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Smart Door using Raspberry Pi

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Abstract: Face detection gives us a decent level of security in our systems but it has been observed it is not safe enough as it may recognize people by their photo. We tried to combine all the security features in one system to provide better security system. In this paper, we propose a Face recognition framework along with extra security features like fingerprint scanner. This system comes with extra biometric security along with the features of existing systems. The combination of different security features makes it more reliable than other existing features.

Keywords: LBPH algorithm, Face recognition, Door lock, Raspberry Pi, Pi camera

I. INTRODUCTION

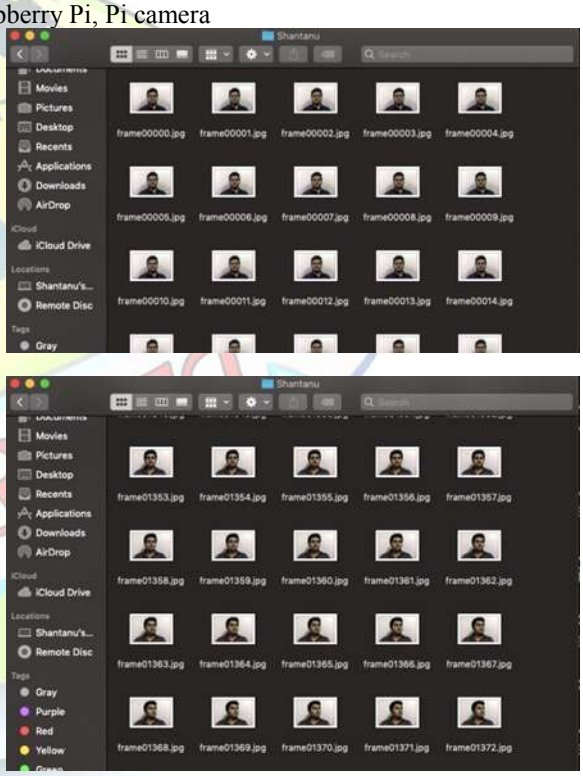
Face recognition system could be a reliable security feature but it has been observed that the Local Binary Patterns Histogram algorithm (LBPH) face recognition may recognize a person by its photo and the level of accuracy also decreases as the facial features such as hairstyle, beard or expression changes which can degrade the level of security that we have using the above face recognition algorithm.

Hence, we need to add some security feature which will give us the most accurate result and something which will never change irrespective of the conditions. Fingerprint is one such feature that we can add to our system, Even if someone uses a photo of the authorized person and the system is not able to decide whether it was a photo or and actual person, the system will ask for another security check which is fingerprint and to trick someone's fingerprint is nearly impossible. This will give us a system which will have high level security.

II. PROPOSED METHODOLOGY AND DISCUSSION

We first used the **Inception v3** model made by Google which gave us decent results but with some disadvantages. The approach with the Inception model was as following:

To train the model with our own dataset, At least 500 images per class was required. It was achieved by recording a video of about 10-15 seconds and making individual frame a single picture. Thus, a class with 2000 images was formed. The video was captured with different facial orientation and in different lighting conditions.



Capturing images in different facial orientation and different lighting conditions helped the model to provide more accuracy.

The training took about 20-25 minutes but it may also vary depending upon the system hardware. We used **OpenCV** for taking a Realtime image of our faces from our **Web Camera** and then identify that image from the retrained model.

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After running the python script, it takes a real time picture using the Web Camera and checks whether the image of the person in front of the camera is recognized or not.

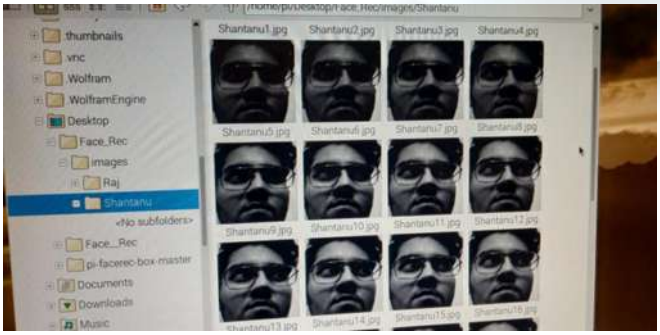
```
Recognised as Shantanu!
shantanu 0.8192518
(base) Shantanus-MacBook-Air:Face_ID shantanugabhane$
```

In our case, it was able to give us accurate results to tell whether the person is recognized or not. It also gave a probability of the correct result every time we ran the script.

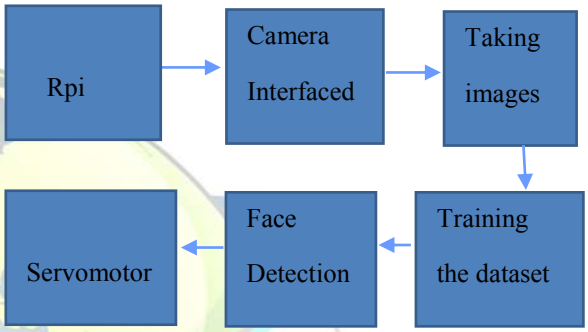
But the pretrained Inception models are trained on images of animals, objects etc. [2] but not on human faces. Hence, although it was able to identify any one human face but it was not very successful to distinguish between two different human faces.

So, we used one of the most popular **LBPH algorithm**. "*LBPH* is one of the easiest face recognition algorithms. It can represent local features in the images. It is possible to get great results (mainly in a controlled environment). It is robust against monotonic gray scale transformations" [1]

It was able to recognize multiple faces accurately even with very less dataset as compared to the Inception model. Our Python script took real time photos of the face of the person when we made a new dataset of any person. It took about 500 images per dataset. It was able to recognize faces even with around 50 images per person but to improve the accuracy and results we took 500 images in different orientations and lighting conditions.

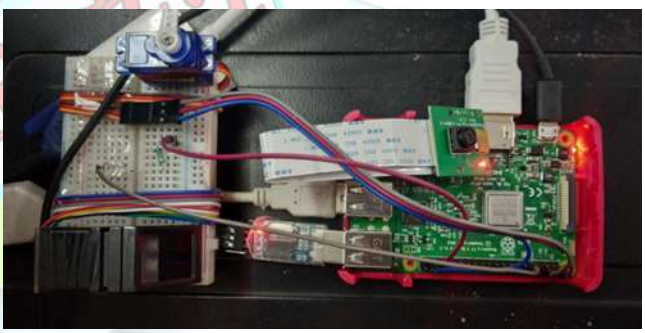


Training the dataset also took very less time when compared to the other models we used. It took few minutes to train the model. We trained the model in **Raspberry Pi**, if we train the Inception model on Raspberry Pi then it takes about an hour to train. Therefore, The LBPH algorithm was much more efficient in training. This is why it is still widely used due to its computational simplicity and discriminative power in many different applications.



III. WORKING

Our circuit consist of few components, Raspberry Pi, Pi camera, Servomotor, Fingerprint scanner.



First, when we run the Python script, it takes a real time photo and checks whether the person in front of the camera is one of the authorized persons or not and gives the probability value along with the result.

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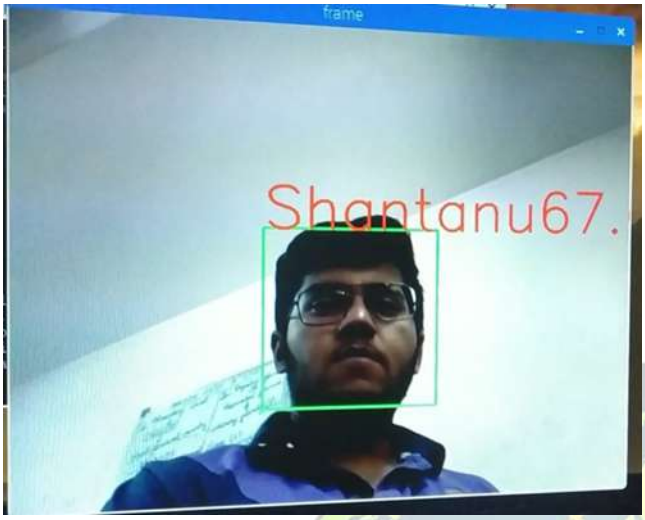
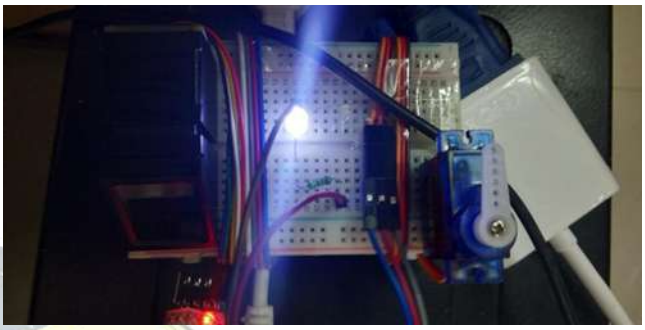
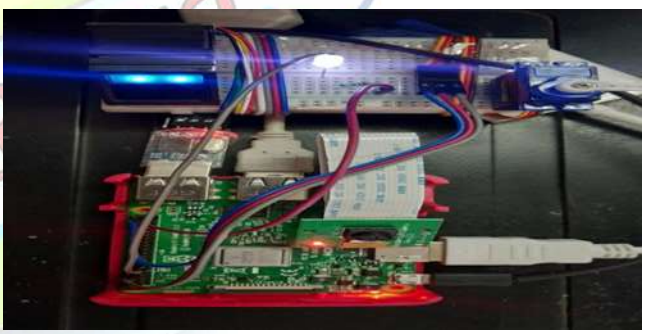


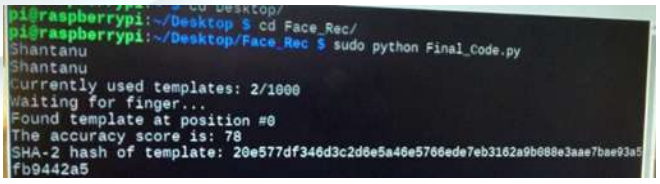
But, we have observed that in some cases if the lighting conditions are good enough, this model fails to give us enough security as it may also recognize the person through there photo. We took a picture of the person and showed it to the camera and it recognized the person and that too with a higher probability value.

This could be a major security concern for the projects that have been made based on LBPH algorithms. So, we added something which cannot be easily tricked by someone i.e., Fingerprint. A fingerprint scanner will act as a secondary security which will provide our Smart Door enough security. After the Face is recognized, The LED glows and waits for the user to scan their fingerprint.



Now, when the fingerprint of the user successfully matches with the database, the servomotor rotates by 90˚ and let the door open.





IV. CONCLUSION

The Inception v3 model works great but it was not able to distinguish between two different persons. Whereas the LBPH algorithm can distinguish between two persons but have some limitations as it was not able to distinguish between a real person and its photo. We added fingerprint

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scanner as an additional security which cannot be tricked easily. Thus, Making a reliable door lock in our "Smart Door".

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