A New Method For Face Recognition Using Wavelet

Lakhwinder Singh[1], Sumit Chopra[2]
[12]*Department of computer science, Kcceit Sbs Nagar, India*

Abstract- Accurate and faster face Recognition task has always been the prominent task of any biometric based personnel Recognition system. However, due to high dimensional space of facial images, the computation tedious and time consuming. The computational cost can only be reduced if the dimensional space is reduced to at least 70% of the original image size. In the presented base work, it is observed that theeigen values are used to evaluate the features from the face under test. The eigen values are same in number as that of the size of the facial image. However, by using the principal component analysis, the eigen vector size is reduced.

Keywords- face reognization,wavelet,transformation,accuracy

I. INTRODUCTION

1.1 Biometrics

Biometrics is the science and technology of measuring and analysing biological data. In information technology, biometrics refers to technologies that measure and analyse human body characteristicssuch as fingerprints, eye retinas, irises, voice patterns, facial patterns and hand measurements, for authenticationpurposes. In computer security, biometrics refers to authentication techniques that rely on measurable physical characteristics that can be automatically checked.

There are several types of biometric identification schemes

- Face: the analysis of facial characteristics.
- Fingerprint: the analysis of an individual's unique fingerprints.
- Hand geometry: the analysis of the shape of the hand and the length of the fingers.
- Retina: the analysis of the capillary vessels located at the back of the eye.
- Iris: the analysis of the colored ring that surrounds the eye's pupil.
- Signature: the analysis of the way a person signs his name.
- Vein: the analysis of pattern of veins in the back if the hand and the wrist.
- Voice: the analysis of the tone, pitch, cadence and frequency of a person's voice.

Though the field is still in its infancy, many people believe that biometrics will play a critical role in future computers and especially in electronic commerce. Personal computers of the future might include a fingerprint scanner where person could place his index finger. The computer would analyze your fingerprint to determine who person is and, based on hisidentity, authorize him different levels of access. Access levels could include the ability to use credit card information to make electronic purchases. (Woodward J. and Orlans, 2007)

1.2 Need for biometrics

Every time a person leaves his home, he enters a world dominated by strangers and anonymity. Although facial or voice recognition may help him authenticate a few of those he encounters butconfusing privacy with anonymity has delayed implementation of robust, virtually tamper-proof biometric authentication to replace paper-based forms of identification (ID) that neither assure privacy nor reliably prove identity. The debate over Real ID and sensitivity to creation of any form of national ID reveal a fear that anything that identifies us to others will intrude on privacy. This has led to a preoccupation with forms of ID rather than the fundamental question of how we can reliably identify ourselves to each other. While anonymity means privacy, it does not confer it. They delude themselves into thinking that they have privacy if the person next to them doesn't know their name. If they use cash and avoid technological conveniences such as credit cards and windshield-mounted Radio Frequency Identification (RFID) devices to pay highway tolls, they may think they are going about life anonymously. They are allowing themselves to believe that their public acts, how they communicate to others by word or deed in public space, are now somehow private.

The lack of reliable authentication becomes a threat to control of their own identity and confidential information, because it enables others to take advantage of living among strangers to assume a false identity undetected. Strangers can falsely assume their identities when one steals identifying information like social security or credit card numbers. Biometric authentication has a role in maintaining and defending their control of their own identity and personal data. This emerging technology makes it virtually impossible toassume someone else's unique identity. It is a way of providing the same kind of security in the virtual neighborhood that people once had in rooted neighborhoods, where the uniqueness of individual identity was assured by neighbors authenticating each other through facial recognition. (Woodward J. and Orlans, 2007)

1.3 Advantages of Biometrics over other authenticated solutions

Since a biometric is just another type of authentication method, it's worth looking at biometrics in general compared to other

ways of accomplishing the same authentication task such as passwords, metal keys and electronic access control devices.

1) Advantages of Biometrics over Passwords

- Person has to change passwords periodically to keep them secure. Biometrics is always with person and never change.
- Passwords can be lost or stolen. Biometrics is very difficult to steal and even more difficult to lose.
- Forgotten passwords generate a large volume of very expensive support desk calls at many large-sized organizations.

2) Advantages of Biometrics over Physical Keys

- A physical key can typically only get a person into a single door while a biometric can be used to identify a person to any number of access systems.
- A key can be lost or stolen or may be duplicated.

3) Advantages of Biometrics over Electronic Keys and Access Cards

- Biometrics can't be lost or stolen, while all the rest can be stolen or lost.
- In case of biometrics, a person doesn't require to carry around anything like access card or electronics key as his one of the body part is used for biometric.

1.4 Available Biometrics

The field of biometrics is a polarizing and controversial topic, with multiple voices debating the merits and demerits of the technology. Many of the discussions have focused on hypothetical, deeply technical and philosophical issues. There are a lot of different types of biometric systems. Here's a high-level comparison of the pros and cons of the most popular ones.

a) Fingerprint Readers

Fingerprint readers shown in figure 1.1 are the most common type of biometrics and the most closely associated in the minds of consumers with the industry as a whole. Fingerprint systems work by scanning the tips of one or more fingers and comparing the scans against known images. There are several types of scanning and matching technologies in use today, but the user experience is pretty straightforward, put finger on a small sensor, wait a second or two for the result.(Woodward J. and Orlans, 2007)

Fig.1: Fingerprint Reader

i) Advantages

- Most people instinctively understand the concept of fingerprint scanning, so there's fairly little user training required.
- Fingerprint sensors are quite small, don't consume a lot of power and are becoming inexpensive to manufacture, making it possible to put fingerprint biometric systems on laptops, cell phones, Personal digital assistance and even Universal Serial Bus thumb drives.
- Fingerprints are the oldest and best-developed sector in the biometrics industry, so there are many vendors and product choices available to the consumer.
- Fingerprint biometric systems have recently become mandated for certain classes of U.S. federal government ID cards, which should spur even more feature development and interoperability among vendors.

ii) Disadvantages

- Though accuracy has been steadily improving, there is still a real perception that fingerprint scanners are too fidgety for everyday use.
- Fingertips are more likely to be dirty than other parts of the body. Dirty fingers can foil the matching process. Dirty fingers also lead to dirty fingerprint readers, which then lead to more poor scans.
- Because many fingerprint systems are not 100% reliable, they are frequently configured with some sort of backup authentication mechanism – such as a Personal Identification Number (PIN) or password - that can be entered in the event that a person can't get a good scan. The existence of these backup mechanisms makes fingerprints more useful as a convenience feature, than as an improvement to overall security.

- As a result of a cultural association with criminal proceedings, many people have a strong aversion to having their fingers scanned. This is a significant barrier to widespread adoption in several countries.
- The proliferation of vendors and products has a downside: the fingerprint biometrics industry is rife with incompatible technologies. Interoperability will improve with time.

II. RELATED WORK

Sukhija P. et al.(2016) [1] proposed a genetic algorithm based approach for face recognition.The proposed algorithm recognizes an unknown image by comparing it with the known training images stored in the database and gives information regarding the person recognized. The proposed algorithm is then compared with other known face recognition algorithms viz: Principal Component Analysis (PCA) and Linear Discriminate Analysis (LDA) algorithms.

Given G. H. et al. (2013) [2]proposed new opportunity for the application of statistical methods driven by growing interest in biometric performance evaluation. Methods for performance evaluation seek to identify, compare and interpret how characteristics of subjects, the environment and images are associated with the performance of recognition algorithms. Some central topics in face recognition were reviewed for background and several examples of recognition algorithms were given. One approach to the evaluation problem is then illustrated with a generalized linear mixed model analysis of the Good, Bad, and Ugly Face Challenge, a pre-eminent face recognition dataset used to test state-of-the-art still-image face recognition algorithms. Findings include that (i) between-subject variation is the dominant source of verification heterogeneity when algorithm performance is good, and (ii) many covariate effects on verification performance are 'universal' across easy, medium and hard verification tasks. Although the design and evaluation of face recognition algorithms draw upon some familiar statistical ideas in multivariate statistics, dimension reduction, classification, clustering, binary response data, generalized linear models and random effects, the field also presents some unique features and challenges. Opportunities abound for innovative statistical work in this new field.

Aleix M. Martinez et al. (2002) [3] discussed PCA and LDA for face systems. Appearance based methods are used in face. So it is noticed that taking all data into account. Author says, PCA computes a vector that has a largest variance associated with PCA, where as LDA computes a vector which is best discriminatesbetween the two classes. Authors say an algorithm based on linear discriminant analysis (LDA) performs better than algorithms based on principal component analysis (PCA). But, this author says,in this system, AR face database is used and author proves that principal component analysis performing better than linear discriminant analysis.Principal component analysis is less sensitive than linear discriminant analysis that is different training data sets when the database is small. Also the reasons for why LDA perform better than PCA are discussed.

AmanR.Chadha et al.(2011) [4]discussed a face recognition technique for local and global features using discrete cosine transform. DCT is applied to whole face for local features and global features such as nose, mouth, and eyes are also extracted. This work is depending upon the recognition rate obtained for each feature such as mouth, eyes and nose. Weights are given to that features and both the global and local features are used for comparison. For face recognition system, false rejection rate should be maximized as compared to that of global features and the false acceptance rate should be minimized for the local features are used. Using discrete cosine transform the recognition rate for global features and recognition rate for local features are calculated. Comparison of Discrete Cosine Transformbetween local features and global features are also done. Results of this paper show that recognition rate improves when face images are normalized and when local and global features are combined discrete cosine transform gives a relatively recognition rate accurate and high.

Anil K. Jain et al. (2009) [5] proposed to utilize the micro features of a face in terms of facial marks, example freckles, scars and moles to enhance the face system. In this proposed work, the author usedprimary facial features segmentation and active appearance model to locate example mouth, nose and eyes. After that, morphological operators and Laplacian- of-Gaussian are used to detect the marks from facial image. Mostly, the marks detected from face are semantically meaningful, and then, to retrieve images according to interest from large database, users can give queries. a Query for retrieval the facial images can be used each morphology on facial mark. For example, query given to the system like "Retrieve all the human face images those face images have mole on the right side of the face." Then system includes first step toretrieve the face images based on face marks are improving the accuracy of detection of face. Secondly, Usingmorphology or local texture around detected mark that improves the accuracy of matching based on marks. Last, third onpartial face images or damaged extended the mark detection process.

Bajwa U. etal. (2010) [6] studied is to have an ICA(independent comparative analysis) that considers bothcomputational complexity and performance of face recognition algorithms based on appearance under equal working conditions namely PCA, A2DPCA , 2DPCA, $(2D)^2$PCA,2DLPP, and LPP. With diverse distance metric

combinations, some subspace methods due to the lack of unbiased comprehensive comparative analysis,author motivated. Comparison with different databasesORL,FERET, and YALE databases, as of FERET evaluationswith evaluation criteria which is simulate real life scenarios closely. In this face recognition algorithms are categorized into five categories are non-linear and linear projection methods, neural network based, thermalhyper spectral methods, fractal based, Gabor filter, lastly methods based on wavelets.

Chin-shyurngfahn etal. (2010) [7] developed a face recognition system which was automatic and installed on a robot.To setup the discriminative models of facial features received from different human beings this face recognition procedure gives a classifier trained with the discriminative common vectors (DCV) algorithm. At last, the Euclidean distance parameter that is used to measure the similarity between a face image and a candidate and then, decide according to minimum Euclidean distance, the most probable person. Then, result comes fromexperiment reveal that the face recognition rate is80% in cluttered backgrounds; and more than 93% in general situations and besides this, satisfied performance and efficiency of this system came.

Das D. et al. (2012) [8] describes the method of eigen faces and PCA (principal component analysis), in human face recognition is a de-facto. A new technique is called2DPCA (Two Dimensional Principal Component Analysis). This new technique was proposed to decrease the computational cost of PCA. Two Dimensional Principal Component Analysis method views an image as a matrix, but, Principal Component Analysis treats images as vectors. To analyse the effectiveness of the 2DPCA and PCA, then, number of Eigen values were obtained there and then compared.

III. THE PROPOSED METHOD

A. Proposed Methodology

We are developing a face system, in which we are using ORL database. In this system, using Jones-viola algorithm we give the group photograph from which faces are detected. From the detected different human faces, select one image as test image. There are 390 images that are stored in data base of 39 persons with 10 distinct poses that would be compared with 390 images that are stored in image database. In this system, of faces is done by using HAAR Wavelet transform and 1-Dimensional correlation coefficient. HAAR wavelet transform is used to decompose the detected face image from the group photograph into LL, HL, LH and HH sub-bands. The LL sub-band image contains the maximum frequency component of the face image. The image is reduced to a size of (N/2 x N/2) of actual size of N*N. Therefore, the speed of operation is fast enough as compared to other methods and without loss of high frequency components. HAAR wavelet transform is used to extract the face features and 1-D correlation coefficient is used to match the face features.

B. ALGORITHM FOR PROPOSED WORK

These are the steps of this proposed work using HAAR Wavelet and correlation coefficient:-

1. Enter the group photograph as an input image, in which human faces must be present.
2. From the group photograph given as an input image, segment the individual faces using Viola Jones algorithm for further processing and select one image for recognizing the image.
3. Using the wavelet transform decompose the detected face which have been selected for testing from the group photograph into sub bands and select the Low – Low sub band which contains the maximum frequency component of the face image.
4. The selected sub band is used to extract the features from the image. The image is now represented by feature vector which is one dimensional.
5. Load the ORL Database of human faces for processing.
6. Wavelet transform is used to obtain the four sub bands to test the face image on ORL database stored images and take the component containing the maximum frequency.
7. The maximum frequency component is used to extract the features from the face image. And then, reshape it for converting 2D matrix into feature vector which is one dimensional.
8. Correlation coefficient is calculated between test image and images of the stored database.
9. After calculating the correlation coefficient between the test image and stored database images, matching is performed based on the maximum value of correlation coefficient.
10. After matching the features, Ranking of different poses of similar face images is performed based on ascending order of value of correlation coefficient.
11. Display all the matched images.

C. ALGORITHM FOR FACE RECOGNITION USING EIGEN VALUES

I. Convert the acquired image into greyscale image.

II. Compute the eigen values

III. Compute the mean of the acquired images

IV. Find out the difference of each image from the mean

V. Form a covariance matrix and calculate its eigenvalues and eig

	No. of Images -->		
EV	E1	E1E1	T1
	E2	E2E2	T2
	E3	E3E3	T3
	E4	E4E4	T4

VI. Sort the eigenvalues in descending order and choose the highe

VII. Calculate the eigen values using eigen faces.
VIII. Find out projected train images using eigenfaces.
IX. Take another image which is a test image and repeat the 1st step for this image.
X. Then project this image with the previous projected images and reshape them.
XI. Find out the difference of the reshaped image from mean and then find out the proj with the help of difference image and eigenfaces.
XII. Then find out the Euclidean distance between projected train images and projected
XIII. Face recognition will be done on the bases of minimum Euclidean distance, minim distance; image will be the best match.

Fig.4: Test Image

IV. RESULT ANALYSIS

4.1 Result Analysis

We have given a group image as input to face detection module. There are number of faces in group image. Then, using the viola-jones algorithm, that faces are detected from group photograph. From that detected images, select one image for testing. We have used ORL database, there are 400 images of 40 persons with 10 distinct poses of one person. In this proposed work, we have taken 390 images that are stored in database for proceeding.

Fig.2: Group Photograph

(Different faces are grouped in one image taken from ORL Database)

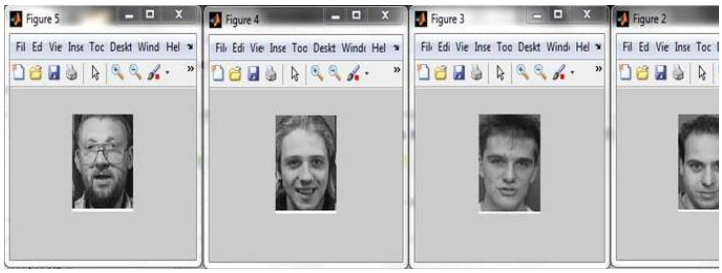

Fig.3: Single Faces are detected from group image

We have selected one single image to give as query/test image. Then apply HAAR wavelet transform on that image and then that is converted into four sub-bands take LL-band that has maximum information. LL-sub band would be of 2-D that would be converted into reshaped into 1D format for find 1D-correlation to matching the features of face with stored database.

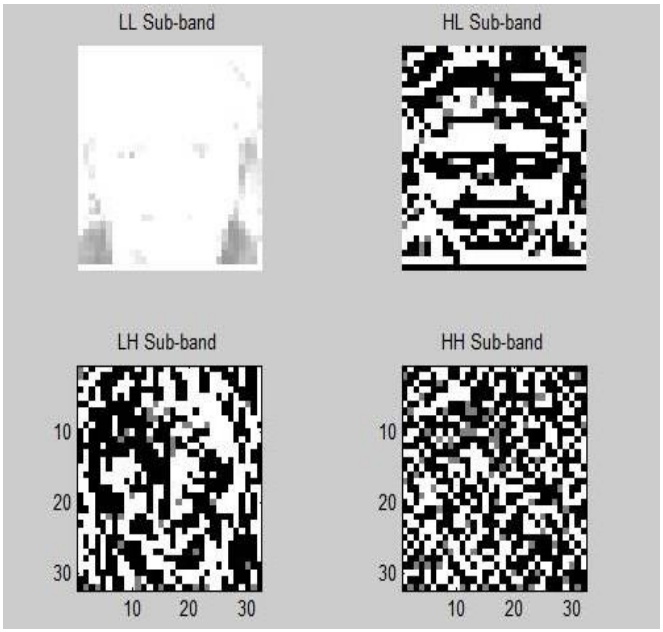

Fig.5: HAAR Wavelet Sub-Bands (LL, HL, LH, HH Sub-Bands)

Fig.6: Recognized Image at variation of pose

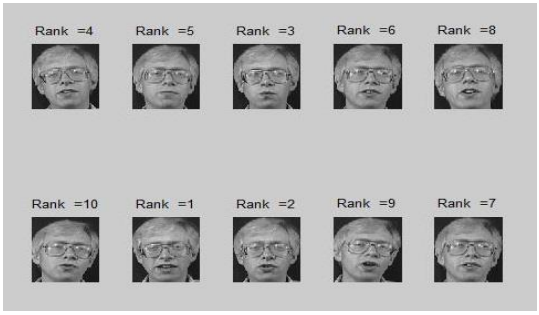

Fig.7: Ranking based upon maximum correlation coefficient

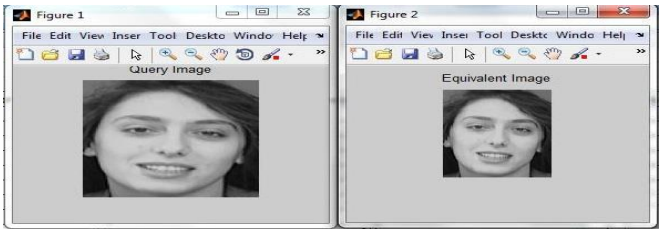

Fig.8: Matching of faces using Eigen Values (same pose)

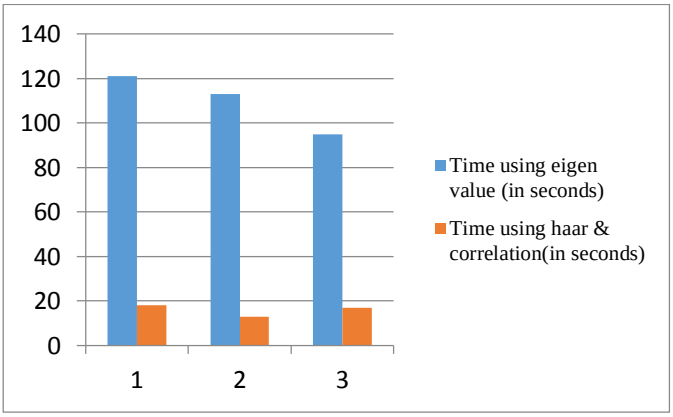

Fig.9: Graph shows the comparison between face using eigen value and using HAAR Wavelet &1D correlation.

V. CONCLUSION

In Face recognition system, challenging to detect the face from group photograph & recognize the faces at different poses. In the proposed work, we have done the detection of human face from group photograph using Viola-Jones algorithm. From the detected faces, we have selected one face image from group photograph's detected faces as a test image. Using HAAR Wavelet and correlation coefficient, we have recognized the face at different poses. Matching of face features based on maximum correlation coefficient Index. Ranking of similar faces at different poses done in this system. That is based upon ascending order of maximum correlation coefficient index and we have compared proposed system with face recognition using Eigen values. In proposed system, system is more accurate to recognize the face at different poses and speedy. Big difference came in time. Processing Time between Eigen value and proposed system is ~110 seconds and ~15 seconds respectively to recognize one face at a time. Face Recognition with eigen values is less accurate to recognize the different pose as compared to proposed work.

VI. REFERENCES

[1]. Ordenes, F. V., & Zhang, S. (2019). From words to pixels: text and image mining methods for service research. *Journal of Service Management*.

[2]. Chaix, E., Deléger, L., Bossy, R., & Nédellec, C. (2019). Text mining tools for extracting information about microbial biodiversity in food. *Food microbiology*, *81*, 63-75.

[3]. Kucher, K., Paradis, C., & Kerren, A. (2018, February). The state of the art in sentiment visualization. In *Computer Graphics Forum* (Vol. 37, No. 1, pp. 71-96).

[4]. Allahyari, M., Pouriyeh, S., Assefi, M., Safaei, S., Trippe, E. D., Gutierrez, J. B., & Kochut, K. (2017). A brief survey of text mining: Classification, clustering and extraction techniques. *arXiv preprint arXiv:1707.02919*.

[5]. Rozeva, A., & Zerkova, S. (2017, December). Assessing semantic similarity of texts–methods and algorithms. In *AIP Conference Proceedings* (Vol. 1910, No. 1, p. 060012). AIP Publishing LLC.

[6]. Gashteovski, K., Gemulla, R., & Corro, L. D. (2017). Minie: minimizing facts in open information extraction. Association for Computational Linguistics.

[7]. Vicient Monllaó, C. (2015). *Moving towards the semantic web: enabling new technologies through the semantic annotation of social contents* (Doctoral dissertation, Universitat Rovira i Virgili).

[8]. Pande, V. C., & Khandelwal, A. S. (2014). A survey of different text mining techniques. *IBMRD's Journal of Management & Research*, *3*(1), 125-133

[9]. Jusoh, S., & Alfawareh, H. M. (2012). Techniques, applications and challenging issue in text mining. *International Journal of Computer Science Issues (IJCSI)*, *9*(6), 431.

[10]. Wu, W., Li, H., Wang, H., & Zhu, K. Q. (2012, May). Probase: A probabilistic taxonomy for text understanding. In *Proceedings of the 2012 ACM SIGMOD International Conference on Management of Data* (pp. 481-492).

[11]. Jusoh, S., & Al Fawareh, H. M. (2011). Semantic extraction from texts. In *Proceedings of International Conference on Computer Engineering and Applications IPCSIT*.
[12]. Wu, F., & Weld, D. S. (2010, July). Open information extraction using Wikipedia. In *Proceedings of the 48th annual meeting of the association for computational linguistics* (pp. 118-127). Association for Computational Linguistics.
[13]. Mulins, M. (2008). Information extraction in text mining.
[14]. Khoo, C., & Myaeng, S. H. (2002). Identifying semantic relations in text for information retrieval and information extraction. In *The Semantics of Relationships* (pp. 161-180). Springer, Dordrecht.