpose of our project is to provide a high security for the house using on Raspberry Pi board for face identification and send an alert to the authorised person in the form of SMS via the GSM module. This project possess a system implementation of

- Interfacing of camera to capture live face images.
- Create a database of authorized person if they exist.
- Capturing current image, save it and compare with the database image.
- Interface GSM module to send alert to authorized person while unlocking the locked door in the form of SMS and CALL.
- The project can also be used for surveillance. For instance, it can capture the images of unidentified individuals and store it which can later be used to determine the impostors who tried to gain illegitimate access.
- Interface relay as on output.

IV. BLOCK DIAGRAM

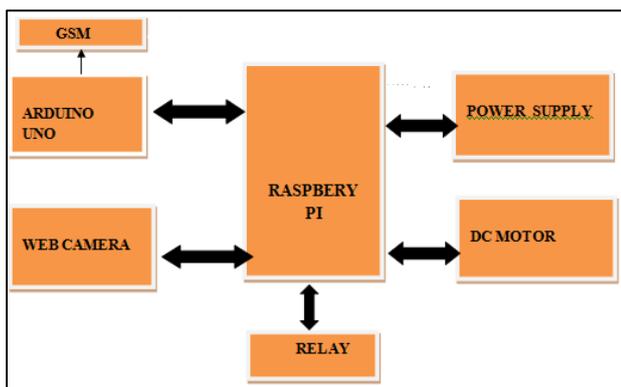


Fig. 1: Block diagram of the system

V. FLOW CHART

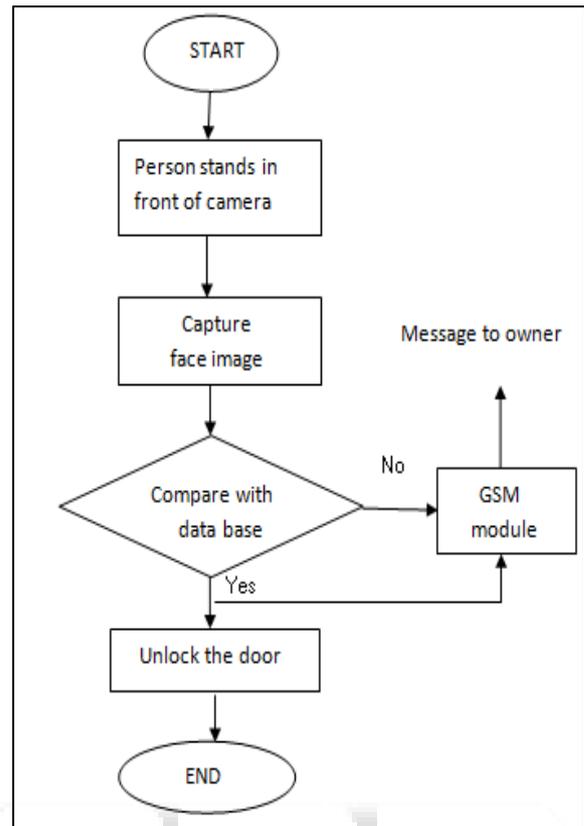


Fig. 2: Process flow of the system

VI. IMPLEMENTATION

This project can be operated in 2 different sections, i.e. one for capturing and creating the database and another section is to capture the image which is used for identifying and comparing images in the database. Here is the second section we use the haar cascade methodology of face recognition for finding the matches. The various components that are used in the implementation along with the important consideration are explained in detail.

A. Raspberry Pi:

raspberry pi 3 module is a small computer board. When an image is taken by raspberry pi it is compared with database image. For the first time when we capture an image to Create a database, the raspberry pi module captures many images to create a database in the system and this database is compared with the live captured images. After comparing the two images, based on whether the output is positive or negative it gives commands to the GSM module.



B. Camera Module:

Camera module is a pi camera interfacing to the raspberry pi module. It is used to capture images and send the clicked images to the raspberry pi module. The camera contains LEDs and flashes to handle that light condition that is not explicitly supplied by the environment and these light conditions are Known as ambient light conditions.



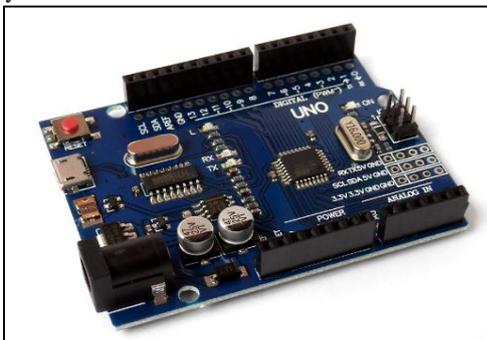
C. GSM Module:

GSM module is used to send a message to the authorized people based on the output. If the output is positive “Information matched Access granted” message will be sent to the authorized people, otherwise, in case of unauthorized access it will send an “Access denied. Some unknown person is trying to unlock the door”. Message to the certified users of the system.



D. Arduino Compatible UNO R3:

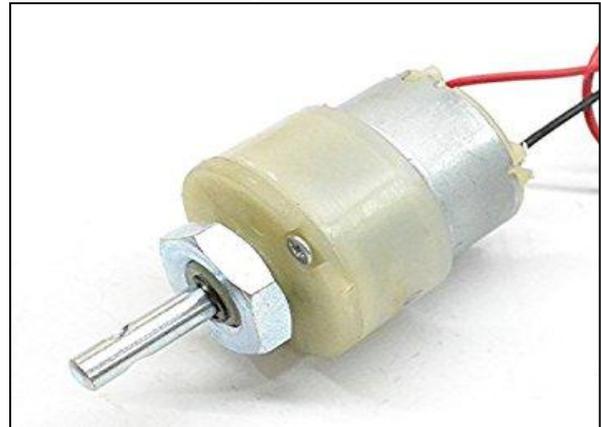
Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a Micro USB connection, a power jack, an ICSP header, and a reset button. It is used for the functioning of Raspberry Pi and DC motor.



E. DC Motor:

A DC motor may be a category of rotary electrical machines that converts power into energy. The most common varieties deem the forces created by magnetic fields. Nearly all kinds

of DC motors have some internal mechanism, that's either mechanical device or electronic, to modify the direction of the flow of current in the parts of the motor.



1) Software

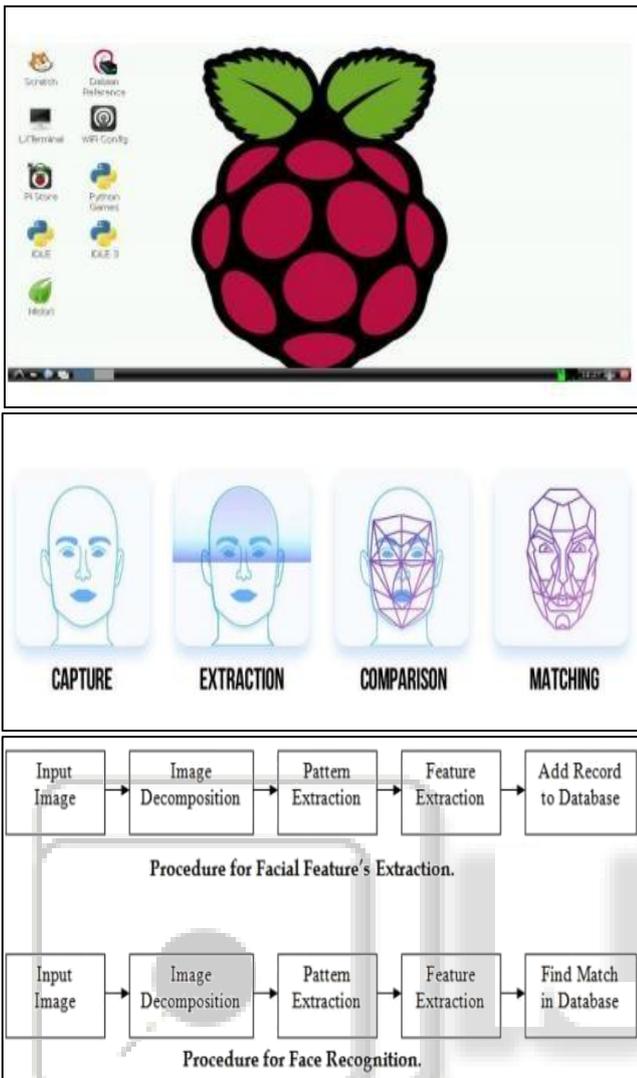
a) OpenCV:

It is a library of programming functions mainly aimed at real-time computer vision. It is developed by the Intel research center and subsequently supported by Willow Garage and now maintained by itself. It is written in C++ and its primary interface is also in C++. Its binding is in Python, Java, Matlab. OpenCV runs on a variety of platform i.e. Windows, Linux, MacOS, OpenBSD in desktop and Android, IOS and Blackberry in mobile. It is used in the diverse purposes for facial recognition, gesture recognition, object identification, mobile robotics, segmentation, etc. It is a combination of OpenCV C++ API and Python language. In our project we are using OpenCV version 2 OpenCV is used to gesture control to open a camera and capture the image. It is also used in the image to text and voice conversion techniques.



b) RaspbianOS:

This provides considerably quicker performance for applications that build serious use of floating purpose arithmetic operations. All different applications will gain some performance through the employment of advanced directions of the ARMv6 electronic equipment in Raspberry Pi. Raspberry Pi was first introduced by microphone Thompson and Peter, it has also benefited greatly from the enthusiastic support of Raspberry Pi community members who wish to urge the utmost performance from their device.



VII. ADVANTAGES AND DISADVANTAGES

A. Advantages

- Door automation system can reduce the time spent at the opening and closing the door manually.
- The system can detect any kind of theft.
- More secure due to face detection.

B. Disadvantages

- The System requires constant power supply.
- It does not give the correct result when the lighting condition is very poor, i.e., when the lighting condition in the environment is very dim/dark.

VIII. RESULT

The experimental results show two different cases like if it is an authenticated person then the door will be opened automatically and in the case of an unauthenticated person the door will remain closed and with the help of the GSM an SMS will be delivered to the user. The snapshot of the authenticated person is taken. The captured image is compared with the image in the database, by extracting the eigenface and eigenvalues. With these options, the image is set to be a genuine one. Once the image is declared to be an

authenticated one, then the door of the system will be opened automatically. Sometimes an unknown person may also enter, this cannot be avoided but at all times everyone will not be aware of the intruder. For this type of situation, this model proposes a solution. If the captured image is an unauthenticated person, then an SMS will be automatically generated to the owner and also a snapshot of the unauthenticated person is sent to the owner and the door will remain closed until the owner gives the permission. Face recognition system has been developed so as to review the potential application for machine-driven door access management. Among the other biometric techniques, the face recognition approach possesses one great advantage which is user-friendliness. The technique of Eigenfaces has been applied to the system which makes the system more secure. A cost-effective and SMS operated home security system has been designed and tested with the GSM network.

IX. CONCLUSION

The design of the face recognition system using Raspberry Pi can make the system 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 free to do software development on the Linux platform. We use the Haar cascade algorithm for the face recognition and detection process. Also, send a security alert message to the authorized person using the GSM module. A face detection system using Raspberry Pi was designed. The system was programmed using Python programming language. Both Real-time face detection and face detection from particular images, i.e. object recognition, were carried out. The efficiency of the system was examined in terms of the face recognition rate.

X. FUTURE WORK

- In the proposed system, we have not used any type of alarm for reporting intrusion.
- Here we used the pi camera for capturing the image which is not suitable for different light conditions.
- Logitech C920S pro web camera is the future enhancement of the proposed system which gives effective results under different light conditions.
- Smart things compatible alarm system is the future improvement of the proposed system which notifies intrusion by a loud alarm.
- The proposed system will be further extended to provide the notices from long distance by providing the internet connectivity which will allow the system to update notices, anywhere in the world.
- If a blacklisted person tries to open the door, the system will send a message to the admin using the GSM module regarding the same.

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