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Novel System for Face Recognition Based on SVD and GLCM

Essam Haider Mageed[1], Professor Hind Rustum Mohammed[2]

Asaad Norri Hashim[3]

Faculty of Computer Science & Math, University of Kufa, Iraq/najaf

Abstract

Face recognition has main attention from several foundations and researchers as a result to the increasing significance of security and its applications. Many approaches were introduced; each one had strengths and weaknesses. Hybrid classifier approach for face recognition using high order statistics is presented in this paper a. It consists of three stages: the first stage for features extraction which used two methods Singular Value Decomposition (SVD) and Gray Level Co-occurrence Matrix features. Hybrid method proved successfulness based on modified Structure Similarity Index (SSIM) to determine the closest similarity for face recognition results were an average of 99%. The main contributions of the proposed system represent by modifying the old ssim by Involves pasties end sill if the original function is greater than or equal to the threshold, the value of new similarity would be 1, as well as suggestion a new formula to perform classification, this formula will give good classification.

Keywords:- The singular value decomposition, The gray level co-occurrence matric , Modified structure similarity index , New method for face classification, and face recognition.

1.INTRODUCTION

Face recognition is critical thing in our live so we should fabricate a framework its capacity as like the capacity of human, to do that we presented wise framework its errand perceive individuals without impact from human in do fundamentally assignment , yet human impact in assemble a framework. The purposes for assemble this framework , initial one is the requirement for face acknowledgment in this day's high, second is to decrease the human impact this prompt to diminish cost ,and there are many reason yet the past reasons are the principle. Genuine movements and exercises in the past ten to fifteen years have pushed stand up to affirmation advancement into the spotlight. . Go up against affirmation is fundamental not on account of the limit of its piece of potential applications in research fields also in view of the capacity of its answer which would help in dealing with other gathering issues like question affirmation. As of late, face acknowledgment look into has picked up unmistakable quality attributable to the elevated security circumstance over the western world.[Z. Wang, A. C. Bovik, H. R. Sheikh, S. Member, E. P. Simoncelli, and S. Member] Confront acknowledgment is a standout amongst the most famous biometric frameworks in operation fundamentally as a result of its non-rudeness and high level of security. Programmed confront acknowledgment has boundless applications in biometric security, observation and criminal identification.[Abhinav Dhall1 Akshay Asthana2 Roland Goecke1;3]. Confront acknowledgment can be utilized for both check and ID (open-set and shut set)[NTSC].

2. METHODOLOGIES

In this part we will explain all the way through which you will have to find a way a hybrid composed of three ways and characteristics of each part of the proposed algorithm so that the researcher understand each part of the algorithm and then understand how combining paths to be one integrated algorithm which (singular value decomposition , gray level co-occurrence matrix and modified structure similarity index)

2.1.Singular Value Decomposition

The Singular esteem disintegration is a result of straight variable based math. It plays an intriguing, major part in various applications that is, face acknowledgment, picture pressure, watermarking, protest location, logical figuring, flag preparing, surface order and so forth. The uncommon component of SVD is that it can be performed on any genuine grid. The solitary esteem deterioration of a rectangular framework A will be a disintegration of the form[Satonkar Suhas S.1, Kurhe Ajay B.2, Dr. Khanale Prakash B.3]

$$\boldsymbol{A} = \boldsymbol{US}(\boldsymbol{transpoe\ V}) \qquad (1)$$

Where An is a m x n lattice, U = m x m and V = n x n. U and V are orthogonal Matrices. A square lattice A with genuine sections and fulfilling the condition A^(- 1)=A^t is called an orthogonal framework. S is a m x n askew grid with solitary values on the diagonal.

$$\boldsymbol{AA^t} = \boldsymbol{USV^t}(\boldsymbol{USV^t})^{\boldsymbol{t}}$$
$$= \boldsymbol{USV^tVSU}$$
$$= \boldsymbol{US^2U^2}$$

Also

$$\boldsymbol{A^tA} = (\boldsymbol{USV^t})^{\boldsymbol{t}}\boldsymbol{USV^t}$$
$$= \boldsymbol{VSU^tUSV^t}$$
$$= \boldsymbol{VS^2V^2}$$

In this way U and V are computed as the eigen vectors of AA^t and A^t An individually. The square base of the eigen qualities are the solitary values along the corner to corner of the grid S. In the event that the grid An is genuine, then the particular qualities are constantly genuine numbers, and U and V are additionally genuine.

2.2.Properties of Singular Value Decomposition

1. The singular values σ1, σ2…σn are exclusive.

2. $\boldsymbol{AA^t}$ = $\boldsymbol{USV^t}$ $(\boldsymbol{USV^t})^{\boldsymbol{t}}$= $\boldsymbol{USV^tVSU}$ = $\boldsymbol{US^2U^2}$ hence V diagonlises ATA. It follows that the matrix V can be computed through the eigen vector of ATA

3. The matrix U can be computed through the eigen vector of $\boldsymbol{AA^t}$

4. The rank of the grid An is equivalent to the quantity of its non-zero solitary qualities.

Confront Recognition Using Singular Value Decomposition of Facial Color Image Database is actualized in MATLAB. The Singular Value Decomposition is exceptionally helpful systems in information investigation and representation. In another method [Satonkar Suhas S.1, Kurhe Ajay B.2, Dr. Khanale Prakash B.3] we have endeavored a similar investigation of Singular Value Decomposition. The primary trial is utilized standard face95 and face96 Database. The execution of SVD is 100%. The second trial is utilized standard grimaces database. Two unique classes are tried utilizing SVD and its execution is 100%.The examination is likewise tried for privately made poor picture quality database and stance variety database and its acknowledgment execution is 100%. Incremental calculation of the SVD is propelled by then infeasibility of playing out the SVD on huge frameworks or when networks are developing progressively. A comparable need holds for KSVD. Here, we propose a surmised incremental KSVD refreshing technique by augmenting the strategy for the direct case details in[SetsTat-Jun Chin† Konrad Schindler David Suter][M. Brand].

2.3. Gray Level Co-Occurrences Matrix

Histogram-based surface descriptors are constrained by the way that the histogram does not convey any data about the spatial connections among pixels. One approach to evade this restriction comprises in utilizing an option portrayal for the pixel values that encodes their relative position as for each other. One such portrayal is the dark level co-event lattice G, characterized as a framework whose component g(i, j) speaks to the quantity of times that pixel sets with powers zi and zj happen in picture f (x, y) in the position indicated by an administrator d. The vector d is known as dislodging vector: d =(dx, dy). where dx and dy are the removals, in pixels, along the lines and segments, of the picture, individually. The dark level co-event grid can be standardized as follows[PRACTICAL IMAGE AND VIDEO PROCESSING USING MATLAB]

$$Ng(i,j) = \frac{g(i,j)}{\sum_{i=1}^{m}\sum_{j=1}^{n} g(i,j)} \tag{2}$$

where Ng(i, j) is the normalized gray-level co-occurrence matrix. Since all values of Ng(i, j) lie between 0 and 1, they can be thought of as the probability that a pair of points satisfying d will have values (zi , zj).

Co-event lattices can be utilized to speak to the surface properties of a picture. Rather than utilizing the whole network, more smaller descriptors are favored. These are the most well-known surface based elements that can be processed from a standardized dark level co-event network Ng(i, j):

$$G(i,j)=\sum_{p=1}^{n}\sum_{q=1}^{m}\begin{cases}1, if I(x,y) = i \ and \ I(x+ \Delta x, y+\Delta y) = j \\ 0, otherwise\end{cases} \tag{3}$$

where the $(\Delta x, \Delta y)$ is determining the distance between the pixel-of-interest and its neighbor. In fact the offset$(\Delta x, \Delta y)$, parameterization permits to the co-occurrence matrix to be sensitive to the rotation case. Fig.1 shows the generation of four co-occurrence matrices using Ng = 5 levels and offsets defined as one adjacent pixel in the probable 4- directions become{[0 1],[-1 1].[10],[-1 -1]}. The implementation in (Fig.1).

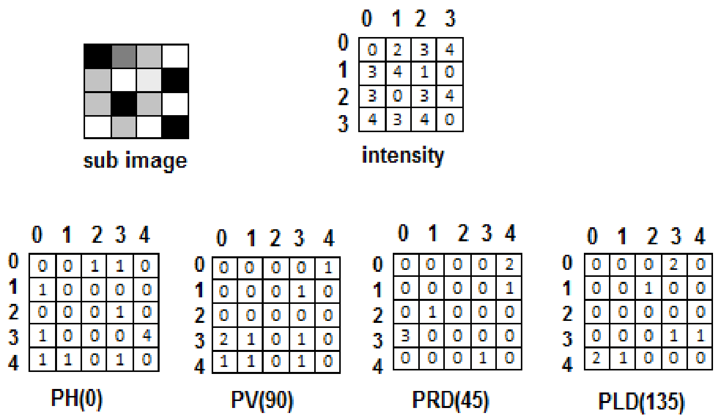

Fig.1. Application method by using the four corners ,$0^{\circ}, 90^{\circ}, 45^{\circ}, 135^{\circ}$

2.4.Haralick features

The rank of the framework An is equivalent to the quantity of its non-zero particular values In 1973, Haralick [Z. Hong] introduced 14 quantifiable components. These parts are delivered by registering the components for each one of the co-occasion networks got by using the headings 0◦, 45◦, 90◦ , and 135◦, then averaging these four qualities. The picture Δ, addressing the partition parameter, can be picked as one or higher. With everything taken into account, Δ regard is set to 1 as the detachment parameter. A vector of these 14 quantifiable segments is used for depicting the co-occasion framework substance. These parts can be processed by using the going with conditions underneath [Alaa ELEYAN1, Hasan DEM˙IREL2]

The normalization before feature extraction in (4)

$$G(i,j) = \frac{original\ matrix\ (i,j)}{\sum original\ matrix(i,j)} \qquad (4)$$

$$Angular\ second\ moment = \sum\sum p(i,j).p(i,j) \qquad (5)$$

$$Contrast = (i-j)^2 G(i,j) \qquad (6)$$

$$\text{Thread} = \frac{\sum\sum(1-\mu x)(1-\mu y).original\ matrix}{\sigma x \sigma y} \qquad (7)$$

$$Sum\ of\ square = \sum\sum(i-\mu)^2 p(i,j) \quad (8)$$

$$ID_{moment} = \sum\sum\frac{1}{1+|i-j|} original\ matrix \quad (9)$$

$$Sum\ Average = \sum iPx + y(i) \quad (10)$$

$$Sum\ Variance = (i - Sum\ Entropy\ )^2 Px + y(i) \quad (11)$$

$$Sum\ Entropy = -\sum p(i)\log\big(p(i)\big) \quad (12)$$

$$Entropy = -\sum\sum p(i,j)\mathrm{log2}(p(i,j) \quad (13)$$

$$Difference\ Variance = \sum i^2 Px - y(i) \quad (14)$$

$$Difference\ Entropy = -\sum Prow - colum(i)\log 2\big(Prow - colum(i)\big) \quad (15)$$

$$Info.Measure\ of\ Correaltion\ 1 = \frac{HXY - HXY1}{\max\{HX, HY\}} \quad (16)$$

$$Info.Measure\ of\ Correaltion\ 2 = (1 - \exp[-2(HXY2 - HXY)])^{\frac{1}{2}} \quad (17)$$

$$Max.Correlation\ Coeff = square\ base\ of\ the\ second\ biggest\ eigenvalue\ of\ q(i,j) \quad (18)$$

2.5. Structure Similarity Index

In this system SSIM[Z. Wang] as the separation measure for expression gathering. It is a procedure of ascertaining closeness among two pictures. The SSIM performs three distinctive likeness estimations of luminance, complexity and structure, and from that point consolidates them to get a solitary number. The SSIM metric between two windows x and y on the same size is given by:

$$SSIM(x,y) = \frac{(2\mu x\mu y + c1)(2\sigma xy + c2)}{(\mu x^2 + \mu y^2 + c1)(\sigma x^2 + \sigma y^2 + c2)} \quad (19)$$

where µx and µy are the average of x and y respectively. σx^2 and σy^2 are the variance of x and y respectively. . σxy is the covariance between x and y.

$c1 = (k1L)^2$ and $c2 = (K2L)^2$ are the variables to stabilize

the division with weak denominator. Hence K1 lees than 1 and K2 less than 2 . L is the dynamic range of the pixel-values. (S(x , y) = S(x , y)), bounded (S(x , y) greater than or equal -1 and less than or equal 1) and has a maximum (S(x , y) = 1 iff x = y). This value decreases as the images start to differ up to a minimum value of -1. Despite its simplicity, the SSIM index performs remarkably well across a wide variety of image and distortion types. We use this as a way of comparing two EI, which simply visualize the expression vectors. If the EI structures of normalized mouth and eye regions are similar, then the SSIM gives a higher value. The default implementation of SSIM uses a Gaussian window for matching. Empirically, we found that the disk shaped convolution window performed better than other shapes, including the Gaussian window.[Abhinav Dhall1 Akshay Asthana2 Roland Goecke1;3]

3. PROPOSED METHOD

The suggested system presents another strategy for face recognition utilizing a mixed of three strategies to produce distinctly new one, SVD (singular value decomposition) simple explanation ,is used for features extraction, it produce three matrices which are (U,S and V), the first and last one represent orthogonal matrices while the second represent the diagonal matrix. The system utilized the first one since, since it gives high probability to make the same person at the same range while others may be cause bugs to the recognition process. GLCM(gray Level Co-occurrence Matrix), is used for feature selection, due to this method (features can be selected to be used to make decision). In GLCM ,it can be used 12 features. Modified_SSIM, used for find similarity.

The core of the system depend on the modified SSIM(M-SSIM), which consist of the traditional ssim as well the new components is depends on threshold to find (full similarity) as 1.

3.1.The overall system can be explained by the following stages:_

Initial segment:- Before apply the proposed strategies that discover the individual arrangement and acknowledgment we apply condition to discover input individual picture have a place with database or not , if the individual found the proposed techniques apply ,else exit from the proposed framework with ('not found'). The condition beneath:_

$$multiple_{stnderdevation} = standerdevation\ of\ database - standerdevation\ of\ input\ image \qquad (20)$$

Second part:- The point is only for dim level co grid , so will be 45 , the explanation for that is the edge 45 will created that the elements for individual with all clasps in a similar range and this range distinctive with the range for someone else , in another edges there are befuddle .

Third part:- New method for classification, Euclidean distance used for classification, The older distance between two points a and b is the length of the line between (a ,b) and the equation below:_

$$d(a,b) = square\ of\ \left(sumation(a-b)\right)^2 \qquad (21)$$

We altered above separation to end up to comprise with our work as:-

D(i,j)=abs(features_matrix(i,j),mean_feature) (22)

Where features_matrix(i,j) are matrix of i person with j poses, and mean_feature is the mean feature for input person to be test it. Since the Euclidean separation is old so we assemble another condition find nearest individual to people in database. The new technique is underneath

$$\boldsymbol{E}(a,b) = \left(\frac{a-b}{M}\right)^2 \qquad (23)$$

Where a is the matrix of features(for all person with all poses), and b is the value of mean input person features value , and M is the mean of all matrix of features for training.

Fourth part:- *Modified SSIM ,* We have somebody with 10 shots for the database sort AT&A so when we discover similitudes(by SSIM) between each shot with itself will give 1 as when we discover the string picks the rest with the principal shot will never hit a similar yield that is 1 so we need that all the recording with the underlying depiction offers 1 to make it prepared capacity gives short of what one we will reconstruct however relying upon programming capacity and give the esteem we pick where to bring about obstruction implies just for shots to a similar individual with a preview a similar individual or with the second shot individual himself will give the yield 1 esteem will be (0.3643) the one to bring about impedance between the likenesses between individuals shots. (Fig.5.)show SSIM and (Fig.6) present modified SSIM.

3.2.Algorithm of proposed method

This section contains two main parts which the training part and testing.

Training Part

All images are enrolled to system, the main steps are:_

Step1:- Read human face image from dataset.

Step2:- Convert database image into grayscale.

Step3:- Convert (step2) double .

Step5:-Apply svd ,this method give three matrices U S V ,take just the U matrix and go to step 6.

Step6:- Apply Gray level Co-Occurrence network for ideal matrix(GLCM).

Step7:- Apply function of 12 elements construct it (not work in matlab) .

Step8:- find mean.

Step9:- Save result in matrix of (i , j), I refer to person and j refer to poses .

Testing Part

This part concerned with the test image(the image which submitted to check with the Database), all steps which are used in the training will adopted.

Step10:- Read face image.

Step11:- Change over to grayscale and after that to twofold.

Step12:- Apply for svd .

Step13:- Apply GLCM for info picture (inquiry picture).

Step14:- Apply capacity of 12 highlight.

Step15:- Find mean of components , that is just a single esteem.

Step16:- Apply new formula classifier between result from (step15) and result in(step9).

Step17:- Find least one , if the result only one person go to step 19 else go to step 18.

Step18:- Apply (SSIM) between the face image and closest person from result (step 17).

Step19:- recognize face.

End of algorithm

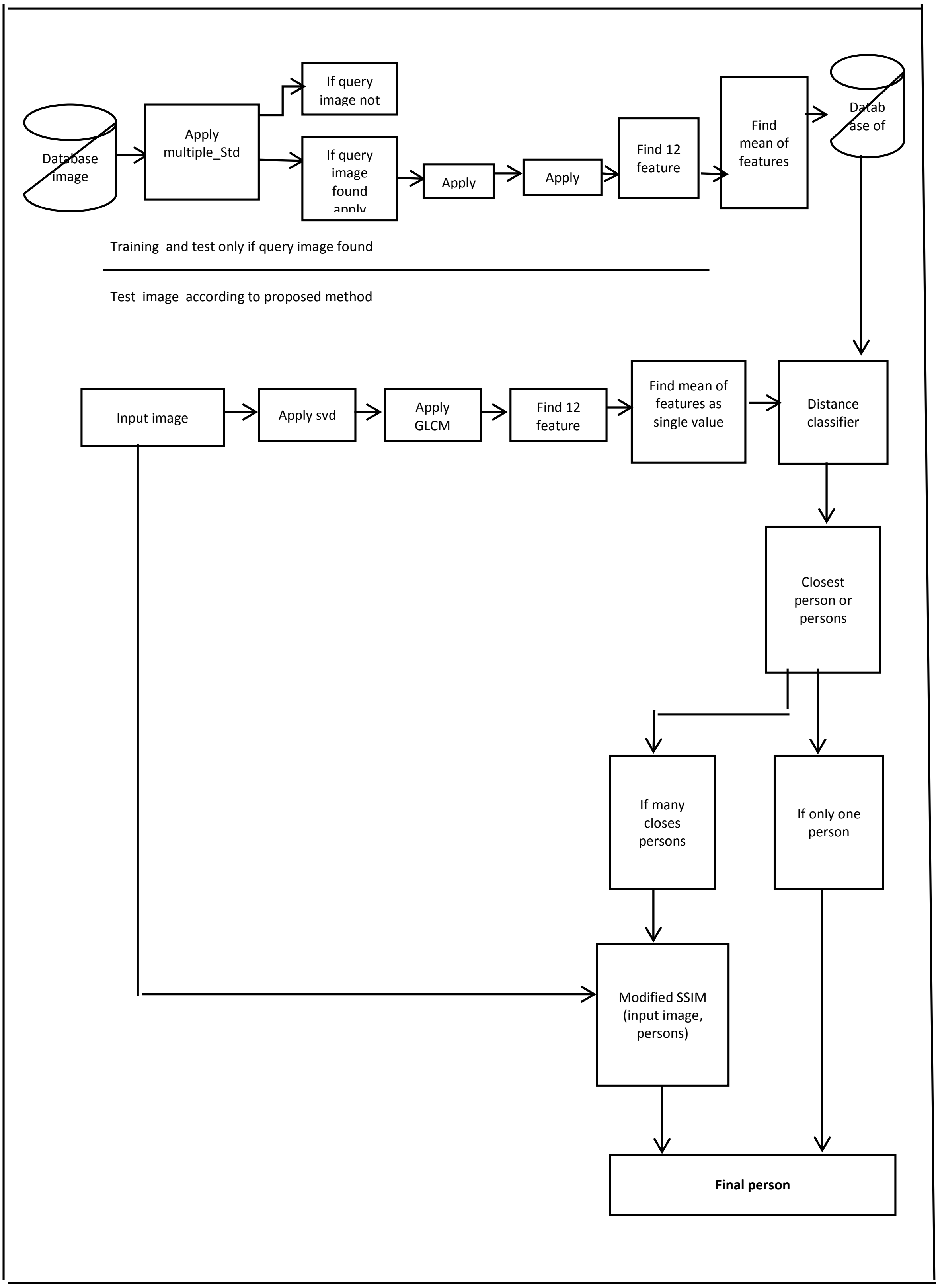

Fig.2. Training and test for proposed method

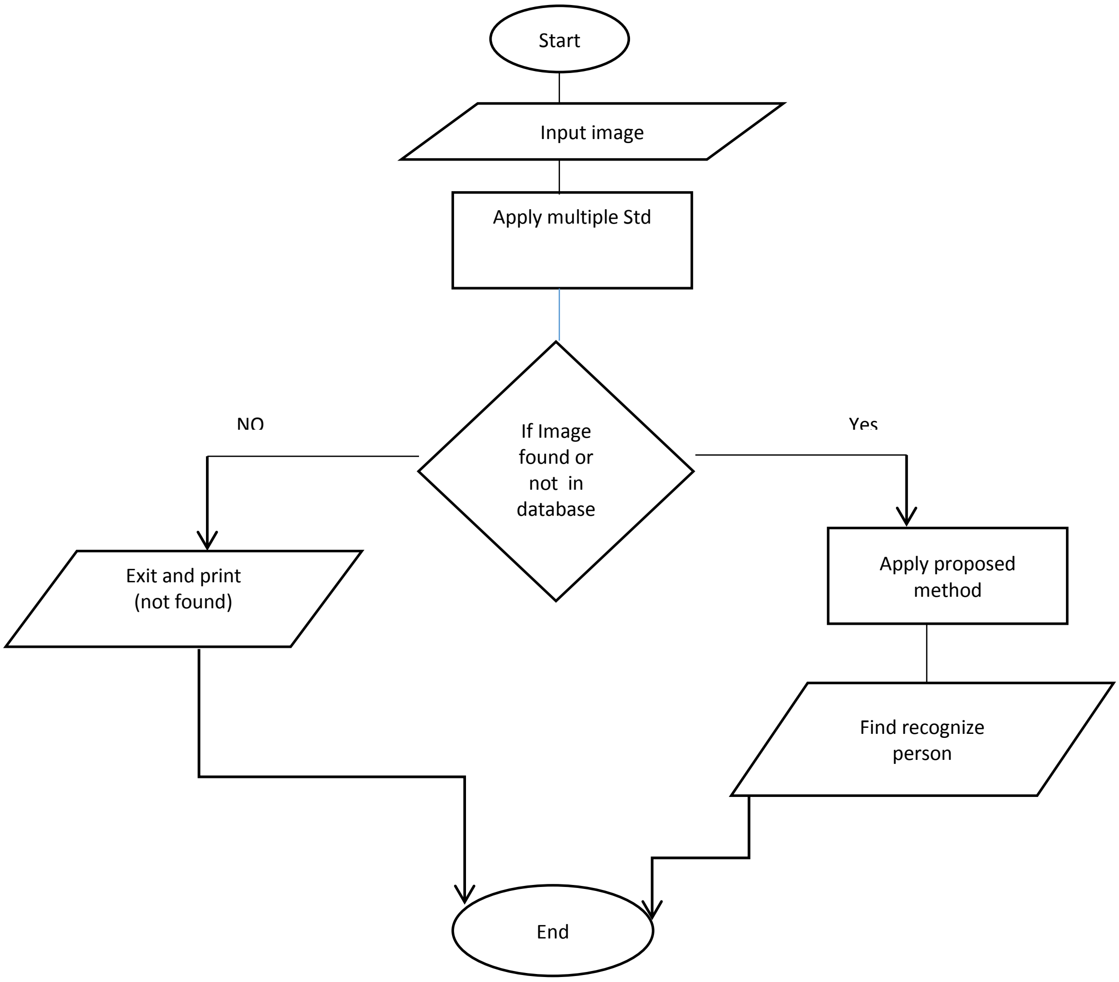

Fig.3. Flow chart of proposed method

3.3.Analysis of proposed method

The investigation of the proposed is relies on upon execution of strategy so we first compute the execution and contrast and another strategies, In table(1) demonstrate the mistake rate of proposed technique and another techniques. In table(2)demonstrate the acknowledgment rate of proposed strategy and another methods.in (Fig.4.) indicate acknowledgment rate for proposed with contrast and another strategies. The usage of proposed calculation on fragmented picture so we needn't bother with face location relies on upon (ORL) database for face as it were:_

$$\boldsymbol{Performance} = \frac{number\ of\ false\ image}{totla\ number\ image} \tag{24}$$

Table(1):-Error rate of proposed methods and another methods

Algorithm	False
Anthroface3D	1.65
ACFFR	1.64
Proposed method	0.66

Table(2):-Recognition rate of proposed methods and another methods

Algorithm	False
Anthroface3D	97.3
ACFFR	97.5
Proposed method	99.92

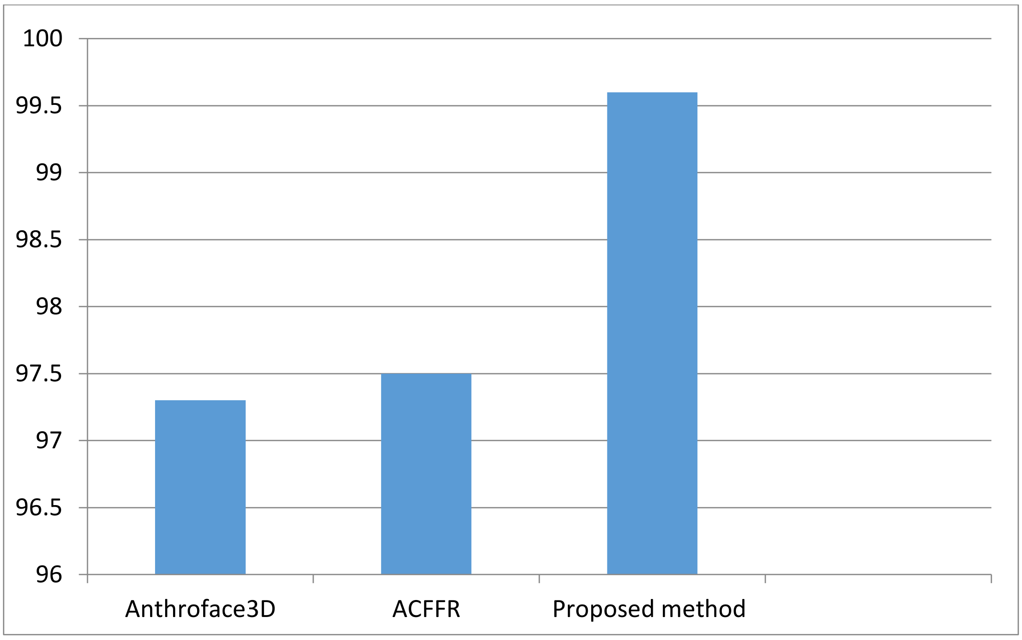

Fig.4. Recognition rate of proposed and another methods

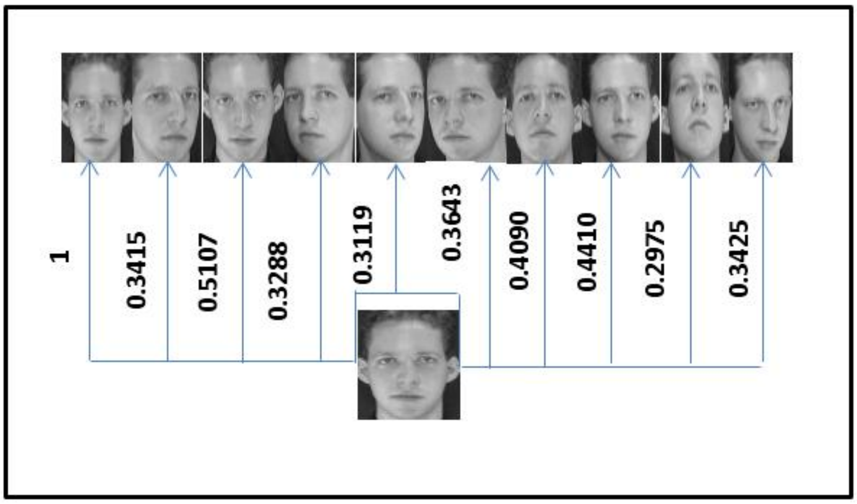

Fig.5. SSIM before modification

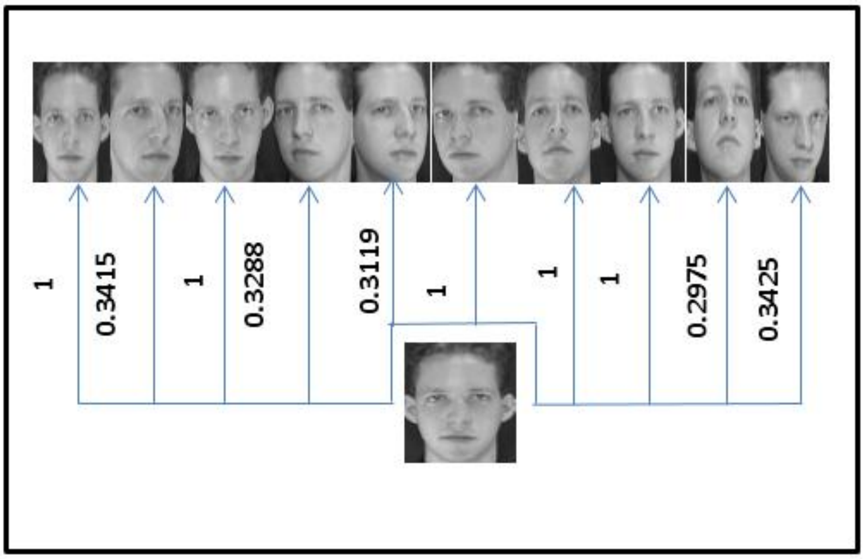

Fig.6. Modified SSIM

4. CONCLUSION

The algorithm used to merge the three methods previously used either one at a time or two and merge not merging three ways it using this proposed method will distinguish more precisely and better results than previous methods. Applying this way on the accounts database with images is not integrated any containing 99% performance will face you deduce that the algorithm will work primarily on databases that contain the face without having to cut off the face and then highlighting it. Possible as an ideal way to non-integrated database. Amendment to SSIM lead to its initial snapshot bonding as an example and ten shots of the same person will increase to four shots and this leads to faster discrimination to be.

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