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Comparison of Various Face Recognition Algorithms

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ABSTRACT: The goal of this paper is to present a critical survey of existing literatures on human face recognition using Local Binary Pattern Method. In this paper, I describe the LBP Technique and different approaches proposed in the literature to represent and to recognize faces. There are different types of algorithms which can be used for Face Recognition that are EBGM (Elastic Bunch Graph Matching), Fisher faces, Eigen face and Neural Networks.

KEYWORDS: Elastic bunch graph matching, Neural Networks, Eigen Face, fisher face, neural network.

I. INTRODUCTION

Image Face Recognition is one of the most biometrics authentication techniques from the past few years. Face recognition is an interesting and successful application of Pattern recognition and Image analysis. Face recognition is typically used in security system and can be compared to other biometrics such as fingerprint or iris recognition system.

There is a huge improvement done in face recognition many algorithms have been proposed but there are still many difficult and challenging problems in the face recognition such as Facial Expressions, pose variations, illumination variations, facial occlusion and face rotation. To overcome these problems Local Binary Pattern is used. Local binary pattern (LBP) is a pixel based Texture extraction method. Local Binary Pattern Method is one of the best performing texture descriptor and it has been widely used in various applications.

II. LOCAL BINARY PATTERN

There exist several methods for extracting the most useful features from (preprocessed) face images to perform face recognition. One of these feature extraction methods is the Local Binary Pattern (LBP) method. Local binary pattern (LBP) is a pixel based Texture extraction method. Local Binary Pattern Method is one of the best performing texture descriptor.

In this section, we present our LBP Orientation based face recognition method as shown in Fig. 1. Our proposed method is composed of two major parts, the LBP orientation descriptor and the matching method. First, we perform contrast enhancement by histogram equalization on the probe image. Then we find the interest points by the SIFT method and describe the information for each interest point by the LBP orientation descriptor. The descriptor is composed of two parts, the histogram of gradient and the LBP orientation. We get magnitude and angle from the gradient and make an 8-bin orientation histogram. Finally, the matching method and matching score is applied to determine the similarity between Gallery and probe images.

III. TECHNIQUES FOR FACE RECOGNITION

A. Eigenface:

The Eigenface method is one of the generally used algorithms for face recognition. Karhunen-Loeve is based on the Eigenfaces technique in which the Principal Component Analysis is used. This method is successfully used to perform dimensionality reduction. Principal Component Analysis is used by face recognition and detection. Mathematically, Eigenfaces are the principal components divide the face into feature vectors. The feature vector information can be obtained from covariance matrix. These Eigenvectors are used to quantify the variation between multiple faces. The faces are characterized by the linear combination of highest Eigenvalues. Each face can be considered as a linear combination of the eigenfaces. The face can be approximated by using the eigenvectors having the largest eigenvalues. The best M eigenfaces define an M Dimensional space, which is called as the "face space". Principal Component Analysis is also used by L. Sirovich and M. Kirby to efficiently represent pictures of faces. They defined that a face images could be approximately reconstructed using a small collection of weights for each face and a standard face picture. The weights describing each face are obtained by projecting the face image onto the Eigen picture [3]. Eigenface is a practical approach for face recognition. Because of the simplicity of its algorithm,

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implementation of an eigenface recognition system becomes easy. It is efficient in processing time and storage. PCA reduces the dimension size of an image in a short period of time.

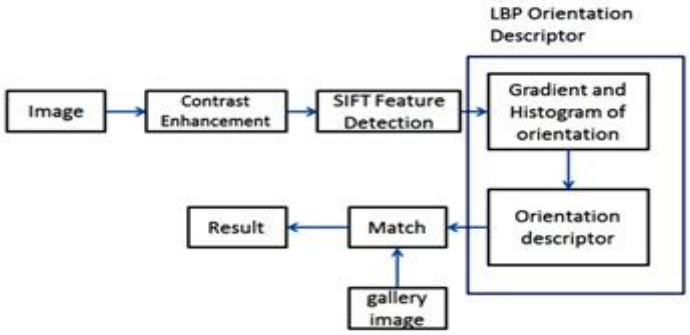

Fig. 1: The LBP Orientation Based Face Recognition flow.

There is a high correlation between the training data and the recognition data. The accuracy of eigenface depends on many things. As it takes the pixel value as comparison for the projection, the accuracy would decrease with varying light intensity. Preprocessing of image is required to achieve satisfactory result. An advantage of this algorithm is that the eigenfaces were invented exactly for those purpose what makes the system very efficient [4]. A drawback is that it is sensitive for lightening conditions and the position of the head. Disadvantages-Finding the eigenvectors and eigenvalues are time consuming on PPC. The size and location of each face image must remain similar PCA (Eigenface) approach maps features to principle subspaces that contain most energy.

B. **Neural Networks:**

The neural networks are used in many applications like pattern recognition problems, character recognition, object recognition, and autonomous robot driving. The main objective of the neural network in the face recognition is the Feasibility of training a system to capture the complex class of face patterns. To get the best performance by the neural network, it has to be extensively tuned number of layers, number of nodes, learning rates, etc. The neural networks are nonlinear in the network so it is widely used technique for face recognition. So, the feature extraction step may be more efficient than the Principal Component Analysis. The authors Achieved 96.2% accuracy in the face recognition process when 400 images of 40 individuals. The classification time is less than 0.5 second, but the training time is as long as 4 hours features in a hierarchical set of layers and provides partial Invariance to translation, rotation, scale, and deformation. The disadvantage of the neural network approach is that when the number of classes increases. [5], [6] Multi-Layer Perceptron (MLP) with a feed forward learning algorithms was chosen for the proposed system for its Simplicity and its capability in supervised pattern matching. It has been successfully applied to much pattern classification problems. [7] A new approach to face detection with Gabor wavelets & feed forward neural network was presented. The method used Gabor wavelet transform and feed forward neural network for both finding feature points and extracting feature vectors. The experimental results have shown that proposed method achieves better results compared to other Successful algorithm like the graph matching and eigenfaces methods. A new class of convolutional neural network was proposed where the processing cells are shunting inhibitory neurons. Previously shunting inhibitory neurons have been used in conventional feed forward architecture for classification and non-linear regression and were shown to be more powerful than MLPs i.e. they can approximate complex decision surfaces much more readily than MLPs. A hybrid neural network was presented which is combination of local image sampling, a self-organizing map neural network, and a convolutional neural network. The SOM provides a quantization of the image samples into a topological space where inputs that are nearby in the original space are also nearby in the output space, therefore providing dimensionality reduction and invariance to minor changes in the image sample. The convolutional neural network (CNN) provides for partial invariance to translation, rotation, scale, and deformation. PCA+CNN & SOM+CNN methods are both superior to eigenfaces technique even when there is only one training image per person. SOM +CNN method consistently performs better than the PCA+CNN method. [8] A new face detection method is proposed using polynomial neural Network (PNN) [9]. The PCA technique used to reduce the dimensionality of image patterns and extract features for the PNN. Using a single network the author had achieved fairly high detection rate and low false positive rate on images with complex backgrounds. In comparison

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with a multilayer perceptron, the performance of PNN is superior. To best reflect the geometry of the 3D face manifold and improve recognition, Spectral Regression Kernel Discriminate Analysis (SRKDA) based on regression and spectral graph analysis introduced in proposed method. [10] When the sample vectors are non- linear SRKDA can efficiently give exact solutions than ordinary subspace learning approaches. It not only solves high dimensional and small sample size problems, but also enhances feature extraction from a face Local non- linear structure. SRKDA only needs to solve a set of regularized regression problems and no eigenvector computation involved, which is a huge saving in computational cost. [11]

C. **Fisherface:**

Fisherfaces is one the most successfully widely used method for face recognition. It is based on appearance method. In 1930 R.A Fisher developed linear/fisher discriminant analysis for face recognition.[12] It shows successful result in the face recognition process. LDA method demonstrated in (Belhumeur et al., 1997; Zhao et al., 1999; Chen et al., 2000; Yu and Yang, 2001; Liu and Wechsler. 2002; Lu et al, 2003a, b; Ye and Li., 2004). [13] All used LDA to find set of basis images which maximizes the ratio of between-class scatter to within- class scatter. The disadvantage of LDA is that within the class the scatter matrix is always single, since the number of pixels in images is larger than the number of images so it can increase detection of error rate if there is a variation in pose and lighting condition within same images. So to overcome this problem many algorithms has been proposed. Because the fisherfaces technique uses the advantage of within-class information so it minimizes the variation within class, so the problem with variations in the same images such as lighting variations can be overcome.[2] The fisherface method for face recognition described by Belhumeur et al [14] uses both principal component analysis and linear discriminant analysis which produce a subspace projection matrix, similar as used in the eigenface method. However, the fisherface method is able to take advantage of within-class information, minimizing variation within each Class, yet still maximizing class separation. Like the eigenface construction process, the first step of the fisherface technique is take each (NxM) image array and reshape into a ((N*M) x1) vector. Fisherface is similar to Eigenface but with enhancement of better classification of different classes image. With FLD, one can classify the training set to deal with different people and different facial expression. We have better accuracy in facial expression than Eigen face approach. Besides, Fisherface removes the first three principal components which are responsible for light intensity changes; it is more invariant to light intensity. [4] The disadvantages of Fisherface are that it is more complex than Eigenface to finding the projection of face space. Calculation of ratio of between- class scatters to within-class scatter requires a lot of processing time. Besides, due to the need of better classification, the dimension of projection in Face space is not as compact as Eigenface, results in larger storage of the face and more processing time in recognition. [4]

D. **Elastic Bunch Graph Matching:**

Face recognition using elastic bunch graph matching is based on recognizing faces by estimating a set of features using a data structure called a bunch graph. [15] Same as for each query image, the landmarks are estimated and located using bunch graph. Then the features are extracted by taking the number of instances of Gabor filters which is called “face graph”. The matching percentage (*MSEBGM*) is calculated on the basis of similarity between face graphs of database and query image. In 1999, Elastic Bunch Graph Matching was suggested by LaurenzWiskott, Jean-Marc Fellous, and Norbert Kruger and Christoph von der Malsburg of University of Southern California. This approach is totally different to Eigenface and Fisherface. It uses elastic bunch graph to automatically locate the fudicial points of the face such as eyes, nose, mouth, etc. and recognize the face according to These face features. Elastic Bunch Graph Matching (EBGM) uses the structure information of a face which reflects the fact that the images of the same subject tend to translate, scale, rotate, and deform in the image plane. It uses the labeled graph, edges are labeled the distance information and nods are labeled with wavelet coefficients in jets. After that this model graph can be used to generate image graph. The model graph can be rotated, scaled, translated and deformed during the Matching process. The Gabor wavelet transformation is used to produce the local features of the face images. Gabor wavelets Are biologically motivated convolution kernels in the shape of plan waves restricted by a Gaussian envelop function, the set of convolution coefficients for kernels of different orientations and frequencies at one image pixel is called a jet. [4] In the Elastic graph matching the basic process is to compare graphs with images and to generate new graphs. In its simplest version a single labeled graph is matched onto an image. A labeled graph has a set of jets arranged in a particular spatial order. A relative set of jets can be selected from the Gabor wavelet transform of the image. The image jets initially have the same relative spatial arrangement as the graph jets, and each image jet relatives to one graph jet. The similarity of the Graph with the image then is simply the average jet similarity between image and graph jets. For increase similarity it allows some translation, rotation and distortion up to some extent. In contrast to

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eigenfaces the elastic bunch graph matching technique treat one vector per feature of faces. The advantage of this is that change or missing any one feature it does not mean that the person will not recognized. The stored data can be easily extended to a database for storage. When a new face images is added, no additional effort is need to modify templates, as it already stored in the database. It is possible to recognized person up to rotation of 22 degrees. Disadvantage of this algorithm is that it is very sensitive to lightening conditions and a lot of graphs have to be placed manually on the face. When changes in lighting are large, result will have a significant decrease in recognition rate. [4]

IV. CONCLUSION

Face recognition is a challenging problem in the field of Image processing and computer vision. Because of lots of Application in different fields the face recognition has received great attention. In this paper different face recognition algorithms are mentioned with their advantages and disadvantages. You can use any of them as per your requirement and application. Future work can be done to improve efficiency of discussed algorithms and improve performance.

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