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Face Recognition using Raspberry Pi

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Abstract: Modern day security related concerns require modern solutions. With the advancement in technologies and proper knowledge, it has become easier to gain access to one's id, password and passcodes by snooping, fishing, hacking, eavesdropping, and stealing which remains the same and forms base foundation to do malpractices. Hence, there is a constant threat to security, be it personal (if required), organizational, institutional, and so on. We need an approach that will address these security related concerns of systems that require passwords, passcodes, and RFID cards which can be tricked. This can be achieved with the help of technology called facial recognition.

Keywords: Face, Image, Recognition, Raspberry Pi, Feature Extraction.

1. INTRODUCTION

Face is a part of human body which is unique for every other human. It is possible to build a facial recognition system using Raspberry Pi 3 model B+ and Picamera which is cost efficient. In addition of being compact, with the help of machine learning, it ensures the password (if required) is entered by the authorised person otherwise it will display whether the person is authorised(known) else gives intruder(stranger) alert message along with the alarm if required. When facial recognition is applied along with or without passcodes, the system becomes more secure and hence cannot be tricked and, in that manner, unauthorised person will not gain access to sensitive information which is confidential and hence fraudulent activities can be prevented.

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Literature Survey

Shetty A. et al. [1] suggested face recognition as a method for the purpose of identity verification. The three suggested steps for the same as follows: (i) To create database with pics of trustworthy or authorized people. (ii)Utilizing the database for the training of face recognizing system. (iii) To provide test data in order to check it's accuracy. Ahmad A. et al. [2] implemented Pi Camera Module V2 which was interfaced with Raspberry Pi. The python library used for the proposed system is OpenCV. Suggested classification algorithm used for face detecting is Cascade Classifier. Thony IDE for python was used to run the program. Ijaradar, Jyotirmaya & Xu, Jinjing [3] proposed a system that can have a focus over regions of the face only. The algorithm used to achieve this purpose is Local Binary Pattern Histogram (LBPH) and Haar Cascade. Barik S. et al. [4] utilized the face detection and recognition as a security measure that has abundant support for python which is adapted by this proposed system by combining both image processing and machine learning as one. Sajjad M. et al. [5] suggested that portable and compact devices like Raspberry Pi can be used to make face recognition systems that can enhance the law enforcement related services being an accurate and efficient device when trained properly. I. Gupta et al. [6] implemented a model that eradicates the use of passwords & RFID cards in order to gain access to secured and permitted areas like office buildings, etc. by utilizing detection techniques like Haar. N. Mustakim et al. [7] suggested a method that works accurately despite the changing conditions of light associated with different environments or areas by utilizing various python libraries that includes NumPy and OpenCV helping the proposed system to make errorless inferences. P. A. Harsha Vardhini et al. [8] referred to use python codes with the implementation of open computer vision for face location framework that ensures the security.

2. PROPOSED METHODOLOGY

For this project of facial recognition, we have used Raspberry Pi model 3 B+, being cost-effective it has rich support for python face recognition related libraries. We have used libraries like imutils, face recognition, openCV which has haar cascade classifier embedded in it as algorithm for this system.

5V power supply was used, 16GB micro-SD card for installing operating system, Pi camera V2 module of 5MP was interfaced with Raspberry Pi model 3 B+ through CSI port.
The operating system used for this project is Raspberry Pi OS Buster (Legacy). It was installed on micro-SD card using micro-SD card adapter through Raspberry Pi Imager software (Headless mode: via laptop) that converts it into bootable device which is then inserted into Raspberry Pi.

Raspberry Pi is nothing but a credit card size minicomputer and not surprisingly also has unique Ip address like other devices. Ip address of Raspberry Pi was determined and by establishing SSH connection, pi's terminal access was obtained. Desktop instance was generated using VNC software.

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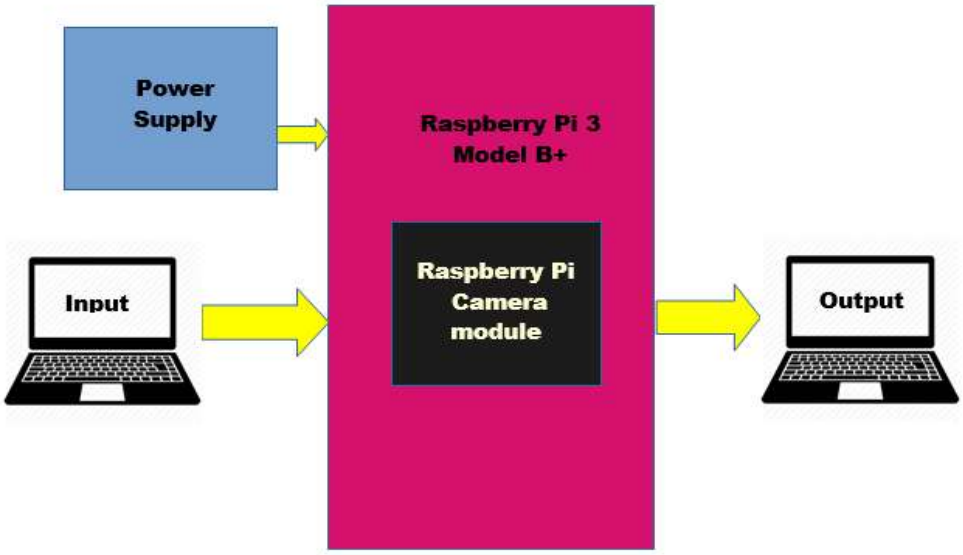

Fig 1: Design of face recognition system using Raspberry Pi (Headless mode)

Steps followed for facial recognition are:

1. Face Detection:
Face detection is the process of focusing only on facial regions of the human body by discarding all other areas.

2. Face Pre-processing:
Face Pre-processing speeds up the detection process. This includes resizing, orienting, and color corrections.

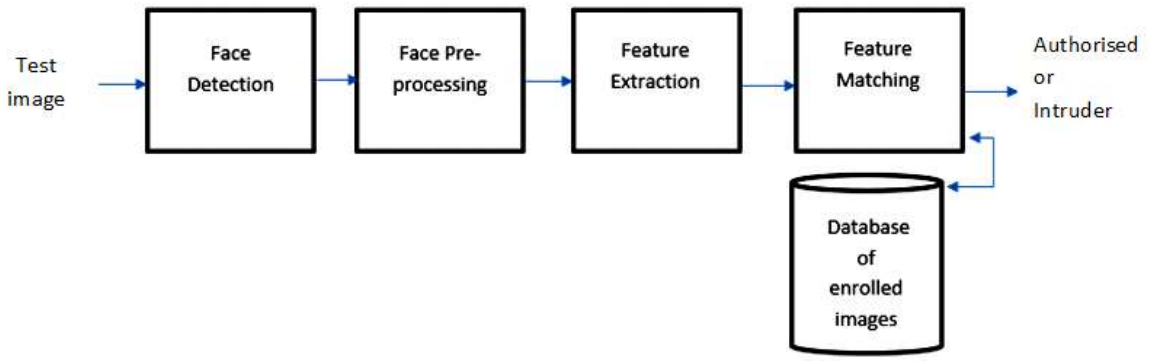

Fig 2: Methods of face recognition system

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3. Feature Extraction:

It is the process that separates out face component features like nose, mouth, and eyes. It is crucial for the initialization of processing techniques like face recognition for obtaining the face print or face id.

4. Feature Matching:

It is the process of comparing the face print of a given dataset with that of an existing dataset and giving inferences accordingly whether matched or not.

3. RESULT & DISCUSSION

Facial recognition for authentication is more reliable because face is a unique feature of human body that can be easily differentiated between individuals. Face recognition does identification as well as verification. The Pi camera captures the image of the face and uses the same for the training of the system.

When a machine is trained on a particular dataset, it accurately gives output for the next instance of test data identifying similar matching characteristics and features. Human beings can be tricked but not the trained machines. Facial recognition is one of the biometrics technologies that are often studied and developed for safeguarding resources.
Outcomes of this project as follows:

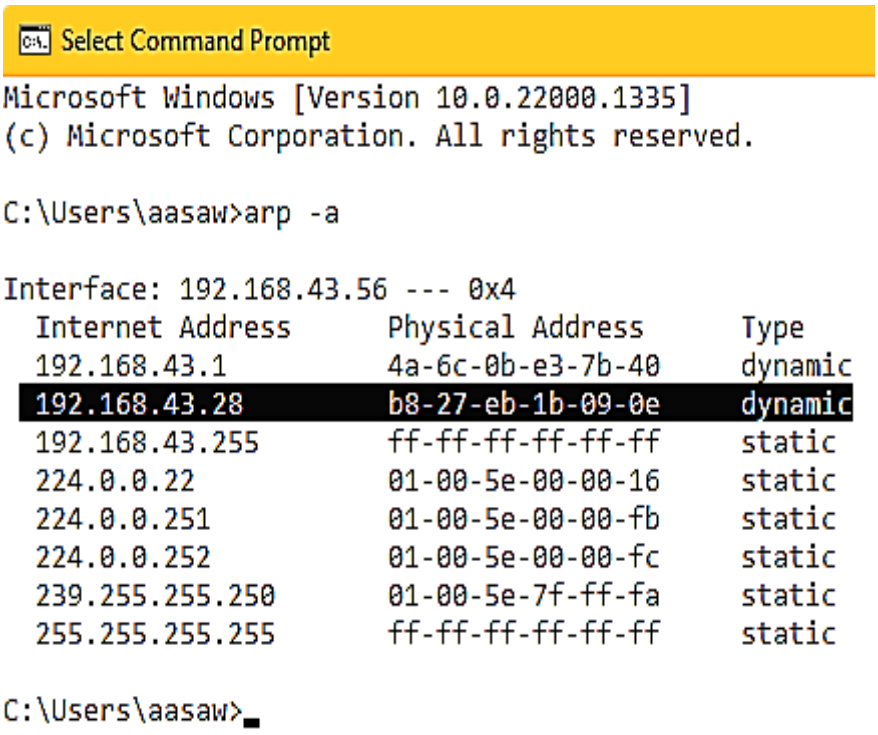

Fig 3: Ip address of pi was obtained

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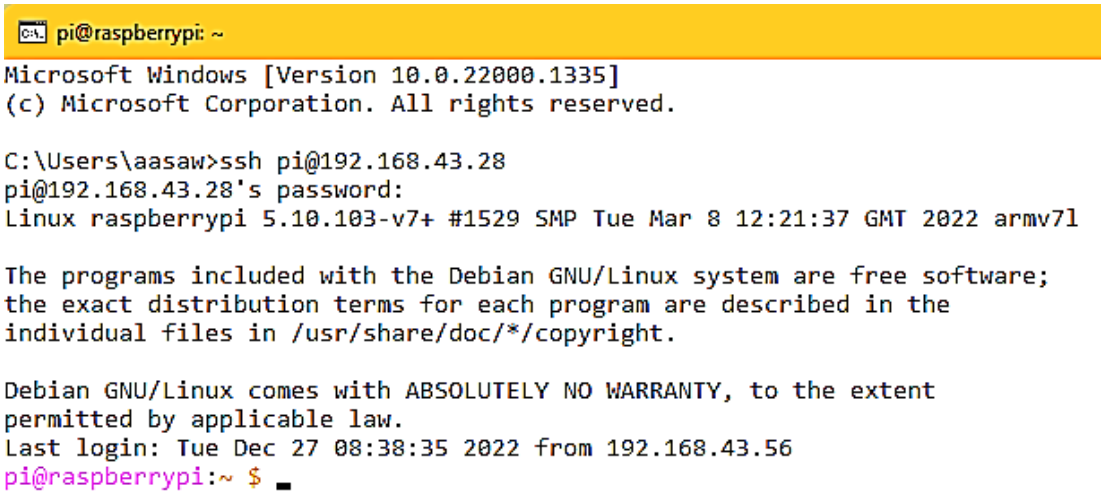

Fig 4: Terminal access via SSH connection

After getting the terminal access of raspberry pi, system configurations are done, and desktop view is accessed with the help of VNC- Virtual Network Connect Software. Such a mode of getting access to pi's GUI is called Headless mode.
Before getting access to desktop via VNC, it is mandatory to authenticate pi with user-id and password.

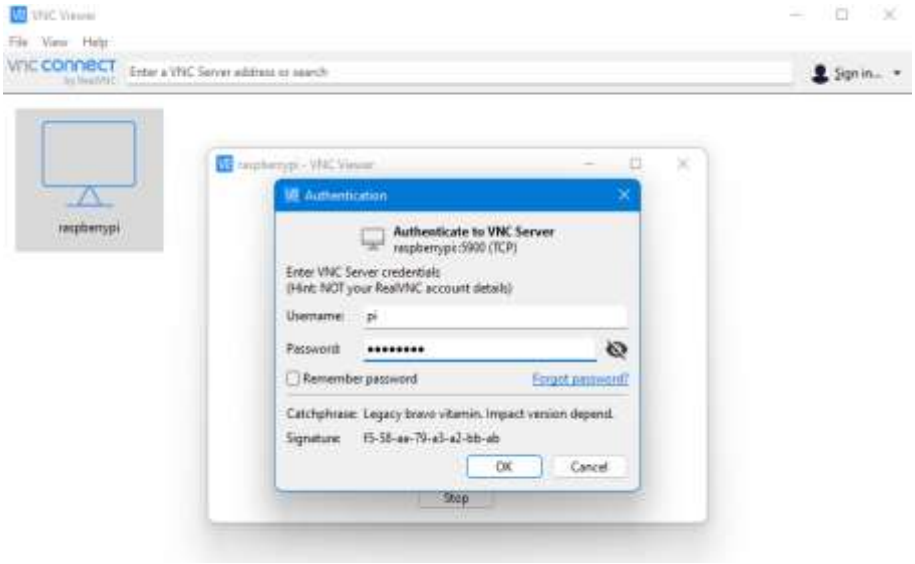

Fig 5: Authentication for VNC remote desktop access

After the generation of desktop instance using vnc commands, it is accessed using VNC software. The GUI for Raspberry Pi is as below. The folders with pics of authorised persons are saved as databases which are used in training the model.

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Fig 6: The Raspberry Pi desktop

The system recognises the face of person whose database is already present in the system during training and alerts the owner by identifying the face of person as Unknown or unauthorised whose data is not saved in the system.

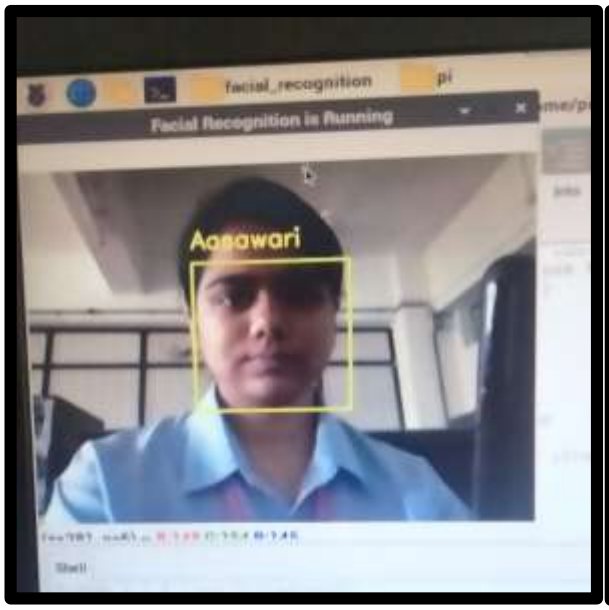

Fig g: Authorised person

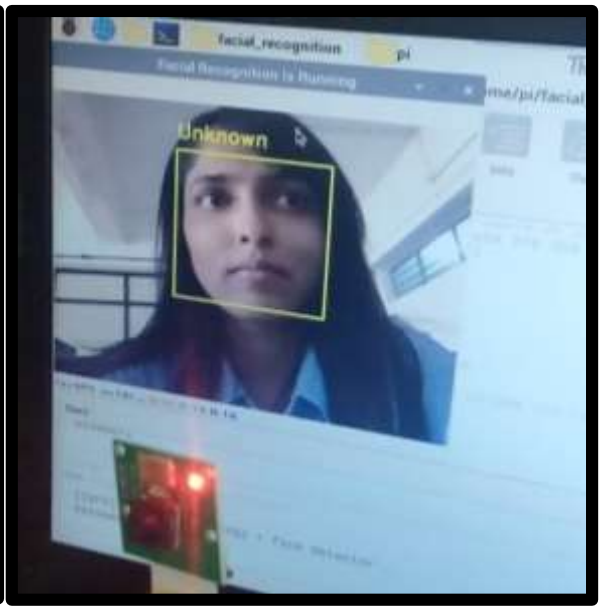

Fig h: Unauthorised person

4. CONCLUSION

From the proposed design we can conclude that an approach to detect and recognize faces of people is made and whenever an intruder or unauthorized person is detected, the system alerts the owner by displaying message. Hence the designed system successfully prevents access to any unknown person and ensures safety.

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