Automated Unlocking of Door upon Face detection

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Abstract — *The main aim of the paper is to develop a program code of face detection and dump it into the microcontroller specifically the raspberry pi series so that it executes the program and evaluates whether or not to unlock the door with the help of a motor. Primarily the face picture is taken with the help of the Universal Serial bus driver (USB) webcam which is connected to the microcontroller, the current image checks the predefined database of images that was previously stored. If the previous image is matched with the current image the motor executes a twist which opens the door or else the door remains locked .The algorithm used for face recognition is Cellular Neural Networks(CNN).Generally the labs and confidential cabins, where precious information is stacked , needs a high security so that no other third party can access the room hence this project helps to detect the faces of members of the group and only allows them inside. The security can be enhanced by varying the locks (high level) instead of a motor.*

Keywords — *Face detection, Face recognition, Cellular Neural Network, False rejection Rate, Rpi(Raspberry pi).*

I. INTRODUCTION

Generally These days we have a number of sophisticated rooms or cabins with a lot of confidential data belonging to a group or any official data that nobody wants it to get leaked, so the complexity of confidential data is directly proportional to the level of security required to safeguard it i.e. The more complex and high alert the data is the more secured it should be. The current generation consists of people who want to succeed pretty easily hence in order to succeed they may involve in any malpractices, which primarily includes hacking. Hence there is an urge to secure such cabins which otherwise if goes to wrong hands may lead to wrong deeds, we must have a secured safeguarding system which a particular group only has the access to and no other random people can trespass through. The whole projects if divided to steps contains , analysis of requirements, specifying the components required , choosing the apt components , segregating the algorithms and choosing the required algorithm, testing the web camera, circuiting the components and running a trail. The requirement have already been sorted out

II. SORTING OF COMPONENTS

The various components used to carry out this experiments are presented as follows.

A. Raspberry pi Microcontroller model B+

We go for raspberry pi microcontroller and not for any other like Arduino because it has the ability to perform faster and also according to the main concept of the paper, to capture a picture, which requires a camera input into the microcontroller and that is not supported in Arduino like microcontrollers.

Generally we have a series of microcontrollers in Raspberry pi like the Raspberry pi model A which has only one USB port and offers only 256MB of RAM. Raspberry pi B+ microcontroller offers 512MB RAM which enhances the speed of processing and additionally it has 3 USB ports, 1 Ethernet port and a HDMI port as shown below.

Fig .1 Raspberry pi B+ Model (source: raspberry.org)

B. Raspberry pi camera or USB webcam

A USB camera is better compared to Raspberry pi camera keeping the cost aside (rasppi camera is costlier) the flexibility of usage is more for USB webcam as it is not mounted to the controller.

Fig.2 USB Webcam (source: Google)

C. Servo Motor

The third main part of the project is the motor

which controls the locking of door, any motor preferably servo motor is used for our project.

The motor is connected to the microcontroller and the codes executed by Rpi results in twist of the motor or to remain as it is.

D. Auxiliary components

- A laptop or a system interface to code the pi preferably an analogue monitor and a keyboard mouse so that it can be processed readily , a laptop might also work but we may have to have SSH and PUTTY software installed which acts as interface between Rpi and laptop

- A breadboard and few jumper wires with both female and male wires to perform the connections, few resistors, pushbuttons.

III. PREPARING A CIRCUIT CONNECTION

The components have been sorted out according to the requirement now is the next step of assembling the components i.e. building a circuit. The paper being discussed is a software oriented one hence the software i.e. developing a code needs more effort compared to hardware assembling.

A .Basic circuit connection

The proposed circuit diagram for the project is as shown below,
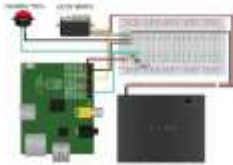

Fig.3 BasicCircuit Diagram (Source: Rpi.org)

As depicted in the circuit diagram the servo motor is connected to the rpi GPIO pins and also to the 4 x AA batteries via a breadboard.

Here the only change is , we use a push button initially to capture the image as soon as the face is detected .Our aim is to,

1. Connect the servo's signal line to GPIO 18 on the Raspberry Pi. Servo motor power and ground should be connected to the battery holder power and ground.

2. Connect one lead of the push button to Pi GPIO 25, and through the 10 kilo-ohm resistor to the Pi 3.3 volt power. Connect the other lead of the button to Pi ground.

3. Connect both the battery ground and Pi ground together.

4. Mount the Pi camera through the hole in the top of the box and attach the cable to the Pi or a USB webcam via USB port.

IV.CODING

The algorithm that we choose is the CNN or cellular neural network algorithm .The CNN algorithm is good enough to find human faces effectively while it also executes accurately. In computers and machine learning, the cellular neural network is a procedure of communicating with the neighbouring units. It finds itself in variety of applications like analysing 3D models, partial differentiators, image processing etc.

For face recognition, the first step is to detect the presence of human head. In video processing it means real-time because this is only the first filtering of the frames. The method should have low false rejection rate (FRR).We give a simple colour based detection algorithm in section three.

Head detection is the next step in the procedure. For detecting the human head we could use more complicated features. CNN algorithms can help for the feature extraction. Further step bears a complex task, capturing the face, the face should be normalized and aligned. The process up until to this stage requires about half of the computation time of the whole face recognition. It needs space and processing power in a traditional way, therefore if this normalization can be speeded up, the time of the whole procedure will be reduced proportionally. The CNN is an appropriate tool for performing this task

The procedure it follows is shown in the flow chart, it first detects the face and separates it from the background image, it detects the presence of head by normalizing it and it represents the face then the next step is it compares the faces with the previous database and matches it
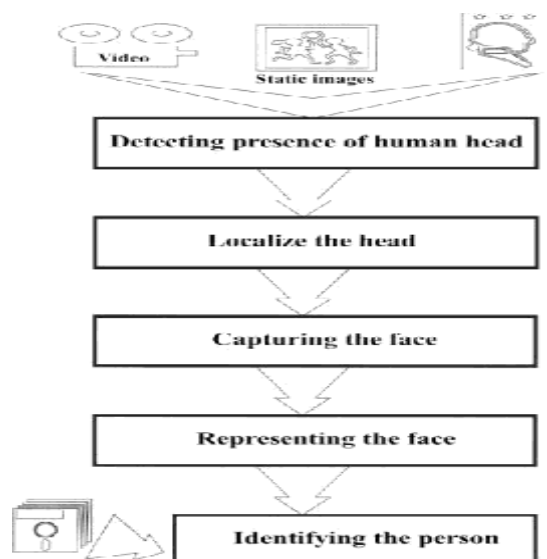
Fig.4 Algorithm for Coding

A. Head detection

Head may consist of many features and one must be able to determine the key points or reference points present which comes under feature extraction i.e. determining the features that can differentiate a face from another face hence the CNN algorithm helps determine the exact features present on the face unlike Eigen face algorithm or Fischer face algorithm, which involves calculation of Eigen vectors between eyes to nose, nose to mouth and vice versa.

B. Face normalization and alignment

One efficient part of face recognition is the eye detection since each pair of eye differs from another pair of other hence the key point is to detect the eye, while the eye is determined, the position of mouth nose can be easily determined with the CNN algorithms i.e. setting the origin at some point and determining the distances from the nose, mouth to the origin. While the data is interpreted in groups the overall face should be normalized hence one of the key feature is to normalize the face, the origin point is the key point and the eye axis is taken as another key point.
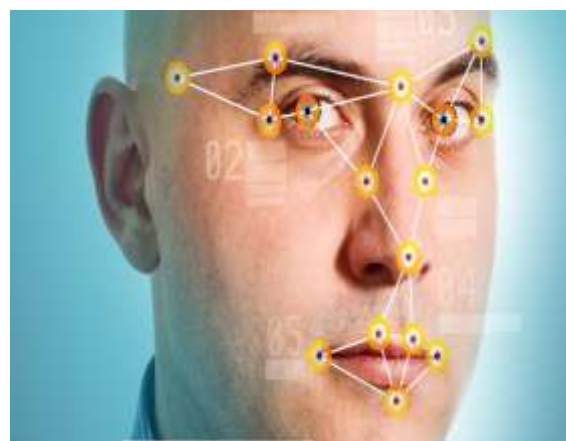

Fig.5 Face normalization CNN (Source: Google)

V. EYE DETECTION AND LOCALIZATION

As discussed earlier, the eye is the important aspect of face recognition, one might feel difficult to propose the algorithm for eye detection compared to head detection because it is too small, the difficulties being to determine the eye position according to head tilt, and to determine whether the eye is open closed or in which position, often it is difficult.
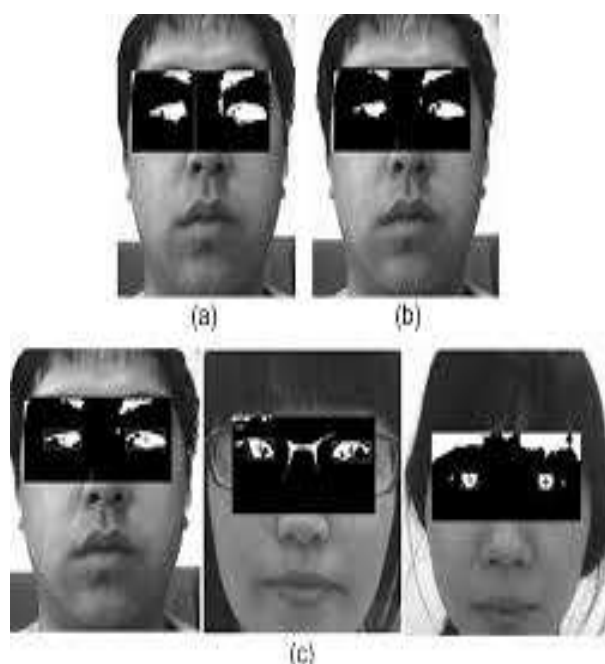

Fig. 6 Eye detection and normalizing (Source: Google)

The different eye sets are compared with the background colour so that to differentiate it from face, the black and white of iris and pupil in eye makes it different from face when viewed in grayscale. Once the eye set are differentiated it is normalized with respect to the reference point on the face. The distance between the eye sets and the

reference points varies for different individuals, hence it gives a higher advantage of face recognition.

Eye being an important aspect in differentiating faces of different people is primarily processed for any face detection algorithm.

VI. CONCLUSION

This method of automated unlocking of door is a modern approach for security management. This method can be installed in Safety measures in bank lockers, where only when the customers face is detected the locker opens up, in the same way this concept which is now applied only to electronic gadgets such as cell phones and laptops, the aim of this paper is to substantiate its use various fields usage. Though at present this system suffers from certain drawbacks such as providing access to similar looking faces etc. By enhancing the Code, it will reduce such drawbacks up to some extent, for this paper this could be added to the future scope.

So far the microcontroller by the raspberry provides functioning and processing of videos and media, once accessed properly makes the microcontroller a user friendly one. The Rpi microcontroller supports programming languages functioning requires a good knowledge in programming language, once lost somewhere may become a tough challenge to overcome. The resolution of the cam used is also to be kept in mind since it may induce image noising and disturbances
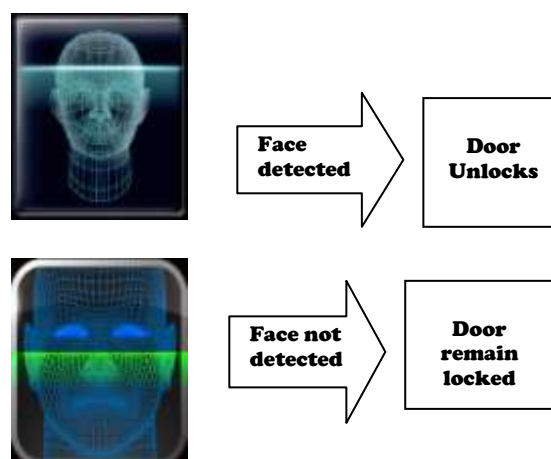
Fig. 7 Conclusion image

VII. REFERENCES

1. An Improved Face Detection and Recognition Method Based On Information of Skin Colour for Security System". International Journal of Engineering Trends and Technology (IJETT).

2. "Human Face Recognition using Elman Networks ", International Journal of Engineering Trends and Technology (IJETT)

3. "Cellular Neural Network "theory IEEE

4. A handbook on how to proceed with Raspberry pi microcontrollers

5. Face and eye detection algorithms by D N Balya Online support www.raspberrypi.org

www.opencv.org for opencv image processing

6. A handbook on starting and initiating   Raspberry.

7. Neural network based face detection by Baluja s and Kannade T from ieee explore