Face Recognition Door Lock System Using Raspberry Pi

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Abstract: The purpose of this paper is to provide a lock system where no physical contact is needed to open a door lock. Typically, a normal lock system requires a contact whether it is a lock-key or biometric system. The system doesn't require any type of physical contact with the person which is a necessity in this Covid – 19 situation. In the system, we need to collect the pictures or face data of the persons who have permission to open the lock. The camera module will capture the person's face when a person comes into close proximity to the sensor connected to this system. That frames then will be compared to the whole database of faces stored by admin, if it matches any of those faces then the lock will be open otherwise an alert message is sent to the user through SMS with the image of the intruder. Through the system not only an admin can see the face of the person at the door, but an admin can also control the whole system through a different place. The system can be controlled through IoT. Hence, providing extra security and service to the user.

Keywords

Face Recognition, Raspberry Pi, Lock System, IoT.

1.0 Introduction

A high-security system is needed in day-to-day life which can save us from security deft. Today we have so many issues related to this which can be solved by updated technology. We have moved from fingerprint to face recognition to enhance security. Facial recognition is already being used in various industries and corporate sectors.

The lock system is mainly based on face recognition. A good quality camera is used to detect the images and trained the system and store the processed data in the databases. If the image is matched with the user/owner/admin then the lock is locked otherwise an alert message is sent to the owner to take further action regarding it.

Our daily life is all about smart devices. IoT allows us to control things over the internet which opens so many ways to enhance the technology we are using or the simple ways we were doing things. Face Recognition is a very complicated process due to its unstable characteristics. Example: Someone has stored its image with glasses and trained the system according to it. But when facing the camera without glasses, it will have some impacts on its result. The study of open CV and its inbuilt libraries helps to generate a code that will authenticate and provide greater efficiency. This will improve the whole security system.

Raspberry Pi is a series of low-cost, programmable computer consists of GPIO pins to control external input and output devices. This system can be used to create IoT solutions. Similarly, in this system admin can control the door lock from any other place with the help of IoT through mobile, PC, or any other system.

1.1 Related works

There are many proposals for Face Recognition System for security as well as others in the literature. [1] In Implement Face Recognition-based Android Application to Take Student attendance, The system will record the attendance of the students automatically present in the class and update the faculty through the application. They can easily access the information of the students present in the class rather than spending time taking attendance.

[2] There is also another example like Face Recognition for Criminal Identification is a face recognition system. It uses CCTVs to monitor criminals and identify suspects. In implementing CCTV - Based Attendance Taking. The system uses CCTV to detect the face and then store the data in a database.

[3]In Implement "Comparative Analysis for a Real-Time Face Recognition System Using Raspberry Pi". This approach analyzed various algorithms on the face recognition system. This analysis took LBPH (Local Binary Pattern Histogram), Fisher Faces, Eigen Faces Algorithms for comparison and checked with different processors to know the time-complexity and accuracy of various algorithms. This approach is very secured and without a matching face no one can access that door.

1.2 Preliminaries

Face Recognition: Face recognition is a method of identifying an individual identity utilizing their face. This technology can match a human individual face from a computerized image or a video frame against a database or in real-time.

OpenCV: OpenCV is a very large open source library use for computer vision, machine learning, and image processing it also plays a major role in real-time operation. This library provides us tools for processing and analyzing the content of a computerized picture.

Dlib in Python: Dlib in python is used for facial mapping, it uses the pre-trained models to identify the different facial landmarks. It calculates the location of 68 coordinates (x, y) which maps the facial points on an individual face.

Requests: Requests is the powerful tool which permits us to send HTTPs request to any API in the world utilizing python and returns Response which has a response header and response data, if applicable.

1.3 Implementation Details

This paper mainly consists Data Gathering, Training the Recognizer, and Face Recognition.

In the first phase, the authorized data of face samples will be collected. For this, we have to take a frame and detect faces. For detecting images, we are using open cv and dlib with Raspberry Pi. After detecting the faces, we will extract the face along with resizing the image. Then, the extracted image will be saved in the database.

In the second phase, the training of recognizers will be done for the saved face samples. for this process, we will take each image from the database and encode that particular face. Finally, the facial encodings of each person will be saved in binary files with the names of the persons. Now, these encodings will be used in the recognition process to identify the owner and the intruder.

In the last phase, the real-time face recognition will be done using trained data. For this process, a real-time frame will be taken and the face will be detected. To capture images, we are using a camera module with Raspberry Pi. Now the face sample is preprocessed and analyzed. After analysis, the data will be stored in the database. Now the process of comparison of all the stored samples with the newly obtained sample will be carried out. It will search out for the best matching person id. If the match is found, then the person standing outside is authorized hence the lock will get unlocked otherwise a security alert will be sent to the authorized person through SMS along with the image of the intruder.

1.4 Flow-Chart/Methodology

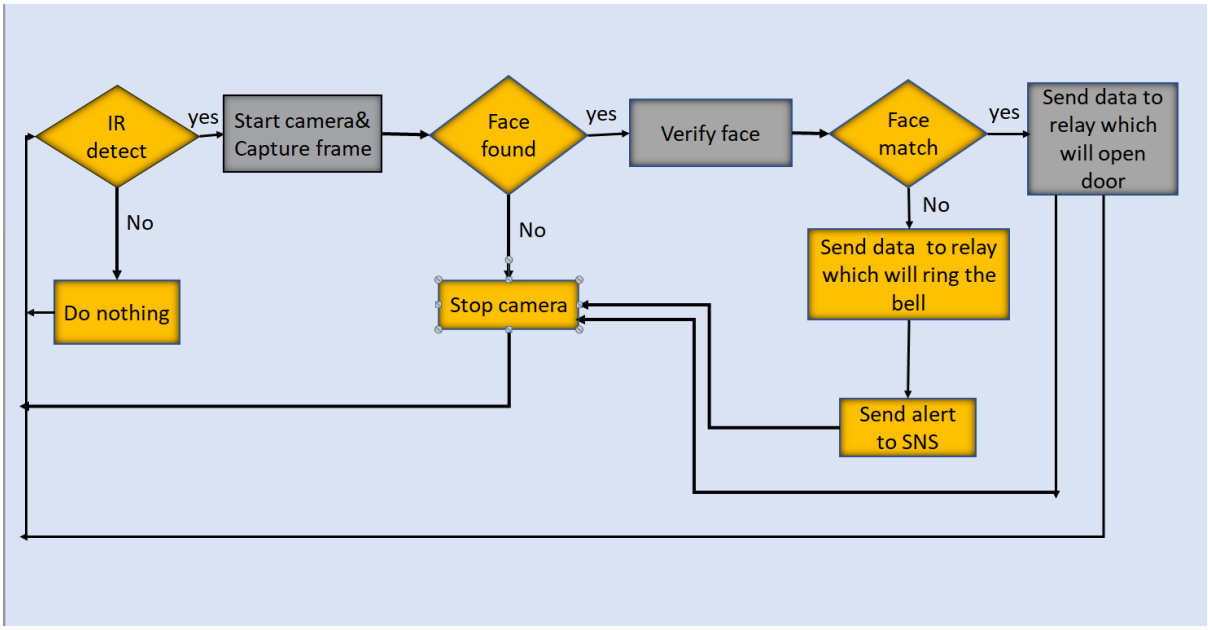

Fig 1: Flow Diagram of the proposed system

In fig 1, the flow chart is shown which describes all the processes in the proposed system. In this system, the camera takes the frame when IR detects something and compares it with the database where all the trained data is present which is

done previously by the admin. If the image captured matches any stored database image then according to the coding in raspberry pi, it will open the door otherwise sent an alert message to the admin and further required steps can be taken by the admin.

2.0 Result

Below table shows the result analysis of the system

TIME	No of Faces	Normal Face		Face with specs		Face with cap		Face with mask	
		Pass	Fail	Pass	Fail	Pass	Fail	Pass	fail
Morning	5	5	0	5	0	5	0	2	3
Afternoon	5	5	0	5	0	5	0	1	4
Evening	5	5	0	5	0	5	0	0	5
Night	5	4	1	3	2	4	1	0	5

Table1: System Result Analysis

All the modules present in this proposed system are individually tested. Mainly capturing an image to detect a person's face depends on the quality of the camera used to take the real-time frame. If the resolution of the camera is increased then it is found that the efficiency of the system is also enhanced. If the person's image is matched to the database then the door will unlock and access will be granted to that person. When a person's image is not matched then it will send the alert message to the admin. Different no. of images can be added to the database without any difficulty. The door lock is demonstrated by a solenoid actuator which has been powered here by a battery.

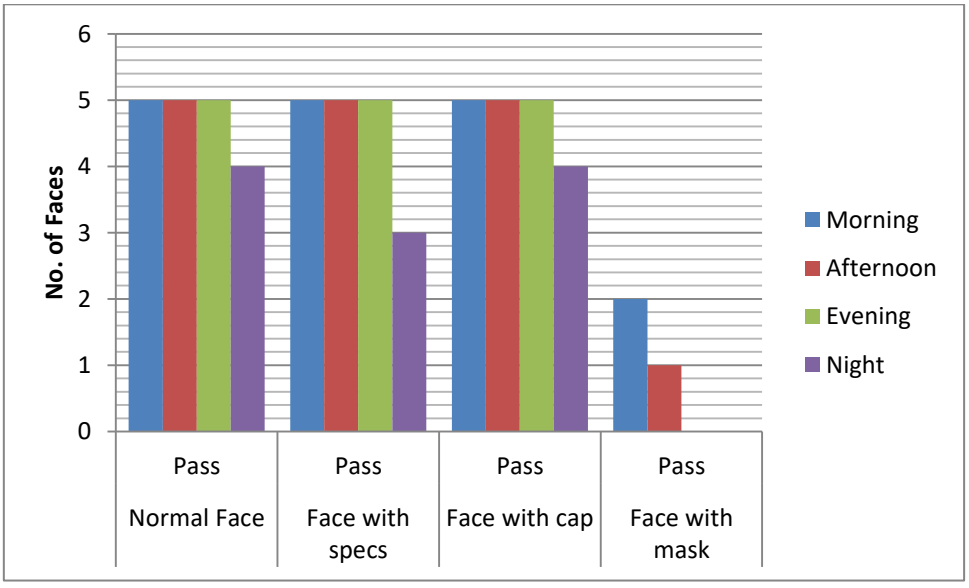

Fig2: Comparision of results analysis taken at different time in a day.

3.0 Conclusion

In this paper, we presented a lock system based on Raspberry Pi. We have used face recognition technology for recognizing people. The proposed system uses a webcam for capturing the image of the person in front of the door. It uses open CV and dlib for face recognition. In the case of an unknown person, it sends the security alert to the admin. The success rate of this system in recognizing face images of the person in front of the door is high. This automated lock system is highly secure as it uses face recognition. This system can be used for residential as well as commercial purposes.

4.0 References

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