Real Time Human Face Recognition Based on PCA for Security

Hla Soe[1], Nang Khin Su Yee[2]
[1]*Department of Mechatronics, Technological University (KyaukSe), Myanmar*
[2]*Faculty of Precision, Technological University (Cyber City), Myanmar*

Abstract- **This paper intends to recognize the human face based on principal component analysis (PCA) using MATLAB for security control system. Face recognition was one of the most interesting technologies in so many different fields such as computer vision in the last three decades. It had also been researched with so many methods. Face is the most memorable part of the body in real life. So, in this research Viola-Jones is used to detect the face detection and human face is recognized with Euclidean distances of Eigen facesbecause PCA algorithm reduces the dimension and also increases the speed of the recognition rates. The algorithm has been generated and tested with PCA and MATLAB.**

Key Words: **Face recognition, Euclidean Distance, Principal Component Analysis, Viola-Jones and MATLAB**

I. INTRODCUTION

Nowadays the usage of manpower has been reduced by the digitalized system. So, day-to-day needs of the human are changing into machine-based digital system. These changes have been making easier the activities for us and reduced our mistake [1].

Security is an ultimate concern in our daily life. One of the most important fields in security system is the access control which controls the entrance ways of a building or an area such as home and office [2].

Human recognized and identified thousands of faces in their lives, even after years of separation or glance of meeting. Despite of changes on the faces like expression, aging, and distraction (accessories, beards, and changes in hairstyles), human still could recognize the faces; this skill wasso remarkable [9].

This system is developed using the PCA algorithm for the recognition process. The PCA algorithm is selected as the main algorithm in face recognition process due to the simplicity of realization and the speed of recognition with respect to the other method. Besides, the efficiency of the system is increased as PCA reduces the data dimension and operate in smaller dimension.

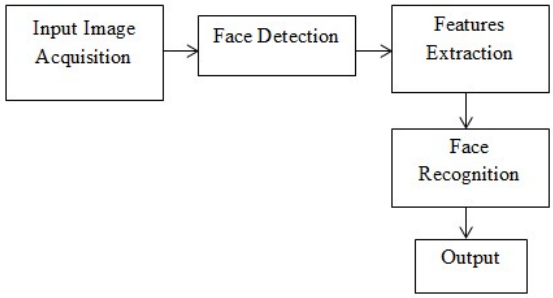

Fig.1. Block Diagram of human face recognition

II. RESEARCH AIM AND OBJECTIVES

The research will develop algorithm for recognizing the human face based on principal component analysis. The objectives of the research are;

- To detect the face location by using Viola-Jones algorithm.
- To develop a face recognition algorithm based on PCA for applying the security control system

1) Problem statement

The problem statement of this research is to provide the better security application than traditional control system (such as using CCTV, password or ID card for authentication and etc.).

III. LITERATURE REVIEW

Face detection and recognition started in 1960s[2]. Many researchers had studied face recognition using various algorithms and approaches [3].

Unknown author studied regarding finger printed-based security control system [4]. Finger print-based security system was considered less effective because the user required putting a finger to the sensor. It was also considered to cause the spread of the virus. Systems with finger print could also be duplicated so that it was rated as having low security[5].

In this research,human face is recognized using principal component analysis method (PCA).This face recognition method is selected with accuracy, time limitations, process speed and availability. By judging these elements, face recognition using PCA is selected

because it is really a simplest and easiest approach to implement extremely fast computation time [5]. This research designs and implements face detection and face recognition system based on PCA algorithm.

IV. BACKGROUND THEORY

1) Viola-Jones Algorithm

The Viola–Jones Algorithm is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection then tracking it [7].

In voila-Jones algorithm, the detection was done by the Feature extraction and feature evaluation Rectangular features was used, with a new image representation their calculation was very fast.

- They are easy to calculate.
- The white areas are subtracted from the black ones.
- A special representation of the sample called the integral image makes feature extraction faster.
- Features are extracted from sub windows of a sample image.

The base size for a sub window is 24 by 24 pixels.

- Each of the four feature types are scaled and shifted across all possible combinations.
- A real face may result in multiple nearby detections
- Post process detected sub windows to combine overlapping detections into a single detection [8].

The algorithm has four stages:

- Haar Feature Selection
- Creating an Integral Image
- Adaboost Training
- Cascading Classifiers

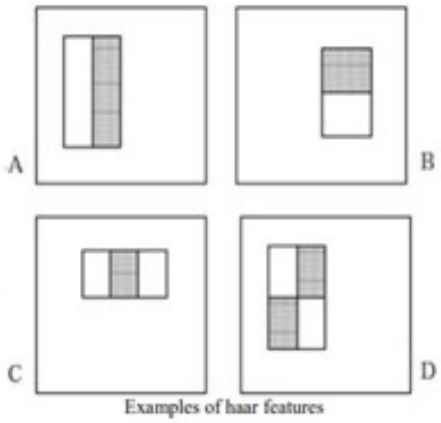

Fig.2.Haar Features

The features sought by the detection framework

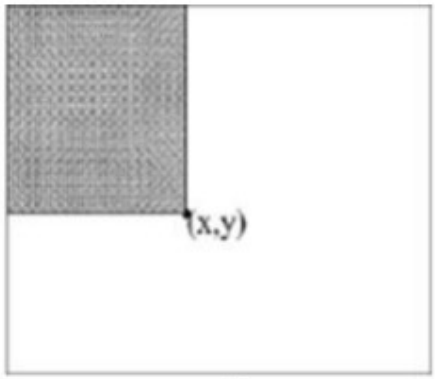

Fig.3.Integral Image

A Haar feature classifier uses the rectangle integral to calculate the value of a feature. The Haar feature classifier multiplies the weight of each rectangle by its area and the results are added together. Several Haar feature classifiers compose a stage. A stage comparator sums all the Haar feature classifier results in a stage and compares this summation with a stage threshold. The threshold is also a constant obtained from the Ada Boost algorithm. Each stage does not have a set number of Haar features. For example, Viola and Jones‟ data set used 2 features in the first stage and 10 in the second. All together they used a total .of 38 stages and 6060 features.

It is possible to eliminate the false candidate quickly using stage cascading. The cascade eliminates candidate if it not passed the first stage. If it passed than send it to next stage which is more complicated than previous one. If a candidate passed all the stage, this means a face is detected

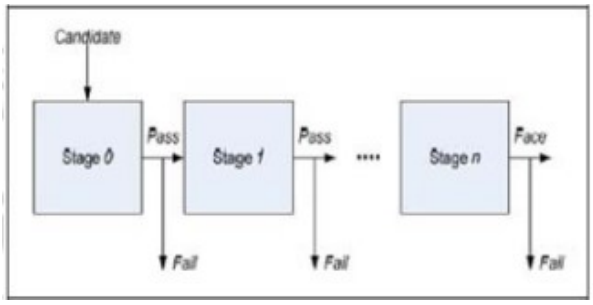

Fig.4. Cascade of stages

2).Principal Component Analysis(PCA)

V. METHODOLOGY

1). Face Detection Algorithm

In real-time face detection,faces are captured as frameworks to carry out rapidlythe processing of face images with high true detection rates. So, Viola-Jones algorithm is usedto get these purposes.

Viola-Jones algorithm detects a face from a frame from the webcam. And then the coordinates obtained after detecting the face in a frame is generated as a bounding box of a face.

And then, the face is cropped depending on bounding box coordinates.

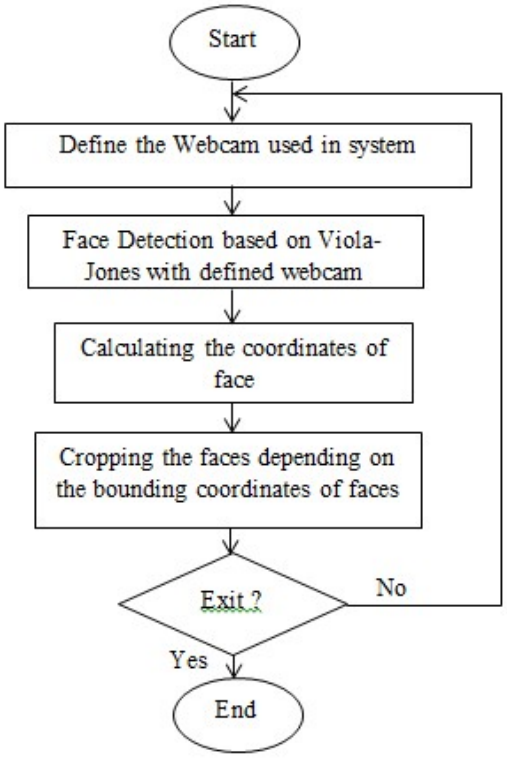

Fig .5.Flow chart of the human face detection system

2).Building of Database

In this research, author builds a database with four persons. The total images are 40 images because each person has 10 images. The bounding box coordinates are calculated with Viola-Jones and then the face image is cropped as the bounding coordinates. Finally, the face image size is reduced to 80x60 for preventing memory storage when face image matrix is changed to column matrix and for speeding up the recognition rate. The trained images are collected as a database in this research.

Fig.6.Train Data base

3). Principle of Operation

PCA algorithm is used to extract the features for recognition task by using trained database. The mean vector for training matrix is extracted. The distance of each column of training matrix with mean vector is calculated and a new matrix named mean centered data is also introduced.

And then covariance matrixes of mean centered data are calculated. The eigenvectors of covariance matrix are computed and sorted to select the most dominant eigenvectors; the matrix of stored eigenvectors is normalized.

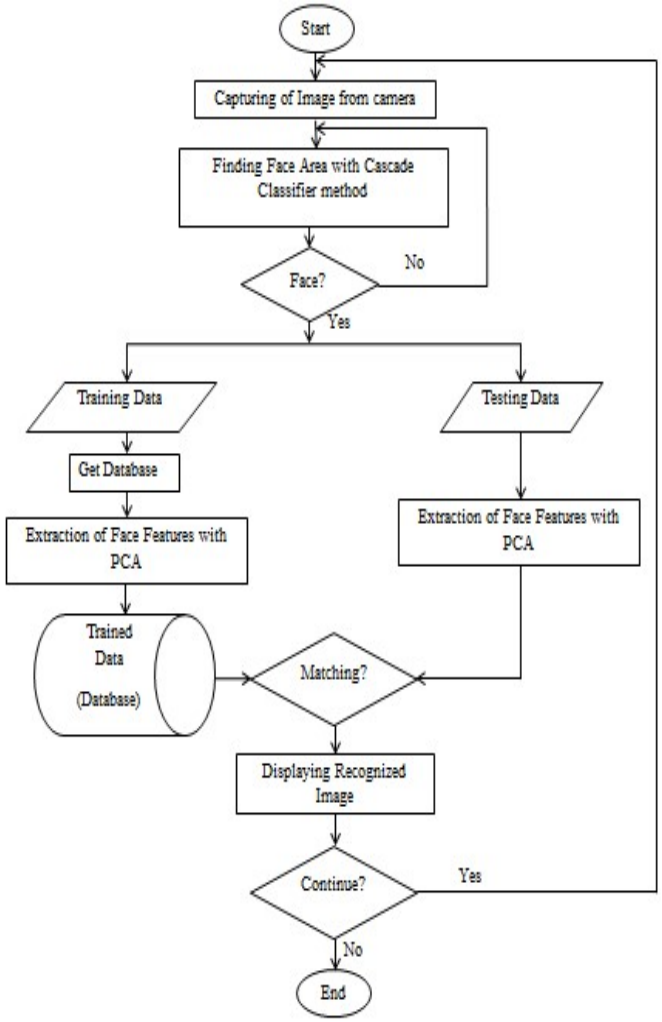

Fig.7.Flow Chart of Face Recognition based on PCA

The eigenfaces matrix is extracted by multiplying the normalized matrix with mean centered data and dimensionally reduction of yield matrix. Different matrices between mean vector and columns of training and testing matrices are found, then each matrix is multiplied by eigenfaces matrix and the projected-images and projected images matrices are evaluated.

The columns of projected-test images are selected on by one and the norm of the differences of each column with all columns of projected- images matrix is calculated. The person's number is recognized depending on the minimum component of the Euclidean distance.

Step 1- building a dataset

Step 2- Extracting the mean data of faces

Step 3- Computing the Covariance Matrix

Step 4- Computing the Eigen vectors, Eigenvalues of Covariance Matrix and Euclidean distance of eigenface.

Step 5- Comparing the Euclidean Distances of the test image with the database images

Step 6- Calculation the minimum Euclidean Distance of the images

Step 7- Displaying the resulted data as the recognized data and image

VI. RESULTS

In this section, the author shows the recognition results and efficiency of the four persons. Face recognition is based on face detection system. If the face is not detected, the recognition function does not process.

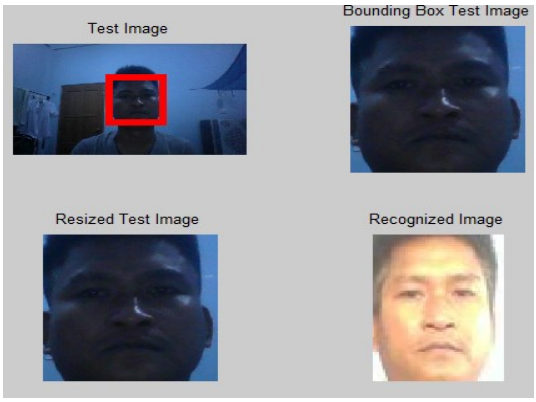

Fig.8. Recognition Result of the person 1

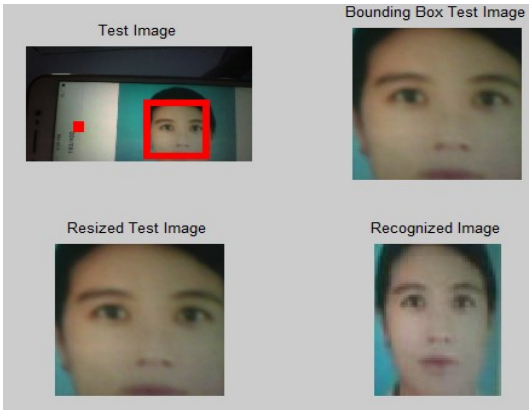

Fig.9. Recognition Result of the person 2

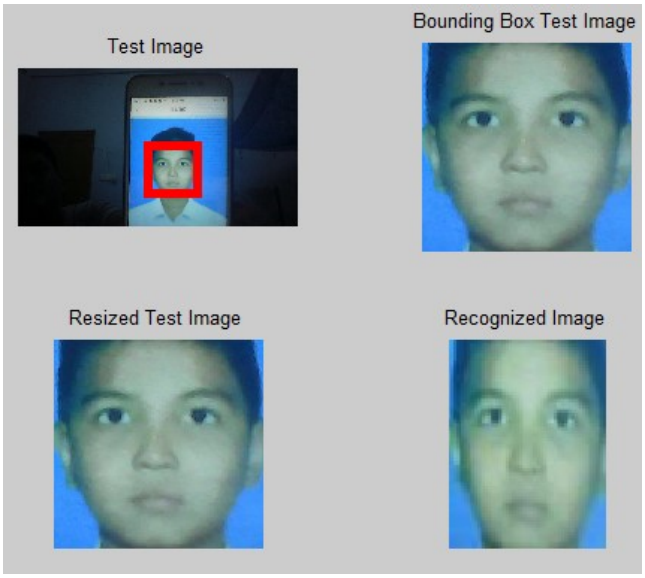

Fig.10. Recognition Result of the person 3

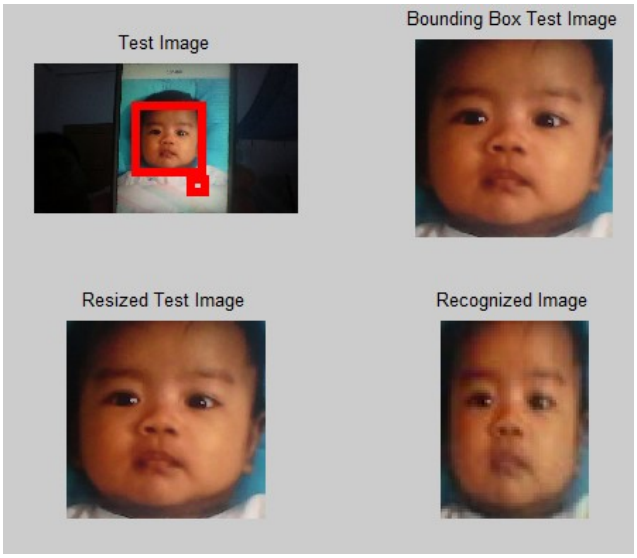

Fig.11. Recognition Result of the person 4

Table.1. Euclidean-distance s and minimum of Euclidean-distance

no	Euc_dist	Recognized name	Euc_dist_min
1	67756586574572.4	Dr. Nang Khin Su Yee	6216945771032.40
2	39286138023704.1		
3	92727957037471.8		
4	64980787133888.4		
5	47745017814916.1		
6	24899695843158.5		
7	6216945771032.40		
8	9955372485006.01		
9	19605093880036.5		

1	312423951457844	Dr. HlaSoe	27742013788 0844
2	311085878863590		
3	46586454743387		
4	312806079511390		
5	422779753773346		
6	441105848878105		
7	278518898127797		
8	277420137880844		
9	326195171992486		
1	107643190952532	Sai Lone	58125919426 882.9
2	645433907968514		
3	721149913869224		
4	2.84575696044606e+15		
5	374953692123262		
6	102913224879854		
7	58125919426882.9		
8	142033290219868		
9	101841283501386		
1	2009048217714.10	Sai On	32716159904 6.900
2	882142155524.399		
3	327161599046.900		
4	3947367713740.10		
5	13271012051024.4		
6	25856255212926.1		
7	24570291754240.4		
8	31495411712217.6		
9	28846913698574.9		

Table.2 Efficiency of the Recogntion

Sr. no	Test image	Test times	Right times	Efficiency (%)
1.	Dr.HlaSoe	10	8	80%
2.	Dr. Nang Khin Su Yee	10	7	70%
3.	Sai Lone	10	7	70%
4.	Sai On	10	7	70%

VII. CONCLUSION

This paper presents a computer software system which can recognize a human face. PCA technique is used for face recognition based on MATLAB. In this research, the author finds that the efficiency is depending on the translation variant and lighting variant. Specially capturing the real person is more efficient than the captured image from phone.

REFERENCES

[1]. P.Janarthanan, N.Thiruchchelvan, K.Thiruthanigesan, " The Real Time Face Detection and Recognition System", International Journal of Advanced Research in Computer Science & Technology (IJARCST), vol-5, Issue 4, ISSN, 2347-8446, Oct-2017.

[2]. Nikita Bakshi, VibhaPrabhu, "Face Recongnition System for Acess Control using Principal Component Analsys", International Conference on Intelligent Communication and Computational Techniques (ICCT), Dec 22-23, 2017.

[3]. Anissa Lintang Ramadhani, Purnawarman Musa, EriPrasetyo Wibowo, "Human Face Recognition Application Using PCA and Eigenface Approach", International conference Informatics and Computer, 2016.

[4]. A. A. Shankar, and K. S. Prasad, "Email based Remote Access and surveillance System for smart home infrastructure,' Perspect, Sci, pp.3-5,2016.

[5]. I. Urifan, R. Hidayat, and I. Soesanti, "Pengenalanwajahdenganmetode Eigenface", Jurnalpenelitianteknikelektro,vol. 3, pp. 320-323, December 2010.

[6]. Dian RetnoAnggraini, " Face Recognition using principal component analysis and self organizing maps", Third ICT international student project conference, 2014.[7] Viola, Jones: Robust Real-time Object Detection, IJCV, 2001.

[7]. P. Viola and M. Jones.Rapid object detection using a boosted cascade of simple features.In Computer Vision and Pattern Recognition, 2001.CVPR 2001. Proceedings of the 2001 IEEE Computer Society Conference on, volume 1, pages I– 511. IEEE, 2001.

[8]. Dian RetnoAnggraini, "Face Recognition Using Principal Component Analysis and Self Organizing Maps",2014 Third ICT International Student Project Conference (ICT-ISPC2014), 2014.