Image processing based intruder Detection using Raspberry PI

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----------ABSTRACT----------

The current paper is mainly about maintaining a secure environment and also free from thefts that are happening in our home. The present paper discusses about the detection of intruders with the help of the various devices and software...OpenCV(open source computer vision) is the major software that is being used in our present work. For detecting faces we are using various algorithms like Haar cascade, linear SVM, deep neural network etc.The main method that we have proposed in our work is, if any person comes in front of the pi camera, first it will look for potential matches that we have already stored in our system If the module finds a match then it continues to record until any intruder comes. If the face is not recognized then the unknown person's face will be captured and a snap shot will be sent to the user's email. The device is developed using Raspberry Pi b+ with 1.4 GHz quad core processor, raspberry pi camera module and a Wireless dongle to communicate with users's email.

Keywords **- OpenCV, Rassberry pi, python**

I. INTRODUCTION

Real time human identification systems are very important for security, surveillance and also for biometric applications. There are numerous approaches to identify, track and recognize individuals in open territories, for example, air terminals, shopping malls and in zones with limited access, for example, private workplaces, houses and so on. Human recognition should be possible from their fingerprints, face, iris, palm prints, palm veins and so on. Notwithstanding, for quick and helpful individual recognition, still the most appropriate biometric parameter is facial data. Distinguishing proof of people by utilizing facial biometrics is as yet difficult assignment, because of the variable illumination, changing outward appearances as indicated by inclination changes, head introduction and posture.

Throughout the years, different face recognition algorithms have been created. Some face recognition techniquesexamine the geometric highlights of facial pictures, for example, area and separation between nose, eyes, and mouth. Be that as it may, these techniques are delicate to the adjustments in illumination and outward appearance. In view of this drawback, the greater part of the face recognition systems attempt to separate some complete featuresfrom the first face images for comparing and matching.

MayuriDahake and N.N.Mandaogade have proposed face detection and recognition system that is capable of processing images very fast while acquiring very high true positive face detection rates[1].

Object location additionally assumes a noteworthy job in distinguishing human faces. Object recognition frameworks have been tried crosswise over different standard face databases, with and without noise and other obscuring effects[3]. Efficiency of the framework is regularly broke down by computing the Face location rate for every one of the database. The outcome of Object recognition frameworks uncover that it very well may be utilized for face recognition even from low quality pictures and shows astounding execution productivity, monitor threats, and avoid/examine criminal activities addition to face detection motion detection is always an important requirement...Nowadays, the Closed-Circuit Television (CCTV) observation framework is being used so as to keep harmony and give security to individuals. There are a few deformities in the video reconnaissance framework, for example, picture is undefined, oddities can't be distinguished consequently, a ton of extra rooms are expected to spare the observation data, and costs remain generally high[3]. The haar-like highlights is utilized for face discovery and HOG +SVM calculation is utilized for face recognition. So as to accomplish a higher exactness and viability V.[4]Desmukh have utilized OpenCv libraries and python PC languageIn the present work raspberry pi,raspberrypi camera and OpenCV are utilized to distinguish the interlopers and furthermore to communicate with the client.

II. RELATED WORK

Closed-circuit tv(CCTV): CCTVs have proven to be hugely popular for security functions because of their low cost performance and smooth functioning . Surveillance could be very useful for regulation enforcement to analyze and save you crook sports, for recognizing and monitoring threats. Also, surveillance systems have continually been playing a vital role in managing the burglary instances. These CCTV structures generally tend to monitor any activity continuously. This consequences in excessive

power consumption and large memory usage. Moreover, it does not give alert on any suspicious activities detected. Radio Frequency Identification (RFID): It uses radio waves to routinely identify individual or gadgets. There are many techniques for identification, however the most trendy is to store a unique serial number that identifies a human or object on a microchip that is attached to an antenna.. The blended antenna and microchip are called RFID transponder or RFID tag and it works in combination with an RFID reader. The reader antenna is used to transmit radio frequency (RF) power. Depending on the tag type, the energy is harvested by the tag antenna and used to power up the internal circuitry of the tag. The tag will then modulate the electromagnetic waves generated by the reader so as to transmit its data back to the reader. The reader receives the modulated waves and converts them into digital data.

III. HARDWARE AND SOFTWARES USED

The Raspberry Pi board[fig:1] is the principal module of the image capturing and and processing device. Its most important parts consist of: primary processing chip unit, memory, energy deliver HDMI Out i.e.. VGA display, Ethernet port, and USB ports. The Picam is hooked up to Raspberry pi through digital camera port that is present inside the raspberry pi board.The version that we've got used is raspberry pi B+ 2017 which is shown below in fig.1 .We are also using a wireless dongle which is connected to one of the usb ports available. The Raspberry Pi is a fundamental embedded machine having a credit score card-sized board computer systems developed within the UK with the aid of the Raspberry Pi Foundation[2]. The Raspberry Pi is primarily based on the Broadcom BCM2835 gadget on a chip (SOC) which incorporates an ARM1176JZF-S Core (ARM V6K)seven-hundred MHz CPU processor, Broadcom Video Core IV GPU having 17 pins, three.5W of electricity, and 1GB of RAM reminiscence. This major processing chip connects a camera and display. The Raspberry Pi layout does not include a constructed in hard disk or solid drive, as a substitute it uses an SD card for booting and long term storage. This board is meant to run Linux primarily based running systems. Python is the main language utilized in raspberry pi .This Raspberry Pi module has a Samsung elegance 4 micro SD card preloaded with the Raspberry Pi NOOBS (New out of Box Software) bundle, and a printed Micro SD card adaptor. The os that we have used in this work is raspian stretch.

Fig 1:Raspberry pi board

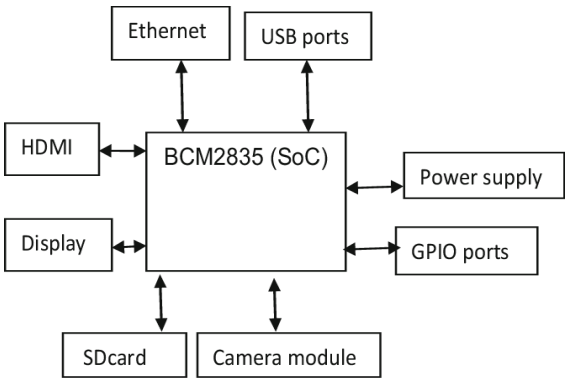


Fig. 2:Raspberry pi Block Diagram

IV. CAMERA INTERFACE

The raspberry pi camera module used in this paper is shown in Figure. 3. The camera module plugs to the CSI connector on the Raspberry Pi. It's able to deliver clear 5MP resolution image, or 1080p HD video recording at 30fps. The camera module attaches to Raspberry Pi by a 15 pin Ribbon Cable, to the dedicated 15 pin MIPI Camera Serial Interface (CSI), which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high datatransfer rates, and it exclusively carries pixel data to the BCM2835 processor.

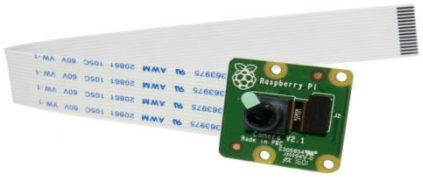


Fig 3:Raspberry pi camera module

V. SOFTWARES USED

5.1 OpenCV

OpenCV 'open source PC vision library' is an open source picture preparing library made by Intel 8109 what's more, kept up by Willow carport accessible for C, C++, what's more, Python. OpenCV is need a compiler like DevC++, code squares, visual C++. In this paperutilizes python dialect furthermore, DevC++ compiler. In OpenCV there are four modules. Predominantly utilized are CV: primary OpenCV capacities, picture handling calculations, vision calculations and highgui: GUI capacities, Image and Video I/O. Utilizing this OpenCV, we will stack pictures caught by camera. These pictures are in three configurations paired picture, dark scale picture and shaded picture. The hued picture contain R G B with pixel values containing 0-255. It has profundity of the picture with 8 bits and 3 channels. For stacking the picture utilizing OpenCV, the taking after program is utilized[2].

5.1 NGROK

Ngrok creates a tunnel from the public internet to a port on your local machine. You can give this URL to anyone to allow them to try out a web site you're developing without doing any deployment. It captures all traffic through the tunnel. It displays information about the HTTP traffic for your inspection. Raw request/response bytes, parsed headers and form data, JSON/XML syntax checking and more are included. It can also replay requests. By default, ngrok will use ngrok.com as a third-party relay. This service is provided at no-cost and without registration but it is possible to get additional features by signing up in the service (which is pay-as-you-want kind). However, it is possible to setup and use its own server. This package installs the client part of ngrok. It can be used directly with ngrok.com service or with your own server if you install the ngrok-server package

VI. METHODOLOGY USED FOR FACE DETECTION

6.1 Deep Neural Network

Neural systems are a lot of calculations, demonstrated freely after the human mind, that are intended to perceive designs. They translate tangible information through a sort of machine discernment, naming or grouping crude information. The examples they perceive are numerical, contained in vectors, into which all true information, be it pictures, sound, content or time arrangement, must be deciphered.Neural systems help us group and characterize. You can consider them a grouping and order layer over the information you store and oversee. They help to assemble unlabeled information as per similitudes among the model sources of info, and they group information when they have a marked dataset to prepare on. (Neural systems can likewise extricate highlights that are nourished to different calculations for grouping and order; so you can consider profound neural systems as parts of bigger AI applications including calculations for support learning, characterization and relapse.).

6.2 Neural Network Elements

Profound learning is the name we use for "stacked neural systems"; that is, systems made out of a few layers. The layers are made of hubs. A hub is only a spot where calculation occurs, inexactly designed on a neuron in the human mind, which fires when it experiences adequate boosts. A hub joins contribution from the information with a lot of coefficients, or loads, that either intensify or hose that input, in this way appointing importance to contributions as to the errand the calculation is attempting to learn; for example which input is most useful is arranging information without mistake? These info weight items are summed and after that the whole is gone through a hub's supposed actuation work, to decide if and to what degree that flag should advance further through the system to influence a definitive result, say, a demonstration of order. On the off chance that the signs goes through, the neuron has been "enacted."

Here's an outline of what one hub may resemble

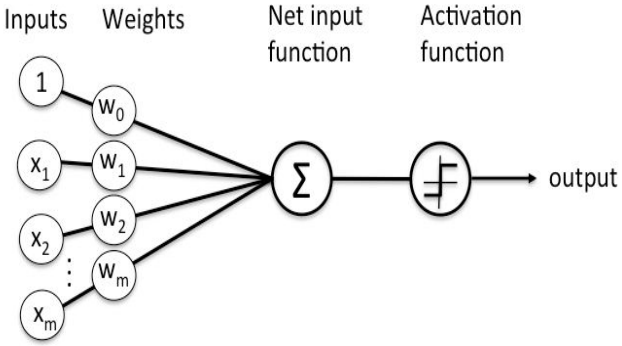


Fig 4:Elements of neural networks

A node layer is a row of those neuron-like switches that turn on or off as the input is fed through the net. Each layer's output is simultaneously the subsequent layer's input, starting from an initial input layer receiving your data.

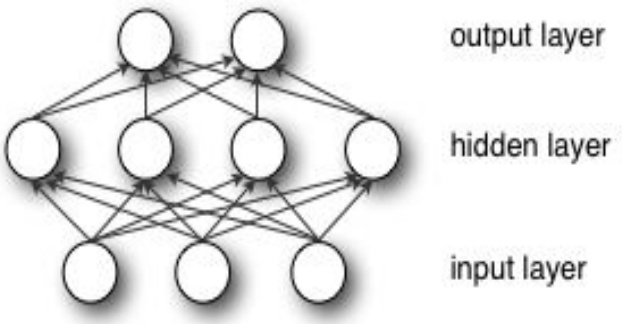


Fig 5: Structure of neural network

Blending the model's flexible loads with information highlights is the way we dole out hugeness to those highlights concerning how the neural system characterizes and bunches input.

6.3 Haar cascade

Face identification is a PC innovation that decides the areas and sizes of human faces in subjective (advanced) pictures. It recognizes facial highlights and disregards whatever else, for example, structures, trees and bodies. Face recognition can be viewed as a progressively broad instance of face confinement. In face confinement, the errand is to discover the areas and sizes of a known number of appearances

6.4 Haar features

OpenCV's calculation is at present utilizing the accompanying Haar-like highlights which contributesto the fundamental classifiers:

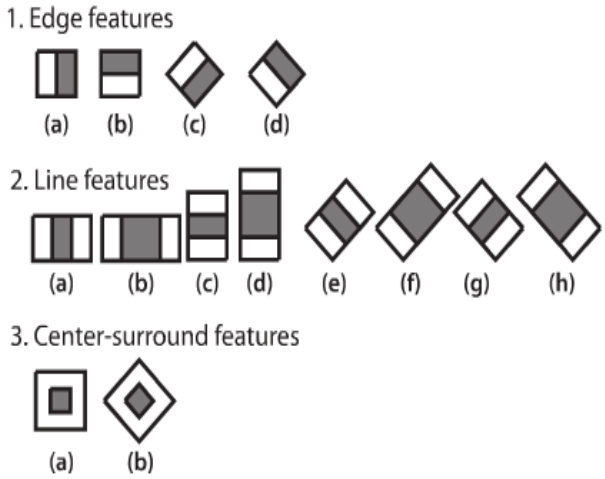


Fig 6:Haar Cascade

6.5 Cascade of Classifiers

Rather than applying all the 6000 highlights on a window, amass the highlights into various phases of classifiers and apply one-by-one. (Ordinarily initial couple of stages will contain less number of highlights). On the off chance that a window falls flat the main stage, dispose of it. We don't think about outstanding highlights on it. On the off chance that it passes, apply the second phase of highlights and proceed with the procedure. The window which passes all stages is a face locale.

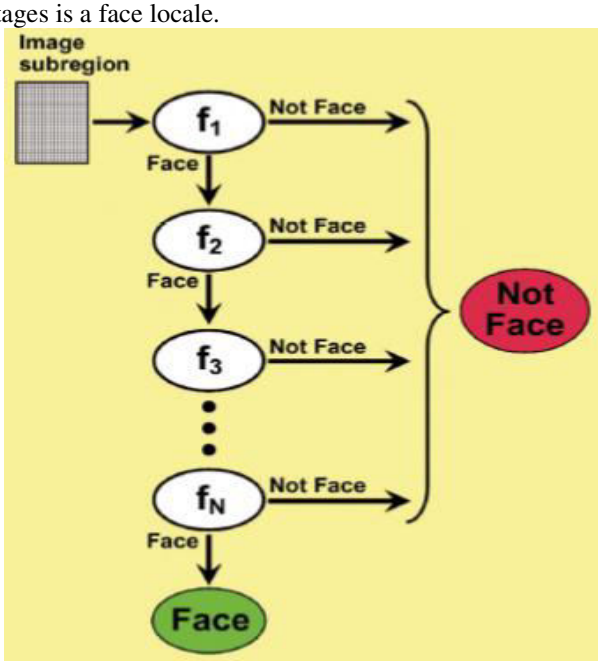


Fig 7:

VII. RESULTS

The testing is done using raspberry pi platform with the following specifications:

- Quad core 64-bit processor clocked at 1.4GHz
- 1GB LPDDR2 SRAM
- 5mp Raspberry pi b+ camera module
- Bootable SanDisk Ultra 16GB micro SD Card

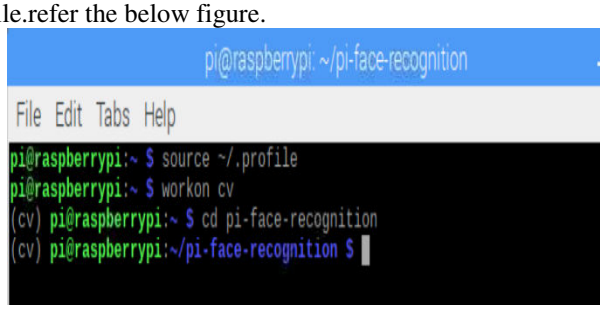
7.1 Steps followed

- Firstly, we need to install the raspberry os onto the sd card
- connect all the components to the hardware
- login to the raspberry using vnc server
- connect the dongle to the raspberry pi

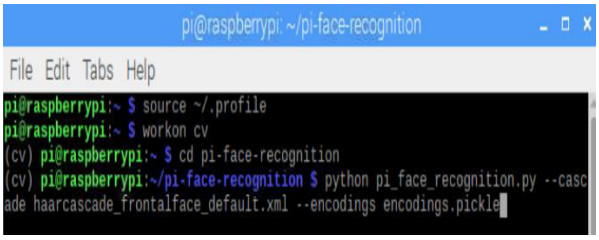
7.2 Command used for setting up the OpenCV and to run the required python file

Initially,all the OpenCV modules are separately installed on a virtual environment.so,our first step is to type the command as given below

After getting into the virtual environment,we need to change the directory to where we have saved our python file.refer the below figure.



Final step is to run the required python code as shown below.



FLOWCHART

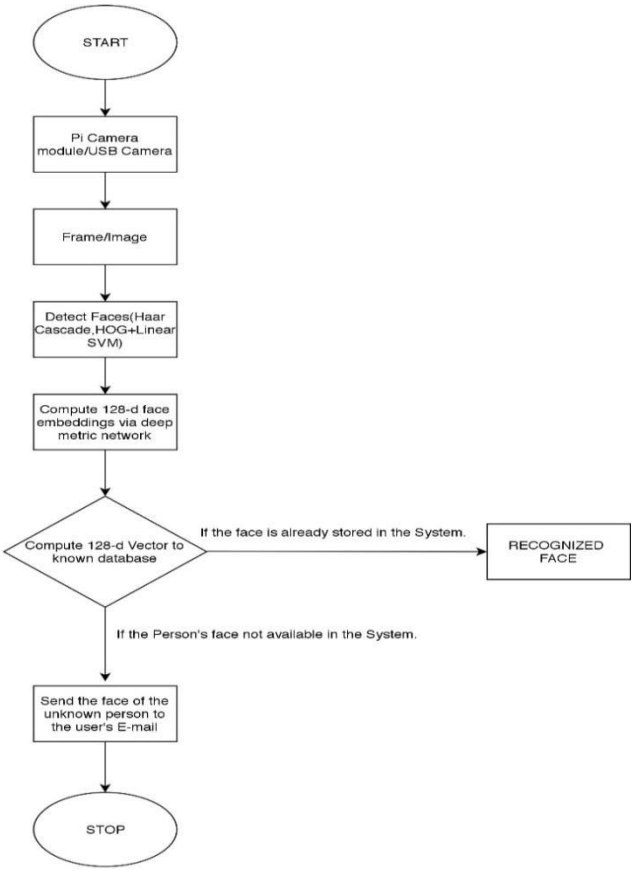
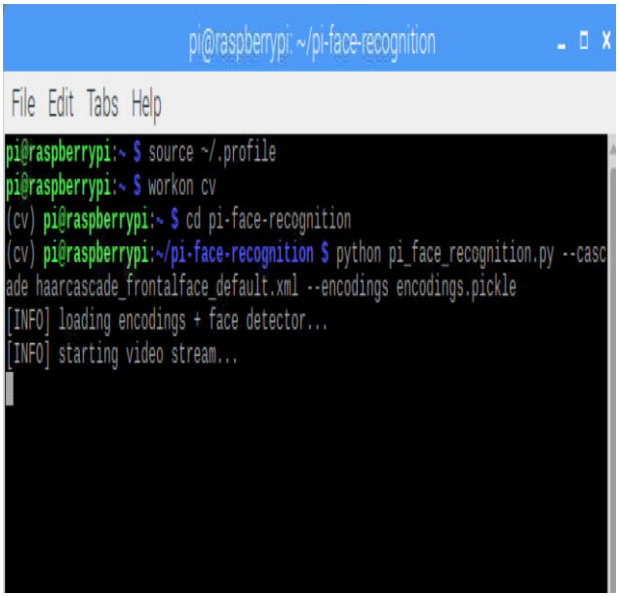


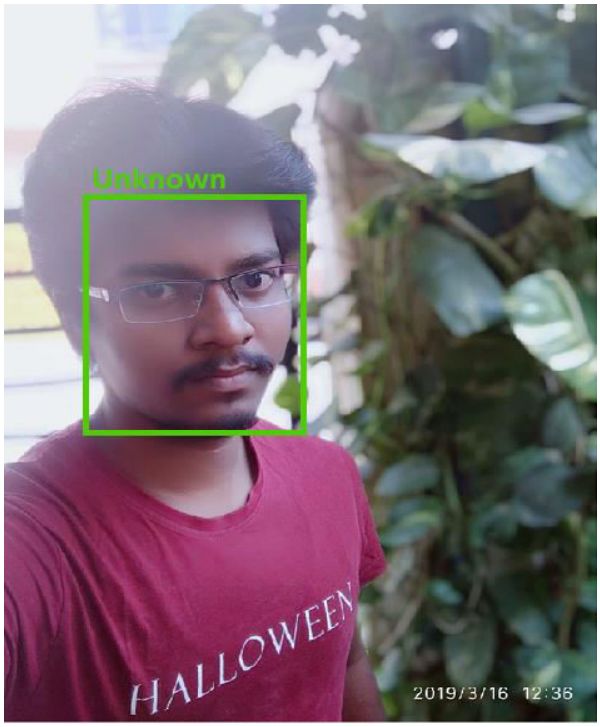
Fig 8: Flowchart

In our project,the main python file that we will running is the pi_face_recognition.py.all the execution part happens in this python file.

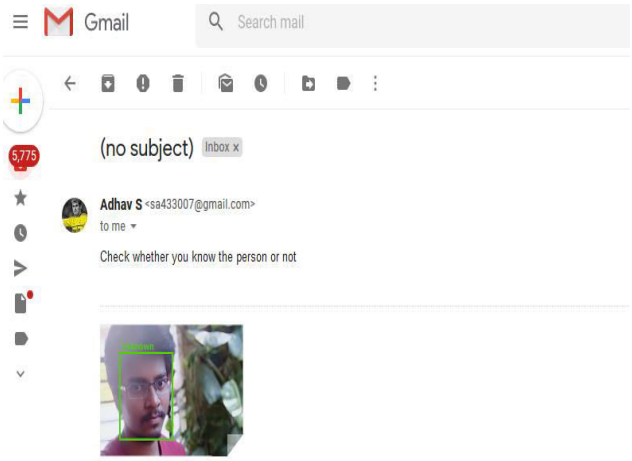
7.3 Execution



In this figure the python script is loaded.



After the script is loaded the face will be recognized.If the person's face is unknown then that persons face will be sent to the users email.



A photo of the intruder will be sent to the user's email.

VIII. CONCLUSION

From the current work we can able to develop a cost effective surveillance system, system which recognizes face efficiently without any delay and sends the email to the user immediately,if it detects any intruders.

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