Biometric Face Recognition Payment System

Surekha. R. Gondkar
Dept. of TCE, BMSITM,
Bengaluru

Saurab. B
Dept. of TCE, BMSITM,
Bengaluru

Dr. C. S. Mala
Dept. of TCE, BMSITM,
Bengaluru

***Abstract*— Use of payment cards in various places such as shopping, restaurants, lodges and online payment for booking hotels, movie tickets, flight and train tickets etc are increasing day by day. So the problem is that a person has to carry payment cards along with him and keep the cards secure to use it all the time. This also lacked security. In the present work the biometric face recognition payments is used in all kinds of payments. Thus it avoids the need to memorize different passwords. Face recognition payment system is safe, secure and even easy to use. It is reliable and more efficient compared to other payment technologies. A general design of online payment system using face recognition is proposed. The methods adopted for face recognition are by finding the eigenfaces and Euclidean distance.**

Keywords—Face recognition; eigenfaces; cardless payment; normalized histogram; authentication; biometric

I. INTRODUCTION

In the recent years, the security has become a vital and demanding service to secure our assets and provide data privacy. Therefore we need a more reliable security system that has to be developed to avoid loss due to identity theft. This has paved way to many researchers to innovate new solutions for improvising security system, especially in human identity. This is possible as one can measure the human identity, to secure the assets and provide data privacy.

The conventional method of payment is not reliable since it can be forged / manipulated and can also be stolen. Apart from these things traditional security methods like keys and payment cards can be lost or misplaced. Thus a more simple and effective payment system has to be developed to avoid greater loss. Biometric based method can be implemented for payment, as it offers a higher degree of security [1]. Since human face is unique, it cannot be manipulated by any means. The biometric techniques endowed with face recognition are more efficient than other techniques. The face is a primary focus in our daily and social life that plays an important role in communicating identity and even emotions. System that recognize and detects face can be applied to a wide variety of applications that include online payments, criminal identification and security systems [2].

Face recognition and detection is a tedious task because these algorithms are rigid and complex. The main difference between face recognition and detection is that, in face detection we need to determine whether the face is present in the image, whereas in face recognition we need to input face from the already existing database [4].

In the present work we have used face recognition technology for the online payments, payment in retail shops and malls etc.The remaining paper is produced as follows: Related work is illustrated in Section II, Methodology is proposed in section III, Section IV Conclusion, Section V is the Future scope.

II. RELATED WORK

Today, Biometric type of payment has made its foothold in many countries in various applications which are administered by trusted organizations. Biometrics recognize individuals by evaluating some metrics from a person's features of anatomy (such as geometry of hand and fingerprint), deeply ingrained skills such as handwriting, voice etc. These are several human discernible traits that fit the definition of biometrics [3]. Many companies insisted on cashless or card payment. There are many techniques that use cardless payments as follows:

A. Online virtual payment applications

In the past, there were different payment systems. Today, there are many applications that make online virtual payments like

- Paytm: The virtual bank which can be applied in many places. It is used in many applications like to book movie tickets, train tickets and flight bookings and for other transactions. With Paytm app, it's simple to send or receive money. It uses Quick Response code scanner to scan all types of Quick Response.
- PhonePe: It's a completely changed the mobile payment services in India. From Unified Payment Interface Payment to online bill payments, you can do it all on PhonePe. This app is used for secure online payment in India. Shop on other online shopping websites that accommodates this payment.

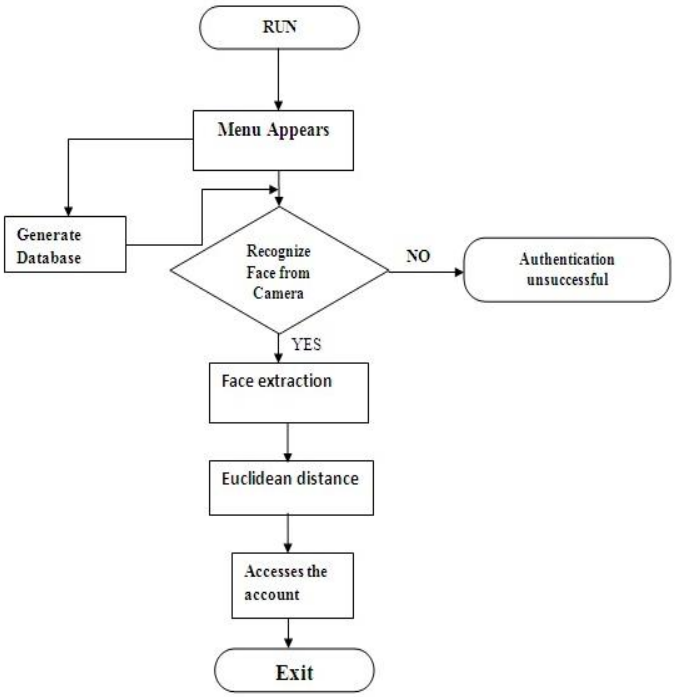
B. No cash or card Just stick in ok finger

Android Pay: A user stores his Android pay account, and when he wants to pay for an item or service, he takes his phone and places it near the retailer's point. Android pay is used to pay for product that is purchased in our daily life, many Android applications support purchasing of products with additional feature of fingerprint verification is introduced in this app.

All the above technology lacked in security of the account and the personal details. Therefore we have designed a face recognition technique which cannot be manipulated.

III. METHODOLOGY

In this paper, we have proposed a safe and secured payment of bills through face recognition. The flowchart of the present work is presented in Figure 1.



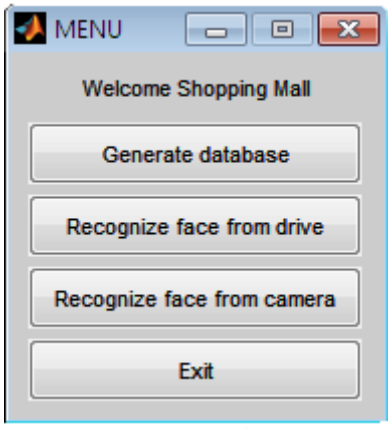
Fig(1): Biometric face recognition payment system

Based on the above flowchart, the programs are developed using MATLAB.

A. Menu

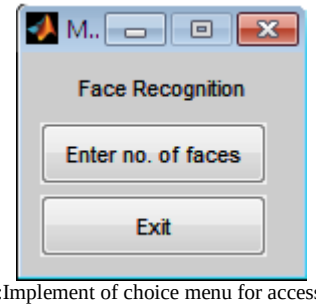
- Syntax:
  choice = menu(message, opt 1, opt 2,… opt n)
  choice = menu(message,options)
- Description:
  choice = menu(message, option 1, option 2,… option n) This is used for displaying a menu dialog box containing the text in message and option which is user defined . The menu function returns the integer value of the selected option or states 0 if the user selects the exit button on the window. States options as a character vectors / string scalars.

  choice = menu(message,options)
  This specifies the choices as a cell array of character vectors or string array. If the users terminal provides a GUI, menu displays the menu items as push buttons as shown below [6]



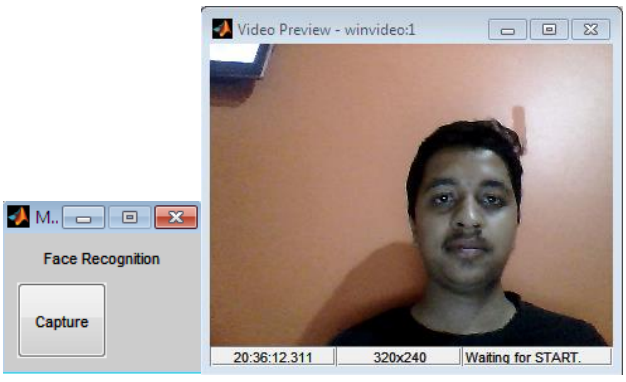
Fig(2): Implementation of choice menu

The Figure (2) is the implementation of the choice menu function that we have used. For option1 “Generate Database” . The following function takes place:

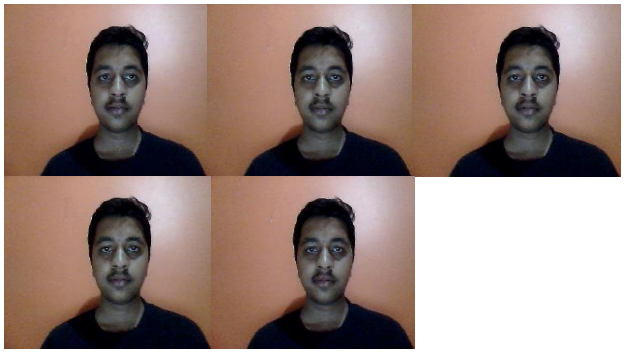


Fig(3):Implement of choice menu for accessing the number of faces

As presented in Figure 3, option1 in it will let you to store “n” number of faces. In the next step, again the camera window appears to verify the person in front it. Then the system compares the input image with the photos in the database as presented in Figure 4.
The camera window appears to take snapshot for generating the database as shown in the Figure 5.



Fig(4):Representation of the camera window appear for generating the database



Fig(5):Generated Database

If there is no match found then the verification will be displayed unsuccessful. If it matches further processing for face recognition, which is the Face Extraction will continue.

B. Face Extraction:

- **Conversion of RGB image to grayscale:**

  The trained set of images which is in the Database is converted into grayscale. Most of the monochromatic image processing techniques are achieved by using gray scale images.

Fig(6):Gray Scale Images

A grayscale images are the matrix, whose pixel values represent the shades of gray. Here we have used uint8(Unsigned Integer 8 bits) have the integer value in range[0,255] respectively.[8].

Syntax: file_name=rgb2gray (variable)

The next process in Face extraction is Normalization.

- **Normalization of the trained set:**

The intensity transformation functions endowed with information extracted from image intensity histograms plays a vital role in digital image processing in areas such as enhancement, compression, segmentation and description. The focus of this is to obtain and use histogram for image enhancement [7].

Fig(7):Normalized Images

The above figure shows the implementation of normalization. The Normalized module stretches an image's pixel values to cover the entire pixel value range (0-255). The normalization is a good tool to combat lighting changes as the camera moves. Many filters rely on absolute pixel values such as threshold. These pixel values can be easily changed in different lighting conditions.

Normalization is one of the apparatuses used to reduce the sensitivity to illumination conditions. Normalized histogram is the ratio of each histogram at gray level **rx** by the total pixels in the image**, n**

P (rx) = nx/n

For x = 0, 1… L-1

- **Mean image:**

After generating a database of n number of images, it selects m number of images as programmed. These selected images are combined into a single image which is used for comparison in the next step.

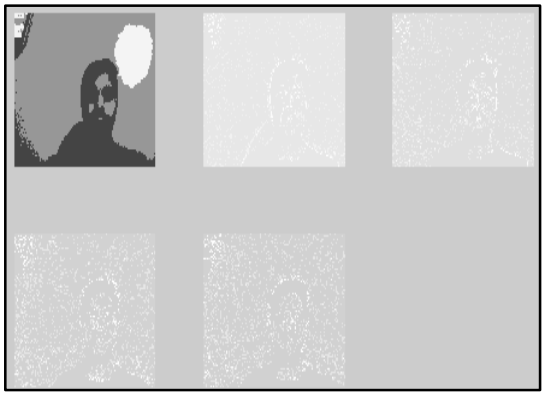
Fig(8): Mean Image

The standard data of an image can be computed using the commands mean2, std2 and corr2 in MATLAB to compute the mean, standard deviation and correlation between two same sized matrices [9].

- **EigenFaces:**

Eigenfaces are a group of eigenvectors used in human face recognition for computer vision problem.

The eigenfaces are used to estimate the variation in facial appearance in a set of face image database and use this information to find the best match [12].



Fig(9):Eigen faces of the trained set

The covariance matrix is constructed from the eigenfaces which are also known as basis images.

Eigenvalues are a scalar λ is called Eigenvalues of the MxN matrix B is the significant solution of Y of Bx=λx such an Y is called an Eigenvector [10].

Compute the Eigenvector, $\Phi_1, \Phi_2, \Phi_3, \ldots \Phi_n$, of S which from the bases for the whole face space. Each, can be expressed as a linear combination of eigenvectors

$$u = \sum_{i=1}^{n} a_i \Phi_i$$

Eigenvector for symmetric matrix are orthonormal

$$\Phi_i^T \Phi_j = \begin{pmatrix} 1 & If\ i=j \\ 0 & If\ i \neq j \end{pmatrix}$$

$$u_x^T \Phi_i = (\sum_{i=1}^{n} a_i \Phi_i)^T \cdot \Phi_i$$
$$= (a_1 \Phi_1^T + a_2 \Phi_2^T \ldots + a_i \Phi_i^T + \ldots + a_n \Phi_n^T) \cdot \Phi_i$$
$$u_x^T \Phi_i = (a_1 \Phi_1^T \cdot \Phi_i + a_2 \Phi_2^T \cdot \Phi_i + \ldots a_i \Phi_i^T \cdot \Phi_i + a_n \Phi_n^T \cdot \Phi_i)$$
$$u_x^T \Phi_i = a_i$$

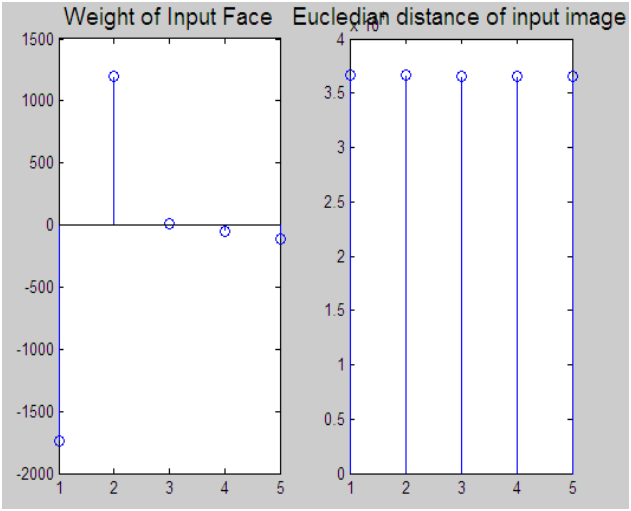
Therefore, $a_i = u_x^T \Phi_i$

The Eigenvector of a matrix can be found through the following formula:

$$u = \sum_{i=1}^{n} a_i \Phi_i$$

Next it constructs the eigenfaces from the various eigenvectors according to the formula [11].

C. Weight of input face and Euclidean Distance :



Fig(10):Graph Of Weight Of Input Face And Euclidean Distance

Euclidean distance algorithm computes the minimum distance between a column vector x and a collection of column vectors in the code book matrix cb. The algorithm computes the minimum distance to x and finds the column vector in cb that is closest to x[5]. The below equation shows the expression of Euclidean distance

$$d(a,b) = |p - q|$$

$$\sqrt{(p_1 - q_1)^2 + (p_2 - q_2)^2 + \cdots + (p_n - q_n)^2}$$

$$= \sqrt{\sum_{i=1}^{n} (p_i - q_i)^2}$$

In one dimension, the distance between 2 points, x1 and x2 on a line is simply the absolute value of the difference between the 2 points as follows

$$\sqrt{(X_2 - X_1)^2} = |X_2 - X_1|$$

In two dimensions, the distance between P = (p1, p2) and q = (q1, q2) as:

$$\sqrt{(p_1 - q_1)^2 + (p_2 - q_2)^2}$$

Weight of input face explores total pixel values and how much intensity does the pixel is. They also tells the number of bytes the pixels of the image has and for that a graphical representation is shown in Fig(10).

D. Access the account

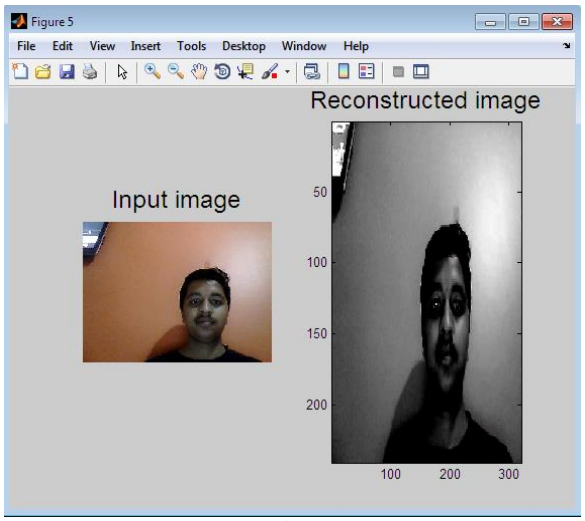
After finding the Eigenvector, it envisions the face image into face space for analyzing and representing it. The comparison of the input image takes place with the images in database and the matched input face and reconstructed image of the person is displayed on the screen (See fig (11)).

Then it accesses the account by giving the information of the account like

- Account name
- Account Number
- Balance
- Mobile number

After accessing the account it tell to enter the Bill amount then it checks for the condition as follows:

- If the entered bill amount is less than the balance then it deducts the amount from the account.
- But if the entered bill amount is more than the balance present in the account, then it denies to debit from the account and displays a message “You Don’t Have Sufficient Balance.”



Fig(11):Representation of comparison that had taken Places

```
raw =

    'NAME'          'SAURAB'
    'ACC NO. '      [    45625]
    'BALANCE'       [199.4000]
    'MOB'           [98765410]


data =

   1.0e+07 *

    0.0046
    0.0000
    9.8765


Balance =

   199.4000

Enter Bill Amount: 100
```

Fig(12):Before deduction of the money from the account

```
Enter Bill Amount: 100
Now Balance Is ....

text =

   1.0e+07 *

    0.0046
    0.0000
    9.8765


num =

    'NAME'          'SAURAB'
    'ACC NO. '      ''
    'BALANCE'       ''
    'MOB'           ''


raw =

    'NAME'          'SAURAB'
    'ACC NO. '      [    45625]
    'BALANCE'       [ 99.4000]
    'MOB'           [98765410]
```

Fig(13): After deduction of money from the account

```
raw =

    'NAME'          'SAURAB'
    'ACC NO. '      [    45625]
    'BALANCE'       [ 99.4000]
    'MOB'           [98765410]


data =

   1.0e+07 *

    0.0046
    0.0000
    9.8765


Balance =

   99.4000

Enter Bill Amount: 100
You Dont Have Sufficient Balance..
```

Fig(14):If the bill amount is greater than balance

IV. CONCLUSION

In this paper the biometric face recognition based payment system is used in all kinds of payments. For any online payments, the user need not use debit or credit card. A person need not carry card and remember the password for the transaction. Face recognition system is being proposed for all transactions. This is found to be more safe, secure and even easy to use. In this if the authorized person of that account is verified and the buffer value is up to 3.5e+04, then the account will be accessed. If any unauthorized person tries to access the account by giving their face for verifying, then the buffer value (min and max values) will be greater than 4.0e+04, and the account will not be accessed.

V. FUTURE SCOPE

In the present work, the person has to get to the counter, and show the face at the computer or gadget which has already the stored data base. There can be further improvements to the present work. We suggest that as soon as an item is picked from the shopping mall, the item payment should be automatically made at the mall exit. At the exit the face should be verified and payment of the bill made automatically.

REFERENCES

[1] Nikita Bakshi and Vibha Prabhu, "Face recognition system for access control using principal component analysis," 2017 International Conference On Intelligent Communication And Computational Techniques(ICCT),Manipal University Jaipur, Dec 22-23,2017

[2] Chinchu. S, Anisha Mohammed and Mahesh B S, "A Novel Method for Real Time Face Spoof Recognition for Single and Multi-User Authentication," 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT).

[3] Dileepkumar and Yeonseungryu, "A Brief Introduction of Biometric and Fingerprint Payment Technology," 2008 Second International Conference on Future Generation Communications and Networking Symposia.

[4] Dileepkumar, Dr.Yeonseungryu and Dr.Dongseop Kwon, "A Survey on Biometric Fingerprint: The Cardless Payment System ," 2008 Second International Symposium on Biometrics and Security Technologies

[5] "Multilayer Image Segmentation Based on Gaussian Weighted Euclidean Distance and Nonlinear Interpolation", 2017 10th International Congress on Image and Signal Processing ,Biomedical Engineering and Informatics(CISP-BMEI 2017)

[6] Rafael C. Gonzalez, Richard E Woods, "Digital Image Processing",4th Edition ,Pearson Education Inc,2018

[7] Rafael C.Gonzalez, Richard E Woods and Steven L.Eddins, "Digital Image Processing using MATLAB," 2nd Edition Tata Mcgraw hill education pvt. Ltd.,

[8] Hung-Yuan Cheng, Chun-Cheng Hou, Shou-Jyun Liang,"Face Detection and Posture Recognition in a Real Time Tracking System",2017 IEEE International Systems Engineering Symposium(ISSE)

[9] Maria petrou costas petrou"image processing:the fundamental",2nd edition,Wiley publications

[10] M. Turk and A.Pentland"Eigenfaces for Recognition",Journal of cognitive Neuroscience,vol. 3,no. 1,pp. 71-86, 1991.

[11] Varthika Mehta and Deepak Punetha," A Fascinating Territory Approaching Edge Detection using Feasibility of Eigenface to Identify an Individual", 2015 2nd International Conference on Advances in Computing and Communication Engineering.

[12] Richard Mejia, Diego Nejer ,Santiago Recalde ,Paul Rosero ,Diego Peluffo, "Face Detection and Classification using EigenFaces and Principle Component Analysis: Preliminary Results" 2017 IEEE International Conference on Information System and Computer Science(INCISCS)