Image Recognition Technique using Local Binary Pattern Methodology for Extraction of Features

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Abstract-*This paper represents an efficient Image Recognition Technique such as Principle Component Analysis Eigenface, Linear Discriminant Analysis Fisherface and Local Binary Patterns (PBP). This System helps to identify and detect a person by their different facial features, expressions using some processing through trained database. This Paper consists of face recognition application consisting of image preprocessing to crop and smoothen the image, convert RGB to Gray, removal of noise and then recognition of the image. It is an application which identifies and then process the image and last validates by recognizing the face from the database. The LBP technique is best suitable to recognize images with different circumstances such as poor lighting, poses and facial expressions. Face recognition system plays a vital task for security issues and authentication for authorization purpose which provides efficiency and high accuracy.*

Keywords: Principal components analysis, linear discriminant analysis, local binary patterns, face recognition, face database

I. INTRODUCTION

Face Recognition field has vast applications which receives huge interest for the security problems. It is a recognition system of detecting a person through capturing the digital picture and comparing it with the trained database. Multiple social networks use face recognition techniques by using tagging system on Facebook, for unlocking the applications. Moreover high-performance method is hard to implement with low-resolution pictures characterized by various facial expressions and dark light lighting conditions. Principal components and linear analysis has been used a long way back approach mostly as they are more efficient to use and are divided as based models. Hence, recent methodologies are been applied to CCTV or laptop or mobile camera systems to implement intelligence in the application. The picture in a camera contains low definition and resolution. Component analysis, Linear Analysis, and Local Binary Patterns are analysed with much accuracy and efficiency as they are pixel-based techniques for processing digital images.

The picture in a camera contains low definition and resolution. In this research, most pixel-based face recognition methods such as component analysis, Linear Analysis, and Local Binary Patterns are analysed through accuracy and efficiency. Face Recognition has been evolved for last few years and due to development there is increase methods difficulty which take much more time in coding. Face tracing and recognizing contains huge different applications and fields where it helps to detect the face of person with much efficiency and it also prevents unauthorized access and security problems. Various Face algorithms are used for recognition techniques. Principle component analysis(Eigenface), Linear Discriminant Analysis(Fisherface), Local Binary Pattern are used. Principle Analysis built by Trunk and Pentland and it also came to known as Eigenface recognition technique. The accuracy of this algorithm is dependent on the face that are centralized and uniform. The Principle Component are repeatedly used to decrease the dimensionality of huge dataset and to decrease the mathematical complexity. The LDA algorithm is used for Face recognition system. It separates the class faces and individual faces therefore by increasing the recognition rate. It is much more difficult than in principle component but it is more robust in lightning conditions.

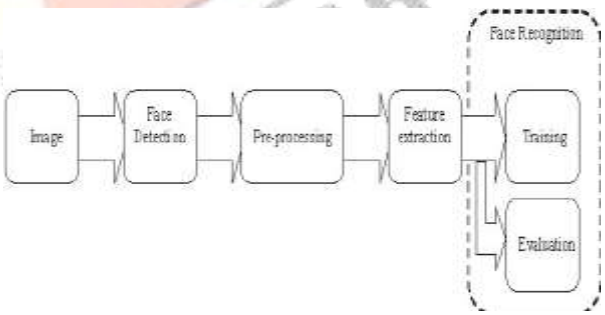

Fig. 1. Block diagram of Face recognition

Image detection and recognition is important application for authentication and with various human system, the face has the most unique features and can be noticed easily by comparing iris detection for authorization or fingerprint which needs to be detected very closely for accessing and detection. Human's different facial features and al the expressions plays an important task in different fields such as human digital image detection, image processing and video surveillance. There are many problems faced by face detection algorithms such as the presence of beard, moustache on the face, a person wearing specs, his weird facial expressions like surprised look and a

crying look. It will also contain different illumination and under dark lighting conditions such as in video surveillance, quality and size of the image such as in the passport. Complexity in the background can also lead hard to detect faces. In this study, many methods and research related to face recognition provides a good solution for image detection and recognition with increased accuracy and a better speed with good response rate.

In order to trace, analyse and process a person's face it should focus more on its unique features. The uniqueness of a person is impossible to clash with the other person unless a very rare case where it has complete identical characteristics. Image of a person can be accessed without disturbing the targeted person and non-contact environment. The technology is very advantages as it is more of noncomplex operation with intuitive result. Therefore, it has a wide application in the fields of information security control, complex criminal detection and automated entrance control. It contains better efficiency and accuracy methodologies which will be flexible and robust.

There are many applications such as military application for security purpose, automated attendance systems, authentication at the airport, to identify criminal person is performed using Image recognition technology. The person face is important key to detect how it will identify its face in the database. There are two steps such as verification and Identification used in face recognition technology for comparing the face of its own or with another person. The image is compared by verifying with its own picture that is already present in the database and it tries to match individual against same person's image stored in database. The next is identification, here it identifies the stranger. Here it matches person's image with every other person in the database.

II. LITERATURE SURVEY

- ***Existing System***

In the Existing System the Eigenface and Fisherface is applied to the Face Recognition Technique. The Objective of Eigenface it search for a few linear combinations, which can be used to summarize the data and loses in data as little as possible. For face recognition a 256x2 face image is equal to a 665546 vector and a new dimensional is achieved which has the stored count of images in the database. The principal components that divide the face into feature vectors and to put across the pixels of 1-D vector from the 2-D facial image into its discrete components of the features. This can be said to be as an Eigen Face projection. A covariance matrix gives us the information about these feature vectors. These eigenvectors are the basis for measurement of variation among several faces. The faces are described by a linear combination of highest Eigenvalues. Each face can be considered as a linear combination of the Eigen faces. Then the face can be estimated by using the eigenvectors occupying the largest eigenvalues.

PCA also known as Karhunen-Loeve method and it is one of the most used methods for selection of different features and dimension reduction. Recognition of human faces was first done by Turk and Pentland by PCA and reconstruction of face image was done by Kirby and Sirovich. The recognition method also known as Eigenface method defines a feature space which decreases the dimensionality of the original data. Not so good discriminating power within the class and huge computation are common difficulties faced in PCA method but this is overcome by Linear Discriminant. It is the most important algorithms for feature selection in appearance based methods. Most of them who uses LDA based face recognition system uses PCA to reduce dimensions and then LDA is used to maximize the discriminating of features. It has the very little size issue in which sets of data must have larger records per class and good discriminating extraction of features.

Fisherfaces is the mostly successfully used Technique for face recognition. It is work on appearance based method. In which LDA to detect set of beginning images which has maximizes the ratio of class scatter and within class scatter. The demerits of LDA the class the scatter matrix is always single value, but the number of pixels value in images is bigger than the number of images so that is the reason of increase detection of error rate if there is a change in position and lighting condition within same images.To reduce this problem different methodologies are been used such as fisherface do their task with excellence within-data of class and decreases the change within class. Problem are related with change in the same images in lighting changes can be control. The Objective of Fisherface is it looks for dimension reduction based on discrimination purpose. The differences within the faces in the stored database comes from distortions noise, dark conditions, no properlights on the image and poses variance. These variations are larger than variations among standard faces. The images under different illumination with fixed pose lie in a 3D linear subspace of the high dimensional image.

PCA also known as Karhunen Lower Transformation is used to reduce the dimensionality. Its main aim is to reduce the data onto lower dimensional space also called as Eigen space by computing the Eigen values and Eigen vectors of dataset. The output of PCA is the input to LDA algorithm. The LDA manipulate the scatter matrix within class and between the class thus distinguishing the images and increasing the recognition rate. By manipulating the matrix we derive the Euclidian distance. The Eigen result method is an iterative for processing of Eigen value and Eigenvectors of a similar matrix. It is named after the person who invented it Carl Gustav Jacob Jacobi. Jacobi Eigen value computation requires a lot of mathematical computation and lot of rotation of the symmetric matrix. The Tranning module consists of face Gray scale conversion module, a Gaussian filter module to filter the image, Normalisation Module, and vector conversion module. The recognition module consists of all the pre-processing steps of training module. The image to be tested in converted to gray scale, filtered, normalized and then Papered onto the Eigen space by multiplying weights. Euclidian distance is calculated between the test image and train images and image is identified as recognized or unrecognized.

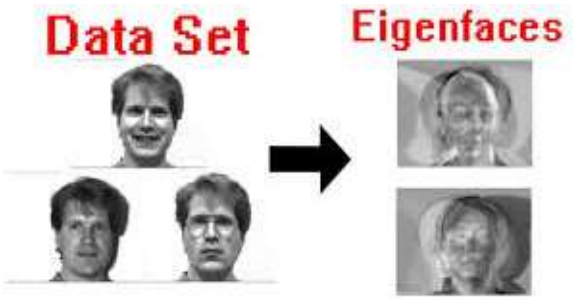

Fig. 2.1 Dataset of Eigenface

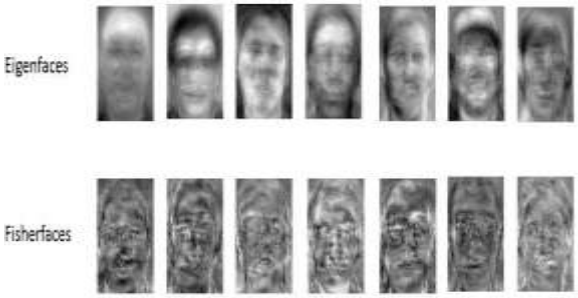

Fig. 2.2 Dataset of Eigenface and Fisherface

- ***Proposed System***

In the proposed system the face recognition technique uses Local Binary Pattern Algorithm and Laplacian of Gaussian methods. Principal Component Analysis, Fisherface and Local Binary Pattern methods are compared with each other. It consists of an image with queries of various facial expressions such happy, sad, grumpy, shocked, suprised. Pre-processing is done by Laplacian of Gaussian (LoG) and then LBP operator is applied to extract the facial feature of the face.

The dataset is been used to classify and test by vector machines and Yale b database is used as training dataset. The LoG operator is used to detect the edges of the image to get the more details of the face. It highlights the changing intensity and removes the noise from the detected image. The operator will take gray image input will give grey image as an output. This method works in first two order derivatives of an image. In this operator the gradient method is used to detect the edges in first order and in the second derivative Laplacian method is used to search the zero crossing. And then to the face image an LBP operator is applied.

III. FACE DESCRIPTION METHODS

Face Detection is a foundational job for different applications such as tracking of face, removal of redeye and face expression recognition. In order to have workable systems efficient and robust face detection algorithms are required. face detection methodologies creates problem for classification as it is difficult to implement a better classifier of a face. Hence, different approaches such as such as neural network model that can be integrated with vector machine methods can be proposed for a reliable classifier. The proposed method use features as pixel values and they are called Haar-like features. These features encode differences in average intensities between two rectangular regions, and they are able to extract texture without depending on absolute intensities. Recently, ViolaJones proposed an flexible system for executing and extracting these features which is called an integral image . And, they also introduced an efficient scheme for constructing a strong classifier by cascading a small number of distinctive features using Adaboost. Its result is more robustness and computationally efficient. Many improvements have been proposed on viola jones. The main objective of a boosting algorithm is to generate a strong classifier composed by some weak classifiers. For each iteration the boosting algorithm invokes another algorithm, generically referred as weak learner, that is responsible to produce the weak classifiers,

The Adaboost algorithm used to boost a set of weak classifiers into a strong classifier. there are two approaches The first approach is an enhancement of the boosting algorithms. This method is largely used such as many variant of AdaBoost as Real AdaBoost, LogitBoost, Gentle Adaboost, KLBoosting, have been proposed. The second is the features enhancement Lienhart introduced the rotation of an image in order to get the correct image and Mita and Kaneko introduced a new scheme which makes Haar-like features are more distinguishable. Haar cascades provides good performance in extracting textures and cascading architecture and integral image representation make it computationally efficient, it is still not feasible on mobile products. In the real world scenario, it is often difficult to get a controlled environment to get the good quality images, for example, in scenarios where face recognition is used in a surveillance system.

Face recognition is successful application of Pattern recognition and Image processing. It compares An image with all other images in a database. It is vital technique as there are many commercial and law, security applications such a as forensic identification, access control, surveillance and human communication and mobile devices applications. Principal Component Analysis and K-nearest neighbour algorithm classifier and Linear Discriminant Analysis, Local Derivative Pattern and Local Binary Pattern. These methods have problems to recognise the face under the constraints like variations in unusual pose, weird expression and lightning. These variations in the image degrade the performance of recognition rate. Local Binary Histogram and Laplacian of Gaussian is used to decrease the lightning conditions by increasing the brightness of the image which does not effect differential pixel used for analysing which is to make the method unchangeable to the illumination effect. LoG is applied to the input image to get the edges of the face images for feature extraction. LBP divides the face image into several regions and generates the feature information locally for ll the regions and finally combining all the local feature information to get global information. The binary pattern is plotted for the image of both the examine and process images and it is matched to get the detected image.

The Local Directional Pattern descriptor (LDP) uses the edge values of surrounding pixel of the centre pixel and Two Dimensional Principal Analysis (2D-PCA) is used for feature extraction. LDP is an eight bit binary code which is assigned to the each pixel of an query image. This pattern is calculated by comparing the relative edge value of a pixel in different directions. The illumination effect is degraded using the binary pattern descriptor. 2D-PCA uses Euclidean distance to measure the similarity between training database images and test image features. The Euclidean distance calculates the distance between the features of face image which is extracted such as eyes, nose, and mouth. The distance between features is calculated to get the similarities between the two images. The nearest neighbour classifier is used to classify the images. The nearest neighbour first computes the distance between the test and all the train images stored in the database and chooses which image is nearest to the test image. To reduce the influence of illumination from an input image an adaptive homomorphism filtering is used in adaptive homomorphism eight local directional patterns method. This method produces eight directional edge images and it is used to create an illumination-insensitive representation for face recognition, it uses all the directional information to recognize the face image with different illumination conditions. One of the disadvantage of this method is constructing the linear subspace requires the several sample images. The light variations impact more on recognition of the image because the changes in the lightning condition may increase or decrease the intensities of the face regions due to the shadow cast given by some light source. The Local Directional Pattern (LDP) is used to describe the local image feature. The feature is obtained by processing the edge values in all eight directions at every pixel position and it generates a code from the relative strength magnitude. Each bit of code sequence is determined by considering a local neighbourhood.. Finally an image descriptor is formed to describe the image by accumulating the occurrence of LDP feature over the whole input Illumination normalization is an important task in the field of pattern recognition and computer vision. To normalize the illumination condition many normalization algorithms are proposed. Belhumeur used three principal components to reduce the illumination changes in the images by normalizing the face image. The working of bad lightning normalization is done and rated by the normalized association. The face expressions are most natural used to identify the expressions of the person. The face image with different poses is also recognized. One of the limitations of the non-frontal view method is that the images will be in different poses. The training dataset should contain the data having possible views of face images to identify the angle of view and face image with different expressions before using algorithms directly. Though all these methods are used for particular applications but due to some drawbacks of these methods the local feature extraction method is used. Survey of face recognition under varying facial expressions is done in order to analyse different techniques, motion-based, model based and muscles-based approaches have been used in order to handle the facial expression and recognition. Facial expressions not only exposes the sensation or passion of any human being but can also be used to judge his/her mental views. This survey is done based on the methods used to recognize the various facial expressions of the person SVMLBP method is used to recognize the face under complex background and different face positions. Median filter is used to remove the noise from the image. It is used to detect the edges of the image. Local Binary Pattern is used to extract the features of face, which divides the face image into different blocks and locally the image information is generated to get the global pixel information of the image by combining all the local pixel information of each block. Support Vector Machine classifier is used to classify the face images. SVM classifier finds maximum distance with the closest points in the training data set. Principal Component Analysis and Linear Discriminant Analysis is compared to recognize facial expressions of the human face. The Euclidean distance is used to calculate the distance between the images which are to be tested and the already available images used as the training images. Then the minimum distance is observed from the set of values. In testing, the Euclidean distance is computed between the new image Eigenvector and the Eigen subspace for each expression, and minimum Euclidean distance based classification is done to recognize the expression of the input image. PCA gives the better recognition rate than LDA and LDA gives more rejection rate than PCA.

The face recognition system consists of two major phase: a) Training phase b) Testing phase

a) Training phase

The input training image is selected and is divided into many non-over-lapping regions. The selected texture model is applied to the sub regions. For each sub regions, dimensional histogram is created. A pattern spectrum is formed by adding all histograms derived for all the sub regions. This spectrum is the global face description of the input given for the training. It is stored as the training feature in the database. Steps are repeated for all the images and the result is stored in the database.

b) Testing phase

The testing input is selected for training and all the steps are repeated to extract the feature of the input. The result will represent description of the face. This feature will test with all the inputs in the database by using chi-square distance.

IV. LOCAL BINARY PATTERNS

Local Binary Patterns (LBP) operator was introduced by Ojala et al which was based on a 3x3 neighbourhood and it contains few number of patterns. LBP operates with eight neighbouring pixels using the centre as a threshold. If a neighbour pixel value is less than the threshold then 0 is assigned to that particular neighbouring pixel otherwise it is assigned as 1. The result of this operation is a binary number which can be formed starting from any position in the 3x3 region neighbourhood. The histogram of this eight bit binary number contains information of the distribution of the edges, spots, and other local features in an image. This binary number

is converted into a decimal value and this decimal value is assigned as the label for the pixel values. If a 3x3 neighbourhood, a total of 256 different binary pattern strings can be generated and the entire image can be represented by a pattern histogram of 256 elements, which can be used as the texture descriptor. LBP acts as a leading role in face recognition and this proves that LBP is still a latest technique in the face recognition algorithms. This paper considers Local Binary Patterns (LBP) as one of the texture models for the comparative analysis in finding the accuracy of the proposed face recognition system.

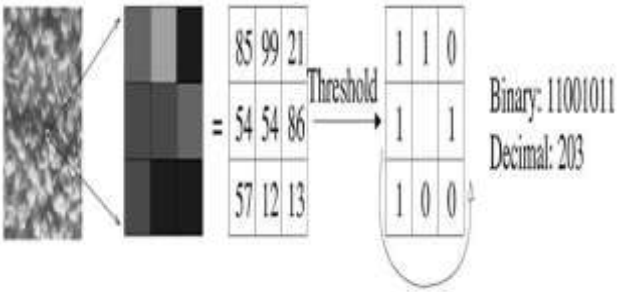

Fig. 3. working of Local Binary Pattern Histogram

Local Binary Patterns (LBP) is a texture descriptor that can be also used to represent faces, since a face image can be seen as a composition of micro-texture-patterns. The procedure consists of dividing a face in different continents. In this the Local binary features are extracted and added into a feature vector that will be used as face recognizer. In this research paper the Local Pattern Histogram method is used for face details which contains texture details which helps to build many local descriptions of the face and grouping them into a large description. The local feature based to face recognition have been gaining interest based on some facial features such as eyes play more important roles in person face recognition than any other features, it can be expected that in this method some of the facial regions contribute more than others in terms of extra personal variance. Utilizing this assumption the regions can be weighted based on the importance of the information they contain.

V. YALE B FACE DATABASE

Yale B face databases which contain images of face under poor, dark lighting conditions with different poses which are suitable for testing face recognition system. Yale B face database consists of 38 subjects with 9 different poses and 64 different illuminations for every pose. In this research 25 face images and 15 subjects are taken. The Frontal images with different lightning variation from each subject are casually selected for training and 16 frontal images are selected from the remaining images of the same subjects are tested. All the images which are selected for face recognition are grouped into 64x64 size and before the processing they converted into grayscale images. In LBP, this texture model uses 256 patterns and took very little time than the other methods.

The experiment compares the facial recognition between local binary, linear analysis, principle component analysis. From the above results on face recognition, it is noted that LBP performs better than other two. Usually a face recognition technique is vulnerable to two errors, False Acceptance Rate (FAR) and False Rejection Rate (FRR). FAR is a quantification tool to calculate how impostors are falsely identified as authentic users whereas FRR is a measuring tool that tells how many genuine users are falsely identified as imposters by the face recognition system. For the evaluation of these error rates (FAR & FRR) of the newly proposed OLTP based face recognition algorithm, 20 selected subjects with 25 frontal face images from each subject of this Yale B face database is divided into two groups such as 11 known subjects and 9 unknown subjects. The system is trained with 50 images of known subjects that are 7 face images from each subject. Testing is done with balance 255 images of both known and unknown subjects. From these two error rates another value called EER (Equal Error Rate) can be derived. EER is the intersection point at which FAR and FRR are equal. And if the value of EER is lower it will be better for verification or accuracy of face.

Genuine Acceptance Rate (GAR) is another important measurement for finding the accuracy of any biometric system. It is calculated by Genuine Acceptance Rate = 1- False Rejection Rate. To define the efficiency on face recognition system for inclusive manner, it finds the GAR values for the varying FAR values for all the texture models that are used in this comparative study. 20 selected subjects with 25 frontal face images from each subject of this Yale B face database is again divided into two groups such as 12 known subjects and 8 unknown subjects. The system is trained with 50 images of known subjects that are 8 face images from each subject. Testing is done with balance 260 images of both known and unknown subjects. The texture model with highest GAR at a certain level of FAR is always considered as the best matching of biometric. It is observed that local binary pattern excels all other texture models in the process of face recognition because it gave best performance in all the factors.

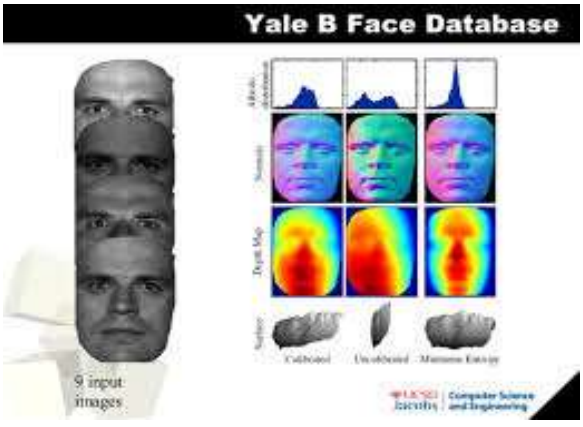

Fig. 4. Yale B Face Database

VI. CONCLUSION

In the proposed face recognition system Local Binary Pattern method is used with Laplacian of Gaussian for edge detection and extraction of different features. It identifies and locates the discontinuities in the edges of the image. Eigenface method and Fisherface is compared with the LBP method. As per the analysis LBP method gives the better recognition rate. The Eigenface method takes more recognition time and the recognition rate is less than the other two methods. The Local binary histogram with Gaussian method increases huge tracing and recognition response rate than Local binary histogram method. It also takes too much detection rate compared to binary method. Eigenfaces and Fisherfaces analysis the important features as a whole in the training dataset, whereas Local Binary Pattern analyses individually and uniquely for every image in the set of training.

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