

# Face Based Door Access System Using PCA and SVM Neural Network

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**ABSTRACT:** Automatic recognition of humans may be a difficult task that has received a lot of attention throughout recent years due to its a few applications in various fields. Face recognition is one among those difficult issues and as of now there were no technique that gives a better solution to all scenarios. This method uses an associate picture-based approach that removing redundant data from face images through compression using the two-dimensional discrete cosine transform (2D-DCT)with PCA (Principal Component Analysis) The DCT (Discrete Cosine Transform) used to get the features from face pictures based on skin color feature vectors are carried out by computing DCT coefficients. Support Vector Machine (SVM) technique is employed to classify DCT-based feature vectors into clusters to verify whether the object of the picture is available or not available in the database of images. Evaluation was performed in MATLAB exploitation a image database of particular object having ten pictures with totally different facial expressions The main advantage of this method is its high-speed process capability and low computational requirements with respect to space and time efficiency.

**KEYWORDS:** Feature extraction, Face recognition, Principal component Analysis, Support Vector Machine

## I. INTRODUCTION

Recognition of human face is really interesting area of research in current years because of expanding security requests and its latent capacity business and domestic applications. The major applications are Human-computer interaction (HCI), Biometric analysis, video surveillance and police investigation. Face recognition process has tested to be very tough in nature due to the following reasons. Faces can be varied significantly in terms of older, skin, color and gender. It also suffers from a problem of differing image qualities, facial expressions, facial piece of furniture, background, and illumination conditions. This paper presents a unique approach for face recognition that derives from a concept advised by Hjelmås and Low. In this review, preprocessing step portrayed to makes an endeavor to discover pixels related with skin. This methodology decrease the information preparing prerequisites contrasted with the current techniques. Since the skin shade of every person fluctuates ordinarily, the skin power is the primary trademark to separate the items.

- A. Smart Door Access using Facial Recognition is a progressed multidimensional visual model and building up a machine model for face acknowledgment is problematic. The paper develops a strategy for face acknowledgment upheld logical hypothesis approach of mystery composing and unscrambling face picture. The objective is to execute the framework for a chose confront and recognize it from an outsized scope of keep faces with some timeframe varieties besides. Face acknowledgment is significant half for the point of security and police examination. We will probably investigate the practicability of executing raspberry pi based face acknowledgment framework.
- B. Door lock system using Facial Recognition : The idea of web of things is obtaining a good pace within a planet that a lot of folks area unit already enclosed by this technology even while not knowing it really. This idea may be taken around in any field out there to create lifetime of humans easier and smarter. Same may be wiped out our security system of homes wherever it'll become simple to handle the protection with simple to access sensible door locks. This project sheds light weight on building a door protection system can acknowledge the face of the owner of the house and relations united Nations agency will have access to open the door within the house. It may be done by exploitation face recognition algorithms that area unit gaining a lot of importance during the era of computer science.
- C. Automatic Door Access System Using Face Recognition: Most entryways are constrained by people with the utilization of keys, security cards, secret word or example to open the entryway. Also, the objective items need to

contact with the necessary equipment in the phase of information assortment. The benefit of this framework is the face acknowledgment doesn't require to be contacted with any equipment. Face detection is the first step of the face recognition system. The performance of the entire face recognition is influenced by the reliability of the face detection. In this system Viola Jones is used for face detection. To extract the relevant features of facial image, PCA method is used.

D. . Evaluation of face recognition techniques using PCA, wavelets and SVM: In this examination, we present an assessment of utilizing different strategies for face Recognition. As highlight separating procedures we profit by wavelet disintegration and Eigen faces technique which depends on PCA (Principal Component Analysis). Subsequent to producing highlight vectors, separation classifier and Support Vector Machines (SVMs) are utilized for arrangement step. We analyzed the arrangement precision as per expanding measurement of preparing set, picked include extractor-classifier combines and picked part work for SVM classifier. As test we utilized ORL face database that is known as standard face database for face acknowledgment applications

## II. RELATED WORK

The authors Zhengzheng Liu & Lianrong LV [11] presented the Adaboost algorithm for detecting &classifying face region gradually in openCV face database. The paper described the texture feature of local area by using LBP and PCA used for dimensionality reduction. The amount of calculation and data quantity was reduced. Ergun Gumus, Niyazi Kilic, Ahmet Sertbas [4] presented wavelets decomposition and eigenfaces based on PCA. Distance classifier and SVM were used for classification step. It should increase the order precision as per expanding measurement of preparing set. High dimensional space making recognition rate has been recorded. Harnani Hassan [7] presented face acknowledgment framework and peripheral interface controller (PIC) as an information/yield transporter to alter on/off attractive lock for entryway lock security framework. It has lower error rates but it increases the cost of implementation.

## III. METHODOLOGY

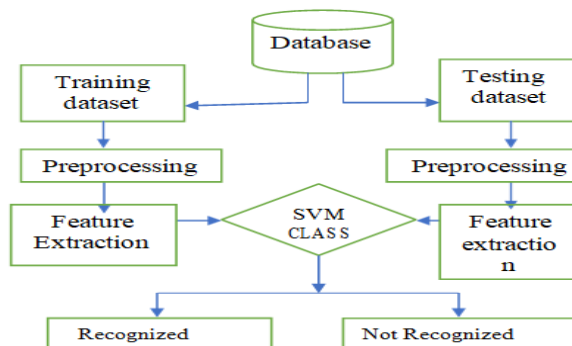
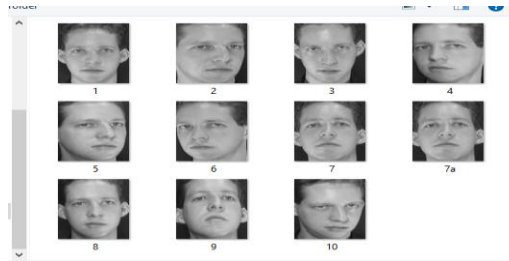


FIG. 1 FACE BASED DOOR ACCESS SYSTEM ARCHITECTURE

Fig 1 shows the architecture of face-based door access system. System should capture the image of human face and perform various operations like preprocessing, feature extraction and face recognition. The face of human should be matched in the database image means the correctly recognized message will be found. The (2D-DCT) with the combination of PCA is performed for each face picture and the discrete cosine change (DCT) coefficients have framed the element vectors. The subsequent stage utilizes a Support Vector Machine (SVM) with an unaided learning system to classify vectors into groups to check whether the object of the image is accessible or not accessible in the database of pictures. On the off chance that the article is surveyed as accessible, the least complex match object is found in the preparation database is shown as the outcome, else the outcome shows that the item isn't found inside the picture database.

### Database of face images:

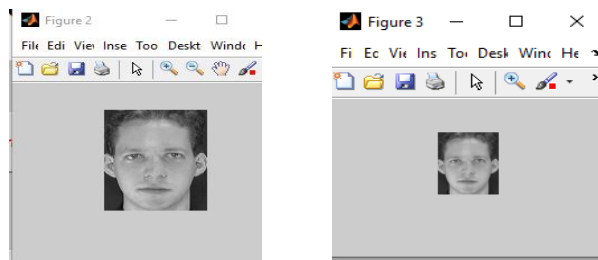
The database of face images is stored in the data folder. It contains pictures of male and female. It contains pictures of male and female objects in independent registries. The data folder is comprised of 10 unique pictures of particular object. The pictures were taken at different times, fluctuating lighting, facial expression and facial information. It can store the various facial expressions pictures in a folder, get and display any one image from that folder. The size of one image is 512x512 pixels.



(a)  
Fig.2(a) sample face image

**Pre-processing:**

The pre-processing step should be implemented by using MATLAB®R 2014a. Pre-processing is the method of include smoothing, sampling, and filtering. In this method, filtering is employed to get rid of the unwanted noises in a picture. MATLAB image processing tool is used to resize the pre-processed image from size 512 x 512 pixels to image blocks of size eight x eight pixels. The grayscale pictures of size 8 x 8 pixels are reshaped in MATLAB to outline a 64 x 1 show with 64 lines and 1 fragment for each image. This technique is performed on all of the 10 test pictures to make the information record for testing the noticeable quality structure. The size square expands or analysts an image by resizing the image on one estimation (row or column). By then, it resizes the image on the other estimation (row or column).



(a) (b)  
Fig.3 Resizing of an image (a) original image (b) Resizing image

**Feature Extraction**

Principal Component Analysis (PCA) and two Dimensional Discrete Cosine Transform (DCT) are joined for extract the elements of the image of human face. DCT is utilized in compression of the image. The DCT is a change which changes a picture from the spatial territory to the repeat space. The tremendous measure of data is put away in low recurrence segment. Lower frequencies are more evident in a picture than higher frequencies a picture is moved into its recurrence parts and higher recurrence coefficients are disposed. This technique computes the two dimensional DCT of the picture squares of the size are eight x eight pixels utilizing 'eight' out of the sixty four DCT coefficients for hiding. The other 56 residual coefficients are disposed of. The picture is then remade by processing the 2D-IDCT of each square utilizing the DCT change network calculation technique. At last, the yield is a set of exhibits. Each exhibit is of size 8 x 8 pixels and speaks to a solitary picture. Observationally, the upper left corner of each (2D-DCT) PCA grid contains the most significant qualities, since they compare to low-recurrence parts inside the prepared picture blocks.

The general equation for 2D DCT is defined as follows:

$$C(k,u) = a(k) + a(u) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x,y) + \cos\left[\frac{x(2x+1)k}{2N}\right] + \cos\left[\frac{x(2x+1)u}{2N}\right]$$

Where k,u=0,1,2.....N-1

The inverse DCT is defined as follows:

$$\sum_{x=0}^{N-1} \sum_{y=0}^{N-1} a(k)a(u) * c(k,u) * \cos\left[\frac{\pi(2x+1)k}{2N}\right] * \cos\left[\frac{\pi(2x+1)u}{2N}\right]$$

PCA is a significant real technique that has found application in fields, for instance, faces affirmation and picture pressure, and is a regular methodology for finding plans in data of high measurement. Numerical thoughts that will be used in PCA covers standard deviation, covariance, eigenvectors and values. The inspiration driving PCA is to reduce the tremendous dimensionality of the data space. Face Recognition reliant on PCA is by and large alluded to as the use of Eigen faces. Eigen faces are Principal Components of the scattering of faces, or proportionally, the Eigen vectors of the covariance system of the course of action of planning set of  $M$  face pictures,  $\Gamma_1, \Gamma_2 \dots \Gamma_M$ , every one of size  $N \times N$

Step-1. Training face images

Calculate the mean value of face images should be calculated as:

$$\psi = \frac{1}{m} \sum_{i=1}^M \Gamma_i$$

Step-2. Find covariance matrix

Covariance matrix is calculated as:

$$C = A A^T$$

Step-3 Find eigenvectors of covariance matrix:

To Calculate the Eigenvectors and Eigen values of the Covariance Matrix:

$$u_l = \sum_{k=1}^M v_{lk} \phi_k, l = 1, \dots, M$$

Step-4 Classify test image

Test image is projected on the same subspace. The projection vector of test image is compared with the stored projections of gallery images.

### Optimize Face Classification

We propose a model for face recognition utilizing a SVM being taken care of with intermediate layers of neural networks (NN) prepared for face detection. The component vector is made out of a lot of neighbourhood yield disseminations from the modules of feature detecting in the face identifying NN. The arrangement of local areas consequently chose around facial segments (e.g., eyes, mouth, nose, and so on.) identified by the NN. Local areas middle level features are characterized with the goal that data on spatial course of action of facial segments is verifiably included as yield appropriation from facial segment recognizing modules. Results exhibit profoundly effective and strong execution both in face acknowledgment and in recognition also.

### IV. EXPERIMENTAL RESULTS

The entire system was implemented with MATLAB<sup>®</sup>R 2014a. The product area is totally founded on MATLAB. In our interface we have utilized MATLAB for face acknowledgment. We applied feature extraction method with SVM classifier on the data folder. The proposed strategy is tried on data folder. Data Folder has more than set of picture of a person's face with various conditions like appearance, brightening and so forth. There are 40 people within the data folder that every of them has 10 different face images, this experiment with a complete of 400 face images are often used for testing. From the data folder it selects two photos of every person, from that, one image is used for training and another image is used for testing, then both the training and testing should have 40 pictures. Each picture has the size of 112 x 92 pixels with 256 dark levels. Eigen faces are determined by utilizing PCA calculation and analysis is performed by shifting the quantity of Eigen faces utilized in face space to as certain the face descriptors of the pictures. The quantities of system utilized are equivalent to number of subjects in the data folder. Among the ten pictures, initial 6 of them are utilized for preparing the neural systems, at that point these systems are tried and their properties are refreshed. The prepared systems would be utilized later on for acknowledgment purposes. For testing the entire database, the countenances utilized in preparing, testing and acknowledgment are changed and the acknowledgment execution is given for entire data folder.

Algorithm	Recognition rate(%)
Individual PCA	91.3
Individual SVM neural network	94.1
Both PCA and SVM neural network	95.2

Table.1 shows the performance of the system

When using individual PCA and SVM it should take more computational time for processing. So, we should combine both PCA and SVM neural network it should reduces the time consumption.

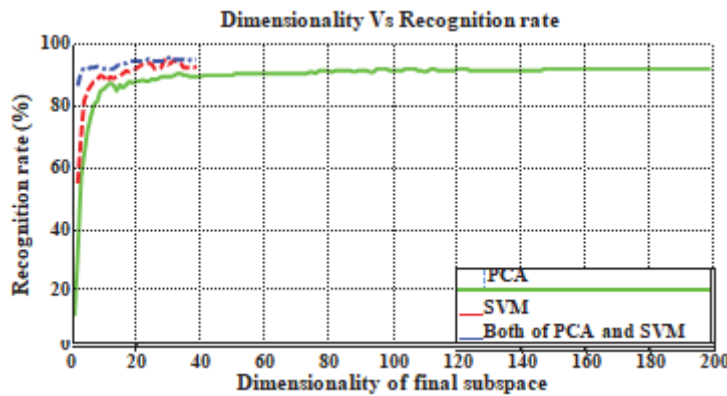


Fig.4 The face recognition rate of three algorithms

At long last, the trial plan was effectively executed. Subsequent to contrasting , it is simple with perceive the right human face from the information folder. At present, many face acknowledgment hardware must let tried individuals face the gadget of picture securing to finish confirmation precisely, and it reduces the effectiveness of ID significantly for those whose face picture obtaining is deviated. It improves the productivity and exactness of the recognizable proof extraordinarily, the test outcomes appeared in figure.

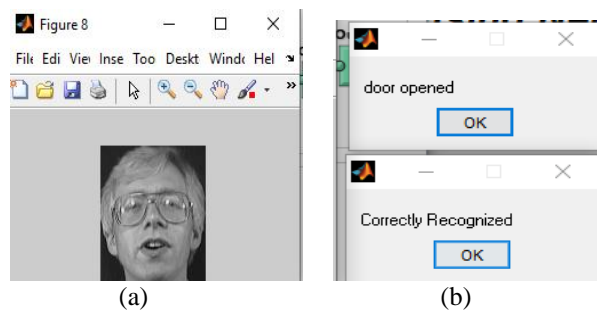


Fig.5 optimize face recognition

### V. CONCLUSION

An epic face acknowledgment system that utilizations highlights got from DCT coefficients, alongside a SVM-based classifier. The framework was assessed in MATLAB utilizing an image data of twenty five face pictures, containing five subjects and each subject having five pictures with very surprising outward appearances. when preparing for about 860 epochs the framework accomplished an acknowledgment pace of 91.36% for 10 successive preliminaries.. A decreased element space, delineate for experiment a pair of on top, dramatically reduces the process

needs of the tactic as compared with normal DCT feature extraction ways. This makes our system similar temperament for affordable, period equipment usage. Industrial usage of this strategy don't presently exist. Notwithstanding, it is possible that a reasonable SVM-based face acknowledgment framework could likewise be feasible later on.

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