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Face Recognition Machine Vision System Using Eigenfaces

Summary:

In this paper Face Recognition Techniques Principal Component Analysis (PCA) and Normalized Principal Component Analysis (N-PCA) are carried out on the ORL (ATT) and Indian face database (IFD) and based upon the results we determine the efficient approach.

Face is a complex multidimensional structure and needs a good computing techniques for recognition. One of the basic face recognition techniques is Eigenface, which is widely used linear statistical technique reported by researchers. The face recognition system consists of two important steps, the feature extraction and the classification. Raw face image may consume a long time to recognize since it suffers from a huge amount of pixels. One needs to reduce the amounts of pixels. This is called dimensionality reduction or feature extraction, it refers to transforming face space into a feature space. In the feature space, the face database is represented by a reduced number of features that retain most of the important information of the original faces. Eigenfaces algorithm, it is a classical statistical method using the linear Karhumen-Loeve transformation (KLT) also known as PCA is popular method to achieve this.

PCA produces the optimal linear least-square decomposition of a training set. The PCA approach is applied to reduce the dimension of the data. The advantage of this reduction in dimensions is that it specifically decomposes the structure of face into components known as Eigen faces. Each image of face may be stored in a 1D array which is the representation of the weighted sum (feature vector) of the Eigen faces. Next the classification step which makes use of Euclidean Distance for comparing/matching of the test and trained images. Now project the test image into the same eigenspace as defined during the training phase. This projected image is now compared with projected training image in eigenspace. Images are compared with similarity measures. Relative Euclidean distance is calculated between the testing image and the reconstructed image of i^{th} person, the minimum distance gives the best match.

N-PCA has been developed to give better results in terms of efficiency. N-PCA is an extension over linear PCA in which firstly normalization of images is done in order to remove the lightning variations and background effects and singular value decomposition (SVD) is used instead of eigen value decomposition (EVD), followed by the feature extraction steps of linear PCA. Images are collected and If the face image taken is colored then it is converted to gray image to make it two dimensional (m x n). Now, Mean and Standard Deviation of Images is calculated followed by normalization and then Eigen vectors and values are calculated too. Eigen Vectors obtained after SVD are sorted in descending order and the top Eigen vectors are considered as Eigen Faces. Now, the weights are determined by calculating the dot product of transpose of Eigen Faces matrix and Train Centered Images. Finally, one by one train weights are stored in sink for further comparison and the difference between this test weights and the train weights stored in sink. Finally, the minimum distance gives the best match or can be said similar Face Identified.

The Eigenface approach for Face Recognition process is fast and simple which works well under constrained environment. It is better to give small set of likely matches. This paper investigates the N-PCA function improvement over the PCA for feature extraction. The experiments carried out with ORL and IFD dataset, shows that N-PCA gives a better recognition rate. It is clear that the comparison shows that accuracy for PCA is 92.50% and 74.17%, while for N-PCA is 93.75% and 76.67% on ORL and IFD for 80/20 Ratio. The promising results indicate that N-PCA can emerge as an effective solution to face recognition problems in the future.