

Analytical Study of Face Recognition Techniques

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Abstract

In today's world face recognition, applications attain great popularity due to best application of image analysis and availability of feasible technologies. It has a wide scope of applications in different fields like pattern recognition and commercial market. A large number of researches have been done research within this field. The different area's Researchers, including computer science and neuroscientist are working within this field. Due to distinct variation in facial expression, occlusion and illumination, face recognition process becomes more challenging from last few decades. In this paper, we critically evaluate different state-of-the-art face recognition techniques. Strengths and weakness of different techniques are identified, which helps in the future research.

Keywords: face recognition; critical evaluation; feature extraction; hybrid approaches

1. Introduction

In biometric technology face is important visual part in daily life, which plays major rule in terms of identification. Therefore, from last 30 years face recognition become the very popular area of research, and best application of image analysis and understanding. Many researchers working within this field not only computer science researchers but Neuroscientist and psychologist as well. Therefore, in short, time, improvement received by biometrics for personal authentication and access control to specific application. Many of the previous methods and approaches were replaced by using biometric technology. The biometric technology using fingerprints, iris, face and voiceprints features to recover issues of easily elapse, stolen and copy secrets in previous approaches. [1] User point of view the face is more sophisticated and friendly visual object using for authentication and access control as compare to be other biometric objects. Face is the more suitable and reasonable approach [2], using in a different area for identification of an entity in the security-related fields, to cover different areas like pattern recognition, image processing and so on [3]. The face-recognition approach received attention from last few years and proved the effectiveness in many fields. Past few years it took attention of peoples it is because of feasible technologies and use of many applications, like in Information security used for desktop logon, Internet security, Application security, file encryption and Personal device logon. In Smart cards used in Passport, Immigration, Driver s' licenses and National Identity Card while in Law enforcement and surveillance used for CCTV control, video surveillance, etc., in Entertainment Training Programs, Virtual Reality, Video games, etc., the recognition system take decision samples that have already been stored on a database by dimension calculation [4]. Recognition of a person's face is a challenge for face recognition systems because of frequently changes in faces due to face expression, illumination, poses and accessories (glasses, etc.) [7]. The general face recognition system has the following main processes.

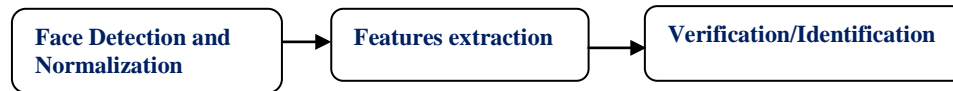


Figure 1. General Face Recognition Technique Diagram

Different techniques are existed for the above key elements, but the basic and more important are feature's extraction. The systems for recognition are getting rapidly advancement in their algorithms. Due to the advancement in these algorithms, the systems are able to recognize and detect other objects as well like car, humans and pedestrians. Because of these advancements, the use with these systems became popular in various fields include industrial manufacturing, security-related systems and medical field [5]. This area is become popular in public because of getting privacy and security. This still a complicated and challenging task for researchers due to human's face is very vigorous (strong) in nature. Changes in a human face can exist in short time (day to day) and long time (month or years) means due to age [8]. Real time face recognition is very important in any educational institutions now days that provide the facility of an automatic attendance system to save time. A researcher has still a big challenge to provide fast and accurate system [11]. The techniques of human face image processing mostly deal image as a two-dimensional signal there for the standard signal-processing technique is applied [14]. It is very difficult to construct a face-recognition model which is computationally less expensive because of the complexity of face. Therefore, in a face-recognition system, the feature extraction is very important for accurate recognition system [15]. Light effect also creates a problem in a face-recognition system; same person image in different light condition can create a problem during feature extraction [16]. Face recognition system recently achieved attention due to terrorism all over the world; the recognition system is important for securing airports and cross border check points in many countries, to compare people images during entering into premises of interest with the terrorist list already exist in a database [17].

2. Approaches to Face Recognition

Face recognition process has three basic approaches for still images, Holistic approach, feature-based approach and Hybrid approach [7].

2.1. Holistic approach: In this approach, the system takes the whole face region as an input and then the recognition system recognizes the face image.

2.2. Feature-based approach: In this approach, the system takes some specified components like nose, mouth and eyes of face as input for making easily recognition.

2.3. Hybrid approach: In this approach, the above both approaches are combined for accurately recognition [7].

3. Classification of Image Operations

Image operation can be categorized as low-level operation, intermediate-level and high-level operation [3].

3.1. Low-level operation: In this type of operation, each image pixel can be changed by point-to-point, neighbor-to-point or global-to-point operation.

3.2. Intermediate-level operation: The operation performs on images and output at this level with other data structure to reduce information like line detection and calculation of center of gravity.

3.3. High-level operation: This level of image processing operations works on vector object or data as vector and provides a result as vector object or data like position estimation. This type of operation can be divided into object-to-point and object-to-object [5].

3. Literature Review

Rao *et al.*, [5] proposed an approach based on image partitions as witnesses for criminals face recognition called "Partition Based Face Recognition System." They say that previous techniques and approaches have issues like in case of image quality is low. It is hard to identify any criminal face. Eye detects from one side, from hard copy of a photograph it is difficult to divide, etc. in this paper in the proposed partition based approach, from the input image after division of face into parts eyewitness considers as a basic part for any face detection, the system afterwards compared the eye witness with database face partitions, if the single match found by single eye witness, after that a system gave to verify criminal face, but in the proposed system during comparison, it is possible to have many same eyewitnesses, then they suggest comparison to other parts stored within the database for to verify criminal face.

Bouzalmat *et al.*, [6] proposed a system for face recognition based on neural network and Fourier Gabor Filter. In this paper, the proposed approach using Gabor filter for feature vector calculation or feature extraction, this is input for BPNN (Back Propagation Neural Network) while BPNN is used for recognition purpose. The authors explained that for feature extraction, they applied the algorithm on whole image, which is colored, after that applies distinctive five resolutions and 8 different orientations using Gabor Filter for getting more information.

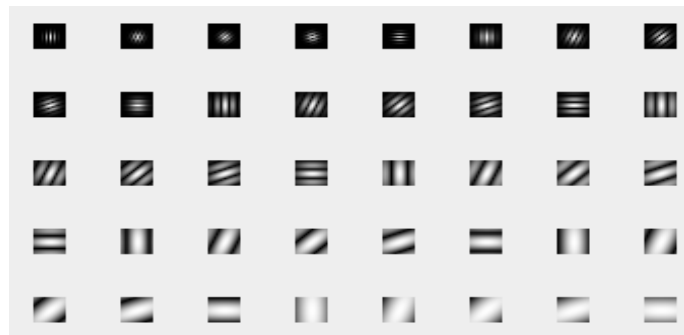


Figure 2. Gabor Filters of size 16 × 16 by 8 Orientations and 5 Resolutions (real part) [2]

In this paper, the feature extraction means that reduction of dimension of 2D image. After calculation of extracted value, the values store in vector for further investigation. The whole system consists of three basic parts; firstly, Gabor filter is used for feature extraction then average value used for reduction and feature vector used for classification using BPNN. They describe the functions to detect the skin regions, which is the actual face; the proposed combination gives fast feature extraction for further processing. The proposed system can extract more information from the face which is very helpful in recognition.

Imtiaz and Fattah [7] describe an algorithm for feature extraction, which is multi-dimensional to recognize face based on two-dimensional discrete wavelet transformations (2D-DWT). They use the local band for selection to have much information based on horizontal bands or segment because the horizontal band has more information and less variation in features as compared to be vertical. They explained that the wavelet coefficient not only used for horizontal band but also uses for vertical and diagonal as well. For reduction of features, they prefer dominant wavelet coefficient. In this paper, they proposed to apply the algorithm on a small part in the H-band to get high between class separations and also useful for feature extraction changes in each image. They expressed that the advantage of this system is the low computational cost because of using few dimensional space and accurate face recognition because of using simplest euclidian classifier instead of complex. The proposed technique can extract more information.

Sarbjeet *et al.*, [8] suggests a new technique for face recognition using Histograms. In this paper for face detection and skin detection, they use a vector machine, Using histogram or frequency histogram (a bar graph) for distribution of shapes and data. According to them, Histograms do not give the exact values, but it provides the basic clue or idea related to data or images. They suggest that for any face detection, RGB image converts to HMMD image for skin detection, Potential face detection, multiple sub-component color histogram Parallel KLTs, face detection (SVM) and then takes a decision about. They proved that histogram technique is best for face recognition, and its accuracy result is up-to 95%.

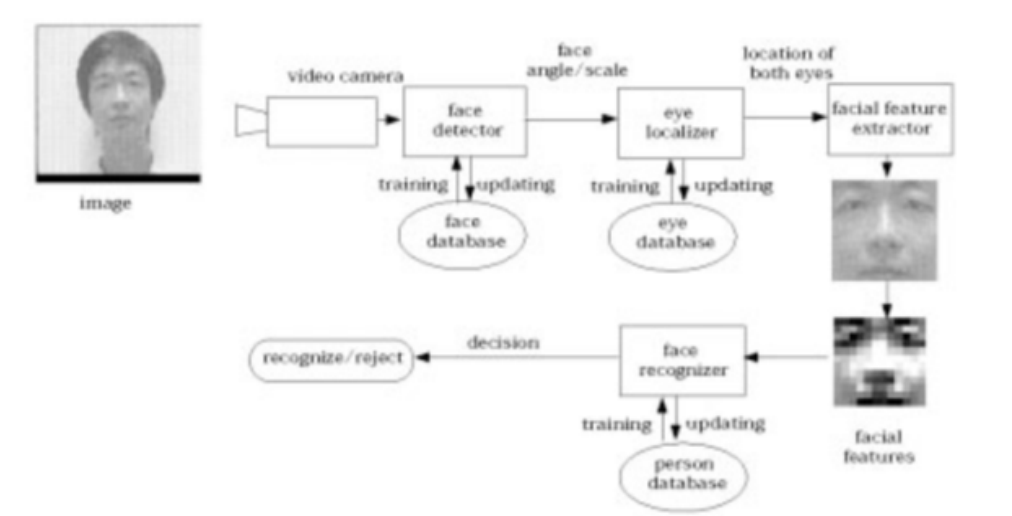


Figure 3. Face Recognition System [8]

Rady [9] suggested a new technique called PCA for feature's extraction and for matching images with training images, using distinct classifiers. He suggests PCA with different classifiers like City-Block, euclidean, Squared euclidean, and Squared Chebyshev that extracted common features and classifies images for recognition of faces. He described that PCA is basically used for dimensionally reduction and feature's extraction in recognition systems.

Kumar and Banerji [10] suggest the combination of techniques for face recognition using Back Propagation Neural Network and for image dimensionally reduction using K2DSPCA (Kernel based 2-Dimensional Symmetrical Principal Component Analysis).

They explain that suggested combination is very faster and accurate recognition of a face even in few seconds. In this paper, they discussed that previous techniques are slow and provide less accurate result, especially non linear face recognitions. They explained, whole input image was taken using a holistic approach which uses K2DSPA for feature extraction means reduction dimensions for high to low, extract all the most important features of data and remove all redundant values. In this paper after calculating the vector of extracted features are then compared with other sets using Back Propagation Neural Network (BPNN) for recognition. For conversion of input space into Kernel space, they generally use K2DSPA.

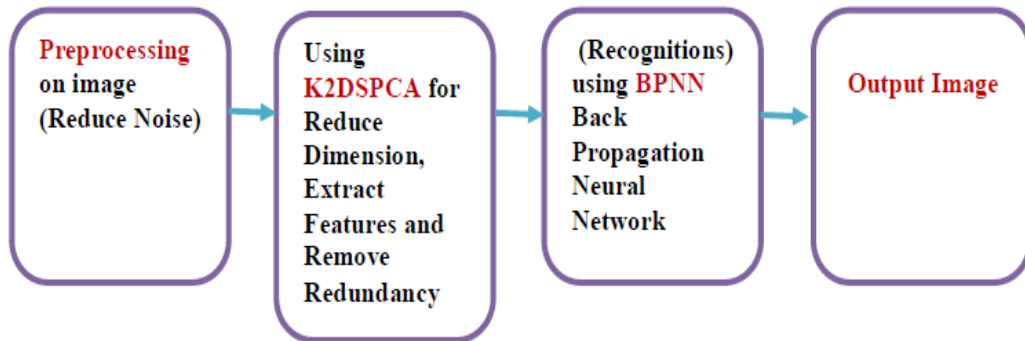


Figure 4. Proposed System for Face Recognition

Hasan *et al.*, [11] proposed combination of more than one technique instead of a particular technique for face recognition called "Face Recognition Using Improved FFT Based Radon by PSO and PCA Techniques" they claimed that previous approaches using single techniques are computationally expensive. In this paper, they suggest for accurate face recognition Radon Transform (RT) with PCA and Linear Discriminant Analysis (LDA) while using two-Dimensional images the Fast Fourier transformed (FFT) theorem is the core for Radon Transform. In this paper for face recognition, two phases use first phase is called enrollment phase of training phase the second is called testing phase, in enrollment phase the images are stored in database and in testing phase, the test image is compared to the database.

Kumar *et al.*, [12] proposed a biometric based real time system using face recognition for attendance. In this paper, the author explained that their proposed system contained AdaBoost with Haar for face detection, AdaBoost is basically used for extraction of lower features and predict the accurate result. Therefore, AdaBoost is combined with Haar for achieving high-accuracy rate and performance improvement; Haar is mostly used for visual face detection like face detection and other object detection as well. In this paper discussed that Haar had the ability for fast decision for accept and reject the segment of the particular area of face image or other objects. Finally, in this paper, the authors perform an experiment on different images, After the experiment, they proved that the proposed system, combination of AdaBoost with Haar and PCA with Linear discriminant analysis provide high-accuracy rate for authentication of a person to enter a specific area and the system also store the authorized person in-time and out-time against the premises of interest.

Rana and Iyad [13] proposed a new approach for face recognition called "Face Recognition Using Harmony Search-Based Selection Features" which give a better result when compared with the existing approaches. They suggest HSA (Harmony Search Algorithm), which is an evolutionary and meta-heuristic algorithm using for

solving different type of problem (summarizing text, flood model calibration, *etc.*) in various fields. The musicians are using the Harmony Search Algorithm for sitting their instruments improving for best harmony during music composition. They explained that Harmony Search Algorithm was based on three basic rules, first randomly selection value from the specific range, secondly value selection from harmony memory and thirdly select adjacent value. Harmony's presentation is done with two values for selection of extraction of features, if the presented value is zero, then the feature is selected if the presented value is 1 it means that the feature is not selected. In this paper, the authors perform the experiment on ORL database with distinct images using the combination of different techniques.



Figure 5. Block Diagram of HS-based Recognition System [13]

Vaidehi *et al.*, [14] suggest a technique to detect a person's face for authentication because they claimed that previous techniques had the problem of detection errors and recognition. Therefore, they proposed the technique which takes a decision on skin color base, to detect the frontal faces of a person while feature extraction of Profile Fourier Coefficient (PFC) using template matching. In this paper, they suggest PCA for extraction of features and then project into subspace. KNN is a classifier which is used throughout this paper for recognition purpose. In this paper, the detection and recognition algorithm has been applied on varies the effect on focused image to detect both dark skin-stone and bright skin-stone. In this paper, the noise issue with focus area has discussed within this paper that if the, there is more noise, the class should be incorrectly assigned, and many k value selection controlled this problem. Therefore, in this paper, the KNN is used to solve this problem of incorrect selection on small values, K Nearest Neighbor is a select small value of K to overcome this issue and select correct class. Shaban and Sulaiman [15] proposed an approach for face recognition based on Wavelet-Curvelet. In this paper, the proposed technique is used for dimension reduction and feature extraction, which is bitter (less computationally expensive and low memory consumption) than other approaches according to authors. The authors use this technique for embedding the similarities in images. In this paper, the wavelet transform is defined on specific number (finite) intervals. In this paper Curvelet and Wavelet transforms are discussed uniquely and then combine both. The wavelet transform is mostly used in digital signal processing for recovering of noisy signal but in this paper, the 2D- DWT transformed is used for image compression into multi resolution for keeping slightest coefficient without missing any useful information, which is necessary for and for face recognition system. The Curvelet transform is basically multi scales transform; elements are indexed through location parameters and scale with the high degree specific direction of its pyramid, but in this paper Curvelet via wrapping is used, wrapped based on Curvelet take less computation time during transformation and robust result with respect to other transformation techniques. In this paper, the Nearest Mean Classifiers (NMS) is used for recognition purpose. When the Curvelet transformed to apply on image size of (256 x 256) take more time for

execution, therefore, the Curvelet is combined with wavelet transform because the wavelet transform output image size is (64 x 64), combination of wavelet and Curvelet transform take very small execution time. The proposed technique can consume less memory size and computationally less expensive.

Gufta and Sharma [16] proposed an approach for face recognition. In this paper, the whole recognition system divided into two steps, first extraction step and second is the recognition step. For extraction the authors use Sub-Window extraction algorithm and for recognition purpose use combination of PCA (Principal Component Analysis) with Back Propagation Algorithm. In this paper in extraction phase, the input images are collected from different devices, in pre processing some action have been applied for removing background and noise from image, they proposed the clipping and filtering technique's while histogram equalization proposed for controlling lighting effects (brightness and contrast). In this paper, the Sobel operator is the use for converting the enhanced image into edge image and after conversion, the Sub-Window algorithm is the use for extraction of the sub window from edge image. Combine PCA and Back Propagation for calculate accurate recognition rate. The proposed Sub-window algorithm with PCA and Back Propagation provide accurate results with less time.

Adebayo *et al.*, [17] proposed face recognition approach for authentication of terrorists. In this paper, the system divided into two phases, (face database formation phase and training phase). The proposed system could be implemented for the security of airport and border crossing points. The weights are then stored within the database with another information (name, *etc.*,) of terrorists. In this paper, they combine feature based technique with principal component analysis for efficient system. The aggregate weights of a single image are calculating through principal component analysis after individual feature's extraction from each image and thus finally stored within the database. In this paper, the recognition phase explained by the authors: according to them, the input image should be taken by camera and normalized for any effects and resize to default on size. In recognition phase, the PCA is then used for calculating weight for an image from these features, PCA calculated and finds eigen face from the extraction phase. The decision has been taken after comparing two weights, database weight and testing weights (acquired image). In this paper, the proposed system checked the similarities, "known" if find similarities otherwise "unknown." Finally, they proved after experiment that the proposed system presented best recognition rate as compared to the existing techniques.

Agarwal *et al.*, [18] proposed method for face recognition using the combination of two different techniques for feature's extraction and recognition, the authors proposed PCA for feature extraction and for recognition using Back Propagation Neural Network. The proposed method performs coding and decoding operation on face image.

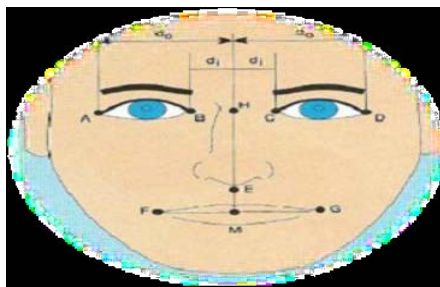


Figure 6. The Face Measurement [18]

In this paper, the discussed approach can extract features without any interference of (open/closed) eyes, facial expression with glasses or without. In this paper, they apply preprocessing, which is necessary for size sitting, equalization of histogram and for conversion into grayscale to improve recognition rate. In the proposed system face, images are stored at the face library; the face libraries are then used in any kind of operation like eigen face calculation or training set generation. The proposed technique is compared with other two approaches (K-means, Fuzzy Ant with fuzzy C-means) the recognition rate of the proposed technique was high.

Saurabh *et al.*, [19] proposed statistical approach for face recognition called "Principal Component Analysis for Face Recognition." Every face-recognition system has the functionality of face detection, feature extraction, and classification (recognition), in all of these steps feature extraction is more vital because of showing differences in different faces. In this paper PCA briefly discussed and show that many systems use PCA for dimensionally reduction and feature extraction before apply any classifiers. The accuracy ratio calculated against the recognized images with respect to training images after applying on two different databases. In this paper, the authors apply euclidean Distance Classifier for classification purpose. The euclidean classifier shows the similarity between test images and database images.

Imtiaz, Fattah [20] proposed an approach instead of taking entire face image for further processing it was good to extract a feature through horizontal line, which is more informative in case of variations. They describe that the whole algorithm based on DFT (Discrete Fourier Transformation) which is two dimensional furthermore explained that information extracted from different segments by each segment contained some sort of information that depended on regions. They say that the segments which are near to eye, mouth and nose have more information as compared to other and the comparison had been performed between pixels in images. In this technique, they propose Principal Component Analysis (PCA) for dimension reduction, which is efficient as compared. They prove that this technique is not computationally strong because of low dimension for extraction space, and it is so simple because of using simple classifier use instead of complex classifiers. They claimed that Spectral Domain Local Feature Extraction algorithm was easily implementable in practical applications because of using Fourier Transformation. However, still there is some problem that this technique also calculates the skinny part from the body as a face.

Anissa *et al.*, [21] describe that Gabor filter created feature's quality is so high and computationally expensive. Therefore, they use Random Projection reduce dimensions for resizing (32x32) which is easy to implement, fast and much effective as compared to be other, therefore, they suggest Spare Random Projection. They use Back Propagation Neural Network for face recognition because BPNN had the quality to control the square error between the output of Network and target output.

Kashe *et al.*, [22] suggest to used PCA for feature's extraction and BPNN for face detection. They claimed that previous techniques had problems like an accuracy acceptance ratio, computationally slow. So this technique overcomes these problems. They used PCA to reduce the size of image to low dimension also it extracted many features from image. They say that PCA is the best approach than any other to detect face, feature extraction. They proposed face landmark approach to find different nodes in the face and calculate its value as characteristic of image. Different variation of the face expression stores in a database like sad, anger, and happiness facial expression. For face recognition, they proposed an algorithm with the combination of neural with PCA.

Satone and Kharate [23] claimed that skin color algorithm had many advantages it's faster than any other approach. Due to variation intensity, it is easier to calculate the value and

detect a face. They suggest this technique because previous approaches have problems like a distinct camera capture a picture with different lights, Object motion. So high and low level of light effect's detection process. Using a skin model avoid this problem. For face detection, they proposed two processes, first to separate skin area form non-skin area in image and then locate face area in an image. For skin area detection, they used RGB model. Problem with RGB not only color is counted also light is counted, which affect a recognition process.

Jain and Pawar [24] suggest instead of 2-D it is necessary to use 3-D model because the 3-Dimensional model could not be affected by light and have the ability to recognize an image up to 90 angles rotate as well. In this approach, they expressed a technique which can take an image from different position. It detects a face from image determine its heads with different position and its size. Next, the system measures the curves on the face and creates a template. Next, the template is converted to a specific code. If the database contains 3D images simply it matched and recognizes the image, but a problem is; when the store image is in 2D form, it converts the input 3D image into 2D and after that matched with a database for accurate recognition.

Manal and Majda [25] describe PCA for feature extraction and data representation. Author did three experiments to optimize the time complexity of PCA using Eigen faces. The authors do a comparison of time between the enhanced algorithm and original algorithm. The author tests the enhanced proposed algorithm using a face database called face94. According to the author result the recognition time is 37% faster and accurate than simple PCA. The author says we improve the time computation of PCA with their exacting performance. For the experiment, the author conduct three experiments in Met Lab.

Daniel *et al.*, [26] claimed that there are many types of LBP are used before for feature's extraction, but the problem existed in LBP is that it can't automatically adapt training data. The author claimed that our technique solved this problem. They explained that DT-LBP technique was the method of LBP performs on the neighbor pixel which is equal to a fixed binary decision tree, two pairs (c. center of pixel, n) is used to make a binary decision tree S level on the tree and the no of a node on each level compare with the center pixel also with the neighbor pixel that n1 b/w n, and each level is compared while if the center pixel value is less than node1 assign the vector to left node if grater assigned the vector to the right node in this way the whole tree is compared from level 0 to level n.

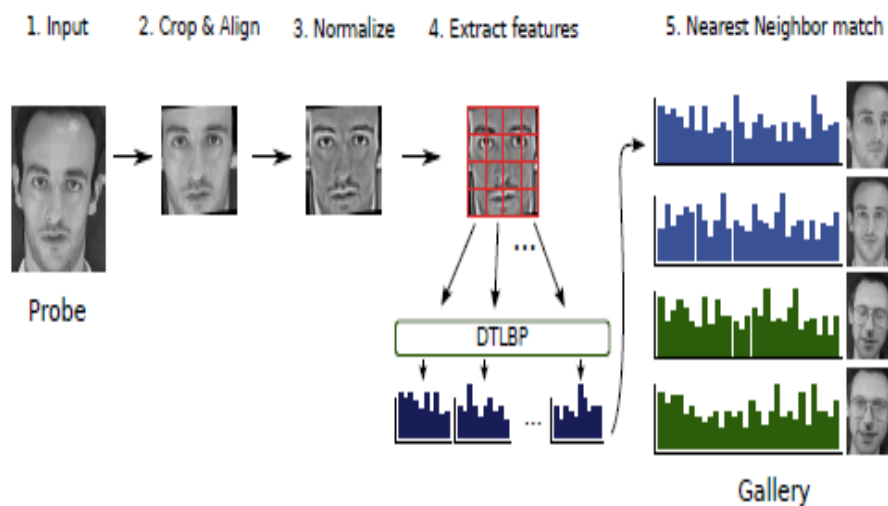


Figure 7. Face Recognition Pipeline [26]

Ramesha and Raja [27] says that store images into the database are in different size and format to apply Dual Tree Complex Wavelet transformed (DT-CWT) the images are first converted to a standard format. The authors claim in previous technique the problem for face recognition is low and high level of light on image and different poses. The proposed discrete wavelet transform (DWT) solved this problem also it reduces the size of image by decomposition method. DWT divides the input image into four sub-bands. Complete information of image is present in a low-low (LL) sub-band which contain enough information of original image. Then two-level DWT is applied to image for image size reduction. Furthermore, it removes light variation and expression from input image. Author claimed that DWT gave us fewer feature and very low accuracy rate. To overcome these problem authors suggest Dual Tree Complex Wavelet transformed (DT-CWT) for feature's extraction. According to the author, the no of feature and dimension are inversely proportional to each other, as the DT-CWT level increase feature dimension size is reduced. The author proposed 5 levels DT-CWT because less no of a feature required less memory and less computation time.

V. Radha *et al.*, [28] suggests a new approach for face recognition called “Neural Network Based Face Recognition Using RBFN Classifier” They claimed that precious techniques had accuracy and acceptance weakness the author suggests a best technique for best face recognition. Radial Base Function Network is used to detect the frontal view of faces in image and also it is used to classify face images on feature base further they used Radial Basis Function network to remove unwanted classes. Curvelet transformed, and linear discriminant analyses are used to extract features from a face. In curvelet transform images are divided into detail parts, which are called cure faces. After that this curve face is used to reduce the dimension of original image. Then LDA is applied to sub band cure face to further reduce its dimensions.

SarawatAnam *et al.*, [29] suggest a new technique combination of back propagation neural network and Genetic algorithm for face recognition. The author claims that the proposed model is computationally fast, very simple technique and can easily implement. Further the author claims that the proposed approach has many advantages compare to other techniques is time of recognition faster and simple also this technique have an ability of learning. The whole recognition process is consisted of three simple steps in first-stage preprocessing is applied on input image. Using different techniques, features are extracted from image, which will be the input for BPNN and genetic algorithm. Classification is done through back propagation neural network and Genetic algorithm.

Anila and Devarajan [30] suggest a new algorithm for fast face recognition. Author's claim suggested algorithm in this paper is faster than previous technique. The proposed algorithm in this paper consists of three steps. In first steps, image quality is improved by applying the median filters also it removed noise from image and applies histogram equalization for contrast adjustment. Histogram equalization recompenses the lighting condition of image and improves the contrast of image, in second step, an edge image is built from enhanced image by applying sobel operator, after that an algorithm called novel edge tracking algorithm is applied to draw a new edge image window from the enhanced image. First, the edges are detected through sobel operator from the image and Novel edge tracking technique is used to detect face and ignore background area on an image. After that the rectangle feature is measured from the new image. The value of a two-rectangle feature is the difference between the sums of the pixels within two rectangular regions. The regions have the same size and shape and are horizontally or vertically. In third step, the features are given to a trained. Back propagation neural network to classify that the new sub window is face or non-face area. To

train back propagation neural network first the rectangular features are normalized between 0 and 1, and assign feature value to input neuron.

Najan and Phadke [31] Stated that an automatic face recognition consisted of three parts face detection, face alignment and face recognition. Usually these processed are in a bottom to upwards a manner. In this paper, DCT is proposed for face recognition. Face recognition algorithm based on local facial regions represented with discrete cosine transform (DCT). These techniques give us a fast face recognition compared with other techniques. Take an input images from database or webcam resize to 200x180. After that the image is again resize to 200x180 and converted from RGB to be gray. The suggested algorithm is applied to a picture database which gives recognition accuracy of 95%. Author claims that the proposed algorithm is computationally fast because no pre-processing step involved in this technique, also it archived high recognition accuracy rate.

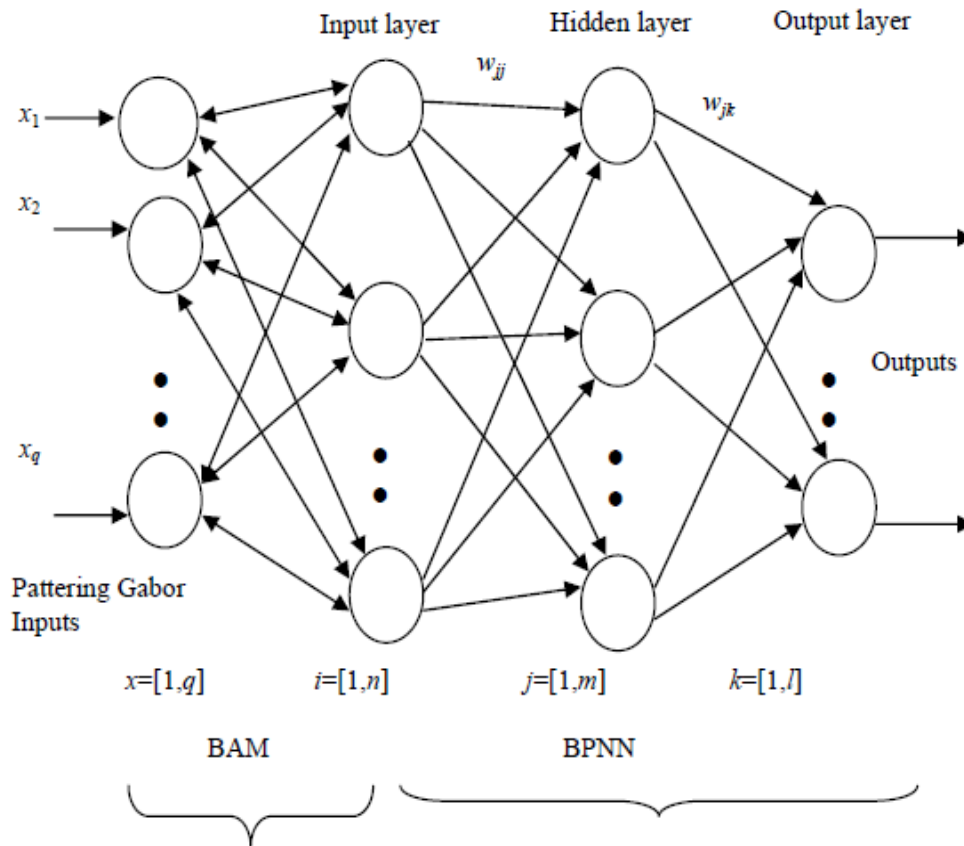


Figure 8. Hybrid Neural Network [31]

Amina and Bhuiyan [32] Author claimed that Gabor based face representation is the most successful technique in face recognition. In this paper, a hybrid neural network solution is proposed for face recognition trained with Gabor features. The model proposed in this paper for face recognition is consisting of five modules. First face is extracted from image. The extracted image is then processed through different techniques; first image is converted into a gray scale image, calculate the centre of eyes and cropped into 100x100 pixels and pre-processed through contrast and illumination equalization, fuzzy filtering and histogram equalization. In third stage, features are extracted by Gabor filter. In patterning each pixel replaced by a pattern that taken from binary fonts. Fonts are used to print an image consisting

of ten gray levels. So each pixel is replaced by 3x3 blocks. At last level face recognition is performed by a hybrid neural network. Consisting of two networks Bidirectional Associative Memory (BAM) and Multilayer Perceptions with a back propagation algorithms to train the network

Patidar *et al.*, [33] says that human face recognition performed naturally by humans it is difficult for a computer to do same recognition like human. Face recognition algorithm classified an image on the base of features. Features in each image are eyes, nose, mouth, hair. These are the factors of features for face recognition. Proposed algorithm in this paper use nose eye mouth jaw etc. key points of face and make a template. After that the template is compared against a database to find the closest match. In this paper, the whole recognition algorithm consisted of four steps. Acquiring a simple in this step the proposed technique is to collect images from different resources like camera and sensors but in this approach the image is given manually. In second step, features are extracted from given simple different techniques are used.



Figure 9. Recognized Faces [33]

M. Ramadan *et al.*, [34] Author state that features selection is a global optimization issue in machine learning. To minimize the number of features, remove unimportant, noisy and duplicated data. Minimization of these factors will give us acceptable face recognition. Further author stated that feature selection was the most important step which affects the performance of face recognition. In this paper, a novel feature selection (FS) algorithm based on particle swarm optimization is proposed. PSO is a fast technique based upon the combination model inspired by the social behavior of fish schooling or bird flocking.

4. Critical Evaluation

Ref	<i>Techniques Used</i>	<i>Strength</i>	<i>weakness</i>
[5]	Partition Based Face Recognition System	Accurate and multiple face processing identification	Slow because of geometrical features
[6]	Back Propagation Neural Network And Fourier Gabor Filters	Maximum and fast features extraction	Computationally expensive and calculate without face area
[7]	WAVELETBASEDDOMINANT FEATURES	Extract more information and fast	Wavelets are not sensitive with illuminations condition
[8]	Robust & Accurate Face Recognition using Histograms	simple	Histogram is not good tools for face recognition. Not stable under different illumination conditions. without face area also calculate because of skin color
[9]	Principle Component Analysis with Different Distance Classifiers	Accurate and fast	In case of missing value not give correct result because of linear data
[10]	Face Recognition Using K2DSPCA	Easily recognition Use in real time applications Fast execution	Because of many layers, consume more time and memory
[11]	Face Recognition Using Improved FFT Based Radon by PSO and PCA Techniques	High recognition rate because of Radon Transformation	Easily suffered by partial optimism at result minimize extraction rate
[12]	REAL TIME FACE RECOGNITION USING ADABOOST IMPROVED FAST PCA ALGORITHM	Used for real time face detection and recognition Fast and simple High accuracy rate	If the relation between two variables are weak then PCA not reduce dimensions
[13]	Face Recognition Using Harmony Search-Based Selected Features	Accurate	Memory consuming and time consuming
[14]	PCA and KNN	Accurate Provide high recognition rate in large database	Memory consumption (lazy learning), need to determine value of parameter K.
[15]	WAVELET - CURVELET TECHNIQUE	Computationally less expensive Consume Less memory size Take less time	Wavelets are not sensitive of illumination condition
[16]	Sub-Window Extraction Algorithm	High recognition rate	Computationally expensive and time consuming

Ref	<i>Techniques Used</i>	<i>Strength</i>	<i>weakness</i>
		Take less time	
[17]	COMBATING TERRORISM WITH BIOMETRIC AUTHENTICATION USING FACE RECOGNITION	Good recognition rate under real time scenario, Fast recognition	Not good with Pose, Beard and Glasses
[18]	Eigen Faces and Artificial Neural Network	Bitter recognition rate. Collect more information	Eigen face is sensitive to head orientations and very mismatched occur on large head orientation
[19]	Principal Component Analysis	Simple Increase recognition rate.	Missing information because of noise and pose
[20]	A Spectral Domain Local Feature Extraction	Less miss rate, efficiently extract feature, high recognition accuracy	More time consuming due to large Fourier transform computations. false positive results
[21]	Face Recognition Using Neural Network Based Fourier Gabor Filters & Random Projection	High accuracy rate and robust to change in illumination.	Computationally very expensive. Due to high dimensional Gabor feature vectors Computation process is slow
[22]	Face Recognition System Based on Principal Component Analysis (PCA) with Back Propagation Neural Networks (BPNN)	Computationally fast. BPNN technique is combined with PCA, non-linear images can be recognized easily Recognition rate is 90%	Yale is involved which can't give correct value. Difficult to solve BPNN by traditional computational methods. its accuracy rate is affected in large amount of data
[23]	Face detection and recognition in color images	Fast and simple Less memory consumption	The implication is only on 30 images. Also detect the skinny part as a part of face. Accuracy rate is 70%.light brightness.
[24]	A Novel Approach For Recognition Of Human Face Automatically Using Neural Network Method	Correct recognition rate. high accuracy	Consume large memory size. and slow due many level layers in BPNN
[25]	Optimizing Face recognition using PCA	Best recognition rate. Claim that achieve FAR 100% but impossible	high computational time especially for big size database Just comparison of two technique not new implementation

Ref	<i>Techniques Used</i>	<i>Strength</i>	<i>weakness</i>
[26]	Face Recognition with Decision Tree-Based Local Binary Patterns	Accurate result	Can't adapt training data LBP is used. If number of neighbor's increases in LBP then dimension is increased, result in more memory consumption. Incorporate weights for different facial regions.
[27]	Dual Transform based Feature Extraction for Face Recognition	The correct recognition rate, efficiency. better if compared to other techniques	900 pre-processed images used with no back ground color.
[28]	Neural Network Based Face Recognition Using RBFN Classifier	Correct recognition efficiency	many techniques are involved which cause computationally slow. no learning process included
[29]	Face Recognition Using Genetic Algorithm and Back Propagation Neural Network	Low miss rate. 91 percent correct recognition rate	Many technique of feature extractions makes the computation slow
[30]	Simple and Fast Face Detection System Based on Edges	Robust to illumination, efficiently remove background	Having False acceptance Rate
[31]	DCT Based Face Recognition	Computationally fast because no pre processing step involve.	Poor recognition rate. Due to light increase and decrease.
[32]	Neural Network based Face Recognition with Gabor Filters	Can crop with illumination changes. Hybrid network (BAM and BPNN) rather than BPNN takes less iteration to train and less time to recognize faces.	Still 16 % false recognition problem. Having FAR. The images have poor contrast because of the limitations of the lighting Conditions.
[33]	Robust Face Recognition Using Artificial Neural Network	Learning process involve	Computationally slow. Consume large memory size.
[34]	Face Recognition Using Particle Swarm Optimization-Based Selected Features	Computationally fast 97 percent recognition rate less time to compare with store pictures	Easily affected of particle optimisms and decrease recognition rate

5. Conclusion and Future Work

From last few decades face recognition cover many fields not only computer vision. Therefore, faces recognition is a challenging task in different fields. Because of feasible technologies of applicable in varies field, face recognition gets attention. Due to changes of human faces in short and long time becomes a challenging and hard task for researchers. In this, paper face recognition; techniques are critically reviewed and discussed. Face recognition latest technique's strength and weaknesses are presented in the above table. In real time environment fast and accurate face recognition is still a challenge for a researcher. In the discussed, techniques have still problems because of illuminations and pose. Performance of the existing techniques can improve in terms of recognition rate, time and memory.

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