

# Analysis of different models for Face Recognition Door Lock

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**Abstract:** The home security is necessary for every residence. There are many kinds of door locks that are present in the market like lock with keys, passcode, or pattern. After switching towards these types of modern locks the problem with security and privacy become less. By using IOT platform and deep learning technique we had introduced facial recognition door lock system. In this survey paper, we are presenting different approaches of facial recognition door lock such as using Face recognition using Raspberry Pi, Face recognition using deep learning techniques along with the other types of evaluation techniques.

**Keywords:** Facial Recognition, Internet of Things (IoT), Raspberry pi, Home Automation, Deep Learning

## I. INTRODUCTION

Currently, home safety is a major issue. The home security system ensures for security and privacy for every residence. In past five years. In terms of the security purpose and it is very essential to have a security system in the residence, for a reason of safety purpose. Most of the countries steadily develop their home security system. Foremost part of home safety system nowadays is to have a modern facial door lock to enter and exit the house. In past year people uses old types of door lock for their home security system. Earlier the security system can be access with a key, password, and ID card. The facial security system is a unique system for security purpose. Biometric system used dedicated hardware as scanner for fingerprints, face, the DNA analyzer etc. This system requires an access to touch hardware to obtain data of human matchless features. One of the most secure verification is the Biometric security system, giving us a more security than old security system. Face recognition is more secure technology than fingerprint characteristics. Facial system door lock is more relevant because face cannot be change, stolen and borrowed verification between individuals. As we know the face detection should be the first step for the face recognition system.

We can catch a face picture with a web cam even face is at distance. The person can be recognized easily without any physical and using special hardware to have a access of human identification. In this deep learning technique has been used for the face recognition. Deep learning is one of the most important approach of machine learning based on learning of data representation, learning can be managed, unsupervised. Using deep learning, system is improved day by day. Some images of the person are being saved in the database because the system at the time of open door lock it

can identify the right person by checking in the database the image of that person. The accuracy is increased. Some examples are like home security could be considered as one of the finest examples of (IoT) applications. Internet of things is referring to the network that is associated to the corporeal objects that could be able to relate the information among itself without any need of human overruling. It uses the internet connectivity through which it is allowing the set in circuit to communicate with each other via the internet current structure so that it could be segregated from internet. It also allows operators to switch more than one device and have capabilities to systematize with many daily odd jobs. User can control the door access and sent notices throughout the internet using the internet of things. Type of the system which are being used are the Blynk apps. Blynk apps will allow us to get-up-and-go graphical interface in the apps conferring to the precise job to perform and helps in controlling the door access. Notifications alert are sent to computer and smart devices using Blynk app.

## II. IOT BASED FACE RECOGNITION DOOR LOCK SYSTEM BASED ON NEURAL NETWORK

“Face recognition is one of the most popular and the challenging topic in the field of the artificial vision and the recognition of patterns. In this project we have used Raspberry Pi as the main operating system for our face recognition system. At first, the raspberry pi camera will capture the face images of the user and then it will give it to the Raspberry Pi/ computer for recognition of the images. For the common the face recognition systems have been differentiated into two sets one is the dynamic matching and the other is static matching. In following system, the dynamic matching could be used when a video order is available. As the quality of the video images is low, resulting in the background is cluttered and more than one face present in the picture. There are several sources of inconsistency in the face recognition system. One of the main differences in the system is the image plane, pose variation, texture variation, lighting, shape change and background variation and many more. In this system, histogram equalization, principal component analysis and back propagation network are used to resolve these face recognition problems.” [10].

## III. FACE RECOGNITION USING CONTENT BASED IMAGE RETRIEVAL FOR INTELLIGENT SECURITY

In this paper, we are trying to create an smart security system by using face recognition technique. The sets of input

which we will be using in this research are related to the facade face images and facial images with their snag, and without snag. Our model uses an image retrieval system i.e. Content Based Image Retrieval method. More than 9,000 images used in the following project, which will be collected from the internet, database or pick directly from the main data. The data of these face images are usually being saved in the database and the other files based on the system must go along the process of identification and facial recognitions and others. Therefore, face images are being resolved using facial comparison techniques and in the other ways. All face images that are stored in the database and with their indexed. The repossession process was carried through matching the query images and the images which are in the database. Face images are stored in the particular database. This work organized the recognition technique by comparing it with the similar face images which are used earlier. When similarity result the same or fully 100 percentage distinguish by the system, or else the facial images will not be recognized by the recognizer. In the phase of recognition, the application could specify the shape of the facade face, performs feature withdrawal, and consecutively smartly similarly. This security system can be used to minimize the incidence of misdoing that are occurring nowadays. The following system could be cast-off such as for the door security for homes, airport gates, office doors and so on.

#### IV. FACE RECOGNITION USING RASPBERRY PI

The primary study on the face recognition system held earlies of 1950 in the sphere of psychology. The real work of programmed machinery for the acknowledgment of face images was taking place in 1970. In the entire research done, there were 2 types of face detection techniques. One which is used is the photo-based face detection and the other is video-based recognition. In the video-based face recognition there is a procedure of obtaining 3dimensional images, while the other photo-based recognition techniques in this process we will detect the faces of a person using camera. The Face Detection System is a structure which subsequently distinguishes and tests the uniqueness of a creature from the images that were captured using the camera. Lots of researchers prefer to use Raspberry Pi for the recognition purpose as it is of compact size. The major incentive of picking Raspberry Pi because of the components has low costing, high usage limit and its ability. By using the Raspberry Pi, it will help in resolving the inadequacy of the computer such as its mass as the computer is very heavy whereas the pi is light weighted, the size as it will consume more space on the other hand pi is of credit card shaped and high-level-electricity consumption. Raspberry Pi is a device which is a shaped of small credit card it which could distribute the computer software parts. One is for filming the pictures that, second is for training purpose, and other is for recognition of face. According to [5] and [3] to the extent that they organized the utilization of Raspberry Pi for the image capture system, the method becomes slighter, simpler, and easier it will also decrease the consumption of energy. Thus, it's more suitable to compare it to the computer-based face recognition system.

#### V. FACE RECOGNITION USING DEEP LEARNING

In the Facial recognition there are many problems like identifying and authenticating the people in a picture by their face that will be captured. The process is performed

irrelevantly by the person, even under the conditions of differing lighting and also thee changes made in the faces according to process of aging or congested with accessories like wearing shades, specs and their facial hair like when person has beard or same person when he is clean shaven. Yet, it is persisted a stimulating computer vision problem for decades until recently. The deep learning techniques can influence at very large datasets of their faces and then learn to rich and the compacted depictions of the faces, permitting modern replicas to first do as-well and later to outdo the face recognition abilities of the humans. In this project, you will also determine how to overcome this problem of face recognition. By using deep learning techniques, we could achieve prodigious performance. Facial recognition has a wide-ranging problem like in identifying or to verifying the user in the images and the videos. Facial recognition is a procedure which involves the detecting, adjusting the images, feature removal, and the recognition. Deep learning signifies the first approaches and then topped the human performance for the facial recognition step.

#### VI. FACE DETECTION USING VIOLA JONES METHOD

Face-recognition based upon the Viola-Jones algorithm help to transform an input image into a new image description known as integral. The used characteristics are similar of Haar Classifier fundamental functions. The Viola-Jones technique evaluates a 24x24 window using characteristics that are containing two or more frames. Each attribute results an individual value which will be computed by the sum of the white frame(s) and deducting it from the sum of the black frame(s). We will use integral representation for the fast processing of these above features. This can be achieved by making all the pixels corresponding to the total sum of all involved pixels. It will be computed by the following formula.

$$(x, y) = \sum_{x' \leq x, y' \leq y} i(x', y')$$

Where  $(x, y)$  is the part of the actual pictures and  $(x', y')$  is the part of integral picture. We can calculate the integral part picture in a single passage over the real picture by using the next pair of repetitions:

$$s(x, y) = s(x, y - 1) + i(x, y)$$

$$x, y = ii(x - 1, y) + s(x, y)$$

$(s(x, y))$  stands the aggregate sum row of  $(s(x, -1))$  and  $(ii(-1, y))$ . The next step is creating a classifying the classifier so to pick a handful of valuable characteristics using the Ada Boost learning technique. Ada Boost is a machine-learning enhancing an algorithm that is efficient enough for creating classifiers. So that  $x$  represents a 24x24 porthole of a picture, where  $p$  is the direction of inequality and  $f$  is the used feature, and  $x$  whether it is categorized as a real image or a nonreal image. The final classifier is obtained after using the Ada boost algorithm. The process to create a cascade classifier is shown in the below figure.

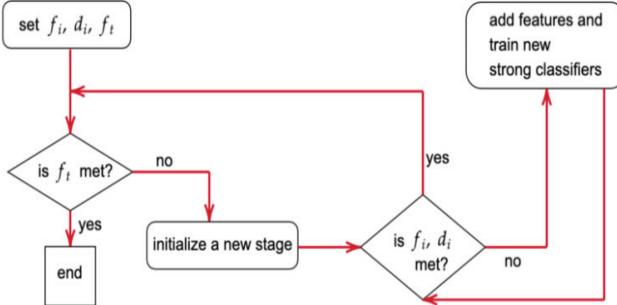


Fig. 1. The process to create a cascade classifier

Where  $f(i)$  is the maximum acceptable false positive rate per stage,  $d(i)$  is the maximum acceptable true positive rate per stage and  $f(t)$  is the target overall false rate.

## VII. PROPOSED METHOD

Firstly, the user is going to press the doorbell then the event is called, and the system will get started. In the next step the images of that specific user will be captured using the Raspberry pi camera and then the recognizer will do its job then the image is being under recognition part and if it is a known person the door will get open automatically and if it is an unknown or a random user then captured image is sent to the owner. If the owner recognizes then he can also give access to the door and the door will open. All these operations are ended with firebase stored in the cloud.

Figure 1 shows the overall block diagram of the system. When the person rings the bell and then door system starts working by capturing the person image using camera module used in our system, then the image is processed and then if it is a known person then the door will get open automatically otherwise it will not. If the user is an unknown person, then the system sends alert msg to the user and it is up to the administrator to authorize it if he/she authorizes the door will get open otherwise access is denied.

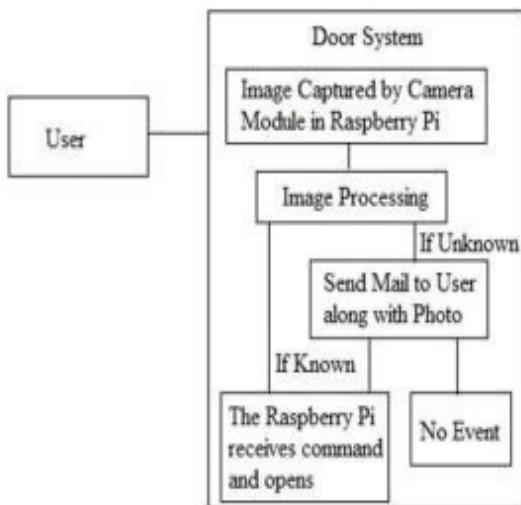


Fig. 2. Block diagram of door lock system

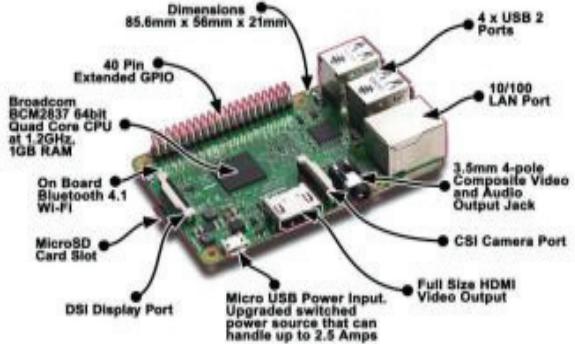


Fig. 3. Raspberry Pi 3 Model

## VIII. HARDWARE COMPONENTS

Raspberry Pi 3 is the main controller of this system. It is a powerful credit card shaped single board computer. It is the brain of our system to assist the Pi with handling the sensors and other components we are using Arduino Uno. It has a logic level of 5V on the other Raspberry Pi has 3.3V of Logic level. We are also using servo motors and to control it we have Arduino which has ability to generate powerful pulse width modulation signals. Although raspberry pi can generate the pulse width modulation, but the limitation comes when the adjusting its duty cycle in this case it is kind of inefficient.

We must use a power supply for the system so we will use 5V lithium-ion rechargeable supply and to recharge the supply we will use two 2000mAh lithium-ion batteries. It has output power of 20watt means 5V and 4A of current at instance through 2 channel each having 2A. We will supply the power to servo motor and LCD display from each channel. To operate the Raspberry Pi, we must use separate channel of power supply as it needs a steady voltage to perform well. So, we will provide 5V to them. Raspberry pi and Arduino both are connected through USB cable A to B. The important part for the system is the camera here we are using Raspberry Pi camera module.

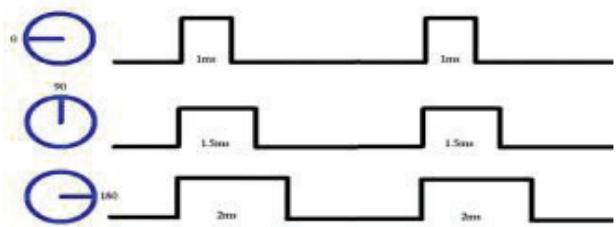


Fig. 4. Different PWM signals for Servo Control

The camera module which we are using in Raspberry pi camera is of 5MP which will be operated through a port known as camera serial interface which is on the Raspberry Pi. There is button to operate the camera i.e., a shutter button for the camera which is connected to the raspberry pi connected through a resister thus it will receive power from raspberry pi. As we know the lighting is the key factor for capturing images successful, so we are using 2 1-Watt LEDs. The overall power consumption of the system will be around

5Watt so we the supply that we are using can handle the load without any fault. If there is no electricity, then the system can run on batteries for approximately 4 hours without any failure and when the electricity comes the battery management system automatically switches the supply to quick power from power adapter of the batteries.



Fig. 5. Raspberry Pi Camera Module

## IX. SOFTWARE AND WORKING

We will use python programming for the implementation as python programming is the official language for Raspberry Pi. We will use OpenCV is a cross platform library it has predefined libraries for the face detection. Haar Classifiers algorithm is used to detect the faces from an images, Viola-jones and Eigen faces algorithm which are offered in many programming languages and mainly we will be using python programming.

On raspberry pi we will compile and install OpenCV after it is imported as module in python programming. Input images are captured by the module with the help of shutter which is connected to the raspberry pi.

In first step (face detection and data gathering) we will collect the face samples using raspberry camera that are authorized to open the door lock. After that in the second step (training recognizer) we will step the recognizer for the samples so to detect the images and at last step (facial recognition) the data we will input it will improve to recognize the faces. If the system recognizes the face the door will open automatically otherwise it remains unlock.

### A. Data gathering for the face detection

First, we will gather the data or images samples to train the classifier for that we must write the code in python programming which will take 30 different images of each person and store them with different label IDs using the pre trained classifier.

### B. Training the Recognizer

In this step we will train our recognizer as according to the data that we gathered in the last step of data gathering.

We will make sure to perform the face detection again to make sure that we have the right images, and we will prepare it for the training data. Ever steps will be implemented using a programming language here we will use python code to implement the recognizer.

### C. Using the recognizer for facial recognition

Using the recognizer which we have set up in the previous step to recognize the face. It will give the label ID how much the match is found to open the relay if the faces match up it will turn on the relay, then we will load classifier to detect faces and recognizer will predict faces and it will train the data. At last, we check the confidence (match found) if it is above 70 then only the door will open otherwise it will remain closed.

## X. CONCLUSION

In this paper, the techniques of facial recognition are discussed concisely. In this the project on the face recognition system it will be able to capture and recognize the face of the person and will send the alert notification to the user if the images that was captured and did not recognized through the recognizer. Although, this project still has a large area for the enhancement that can be done in future. Like mainly in the part of the efficiency of the image capturing and the processing part. It is because of the Raspberry Pi 3 that we have used in our project because it takes more processing time for the coding part of the process part like image capturing and its other operations. Whereas this project can be improved considerably by using any other module.

## REFERENCES

- [1] F. Bin Jamali & M. H. Jusoh, "Home security system using internet of things," 2017.
- [2] M. Sahani , C. Nanda, A. K. Sahu, B. Pattnaik, "Home security system based on face recognition," 2015 Int. Conf. Circuits, Power Comput. Technol. [ICCPCT-2015], , 2015.
- [3] K. Gopalakrishnan, G. Senthilkumar, V. S. Kumar., "Embedded image capturing system using raspberry pi system," vol. 3, No. 2, pp. 213-215, 2014.
- [4] M. R. Mulla., "Facial image based security system using PCA," pp. 548-553, 2015.
- [5] Y. Januzaj, A. Luma, Y. Januzaj, V. Ramaj., "Real time access control based on face recognition," in International Conference on Network security & Computer Science (ICNSCS-15), pp. 7-12, 2015.
- [6] S. S. Liew, M. Khalil-Hani, S. Ahmad Radzi, R. Bakhteri., "Gender classification: A convolutional neural network approach," Turkish J. Electr. Eng. Comput. Sci., vol. 24, No. 3, pp. 1248-1264, 2016.
- [7] M. Sajjad et al., "Raspberry pi assisted face recognition framework for enhanced law-enforcement services in smart cities," Futur. Gener. Comput. Syst., 2017.
- [8] S. S. Liew, R. Bakhteri., A. R. Syafeeza, "Convolutional neural networks with fused layers applied to face recognition," Int. J. Comput. Intell. Appl., vol. 14, No. 3, 2015.
- [9] M. Khalil-Hani, A. R. Syafeeza, S. S. Liew, R. Bakhteri., "Convolutional neural network for face recognition with pose and illumination variation," Int. J. Eng. Technol., Vol. 6, No. 1, pp. 44-57, 2014.
- [10] Khaing Zar Myint, "IoT based Real Time Face Recognition Door Lock System using Neural Network", June 2018.
- [11] Sri Karnila, and Rio Kurniawan, "Face Recognition using Content Based Image Retrieval for Intelligent Security", January 2019
- [12] Suhendro Irianto, A. Karpathy, Q. V. Le, R. Socher, C. D. Manning, A. Y. Ng, Grounded compositional semantics for finding and describing images with sentences, TACL 2 (2014) 207–218.
- [13] P. M. Number, M. Student, L. C. Wing, T. Tat, "Image-Based Face Detection System"
- [14] P. Kamencay, M. Benco, T. Mizdos, R. Radil, "A new method for face recognition using convolutional neural network face recognition system - state of the art," pp. 663-672, 2017.

- [15] S. Ahmad Radzi, M. Khalil-Hani, R. Bakhteri., "Finger-vein biometric identification using convolutional neural network," Turkish J. Electr. Eng. Comput. Sci., vol. 24, No. 3, pp. 1863-1878, 2016.
- [16] S. Ahmad Radzi., "A MATLAB-based convolutional neural network approach for face recognition system," J. Bioinforma. Proteomics Rev, vol. 2(1), pp. 1-5, 2016.
- [17] M. K. M. F. Alif, A. R. Syafeeza, P. Marzuki, A. N. Alisa., "Fused convolutional neural network for facial expression recognition," in Symposium on Electrical, Mechatronics and Applied Science 2018 (SEMA'18), vol. 2018, no. November, pp. 73-74, 2018.
- [18] K. Papineni, S. Roukos, T. Ward, W. Zhu, Bleu: a method for automatic evaluation of machine translation, in: Meeting on Association for Computational Linguistics, Vol. 4.
- [18] Daniel Georgescu, "A Real-Time Face Recognition System Using Eigenfaces", published on the Journal of Mobile, Embedded and Distributed Systems, vol. III, no. 4, 2011.