

# Face Recognition Using LBP and PCA for Diverse Images

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**Abstract :** Recognition of human faces is one of the most pertinent applications of image analysis. The challenge is to build an automated system to recognize faces equal/comparable to human ability to face recognition. Face is a complex 3D visual model and developing a computational model for face recognition is a difficult task. The paper presents a methodology for face recognition based on LBP and Principal Component Analysis for diverse range of images with varying conditions.

A classifier is combined with an extractor. The extractor provides the features required by the classifier, the pre-processing is done by the operator to sharpen the experiential face image. The proposed face recognition method combines PCA as classifier and LBP as operator in pre-processing stage. LBP is a good operator to perform face recognition and its texture analysis. LBP sharpens the observed image characteristics to summarize the local structure of the image. PCA as a classifier finds images that are identical to or look like the input image.

**IndexTerms –PCA,LBP,Eigenfaces,Euclidean Distance.**

## I. INTRODUCTION

The face is one of the prime focus of interest and plays a most important role in identification and establishing the distinctiveness of a particular person from the rest. Human eye has the ability to recognize and differentiate one face from another. Humans can distinguish thousands of faces known throughout the lifetime and identify familiar faces at a glimpse. The human eye is effective in identification even with changes due to aging, expressions and changes in looks due to spectacles, beards or in hair style. There are many approaches such as security purpose, credit card verification, criminal identification, face based Attendance system etc. where the identification of a face plays an crucial role. Though people are superior at recognition of faces, but it's not evident that a human brain can encode or decode every face. Developing an appropriate program which can be used in recognizing faces is a challenging task, as human faces are complex and are diverse from each other in every aspect. Therefore developing a program, to automatically recognize faces is a complicated task.

## II. LITERATURE SURVEY

Many methods are developed in facial recognition related research, where they are specifically created for face recognition or derived from developed texture analysis methods. Many algorithms have been modified and adapted and methods to their purpose. For example, PCA was invented by Karl Pearson in 1901, but proposed for pattern recognition 64 years later. Finally, it was applied to face representation and recognition in the 90's [1]. The methods contain two elements, namely feature extraction and classifier. Feature extraction includes Data Transformation, Principal Component Analysis, Feature Matching, and Dimensionality reduction. Classification includes SVM, Bayesian Matching Algorithm, Neural Network, PCA [2], [3], [4], [15], and LDA [6], [7].

The preliminary step is extraction of the significant features from face images. The face features that a computer can use to identify a face. Certain facial features are used by human beings to identify faces likewise Principle component analysis (PCA) method may be used in feature extraction. Hau T. Ngo et al. described a flexible and efficient architecture for real-time face recognition system based on modular Principal component Analysis method in an environment of FPGA, they showed that modular PCA improves the accuracy of face Recognition when face images have varying expression and illumination.

## III. THE PROPOSED METHOD:

### Categorization of Facial Image Data

All images are divided into two sets, to represent the training set, used as a database for the computer to recognize face image input, with four 4 image representations for each person. The second set represents a test set. The test set contains images with different expressions and illuminations from each person. The classification results are obtained and the accuracy rate is averaged as the final result of the experiment.

### PCA

Principal component analysis, is widely used to reduce the number of dimensions in large datasets to principal components that preserve most of the original information. It transforms correlated variables into a smaller set of variables, called principal components.

#### Features of Principal component analysis

- PCA does not take into consideration the fundamental class structure and manages the entire data for analysis.
- It does not require large computations.

- The directions of the maximum discrimination are not the same as the directions of maximum variance, as it is not required to utilize the class information such as the within class scatter and between class scatter.
- PCA examines the directions that have widest variations.

#### **Advantage and disadvantage of PCA**

The advantages of PCA are listed below:

- 1) Smaller database representation since only the image projections are stored in a reduced form
- 2) Lack of redundancy of data given the orthogonal components.
- 3) Reduces the complexity in face images by
- 4) Reduces Noise, the small variations in the back ground are ignored automatically.
- 5) The feature vector is now two-dimensional greatly reduced and so is the problem of dimensionality

#### **Disadvantages of PCA are:**

- 1) The covariance matrix is difficult to be evaluated in an accurate manner.
- 2) The simplest invariance could not be captured even by the PCA unless the training data explicitly provides this information.
- 3) PCA is a less sensitive to different training data set.
- 4) Computationally expensive and complex with the increase in data size.
- 5) Time complexity is high.

#### **LBP**

LBP is a well-known and widely used feature for many applications, including face recognition, fingerprint identification, and other classification problems. LBP is a texture descriptor that captures local binary patterns in an image by comparing a central pixel's intensity with its neighbors. Local Binary Pattern (LBP) is used as an operator to describe local texture features of images. It has the obvious advantages of rotation invariance and gray invariance. It was first proposed by Ojala et al. for texture feature extraction, the extracted feature is the local texture feature of the image.

The steps of the LBP algorithm are as follows:

(a) Division of area

Firstly, the detection window is divided into cells.

(b) Calculation of LBP value

For a pixel in each cell, the gray value of the adjacent eight pixels is compared with it. If the surrounding pixel value is larger than the central pixel value, the position of the pixel is marked as 1, otherwise 0. In this way, eight points in the 3\*3 neighborhood can generate 8 bits binary numbers after comparison, that is, the LBP value of the pixel point in the center of the window can be obtained.

(c) Calculation of histogram

Then calculate the histogram of each cell, which is how often each number (presumably the decimal LBP value) appears. Then normalize the histogram.

(d) Generation of eigenvectors

Finally, the statistical histogram of each cell obtained is connected to an eigenvector, which is the LBP texture eigenvector of the whole image.

#### **Features of LBP**

The LBP is an efficient method used for texture feature extraction. This method is very popular for face detection and pattern recognition approaches.

The LBP operator transforms an image into an array or image of integer labels describing small-scale appearance of the image.

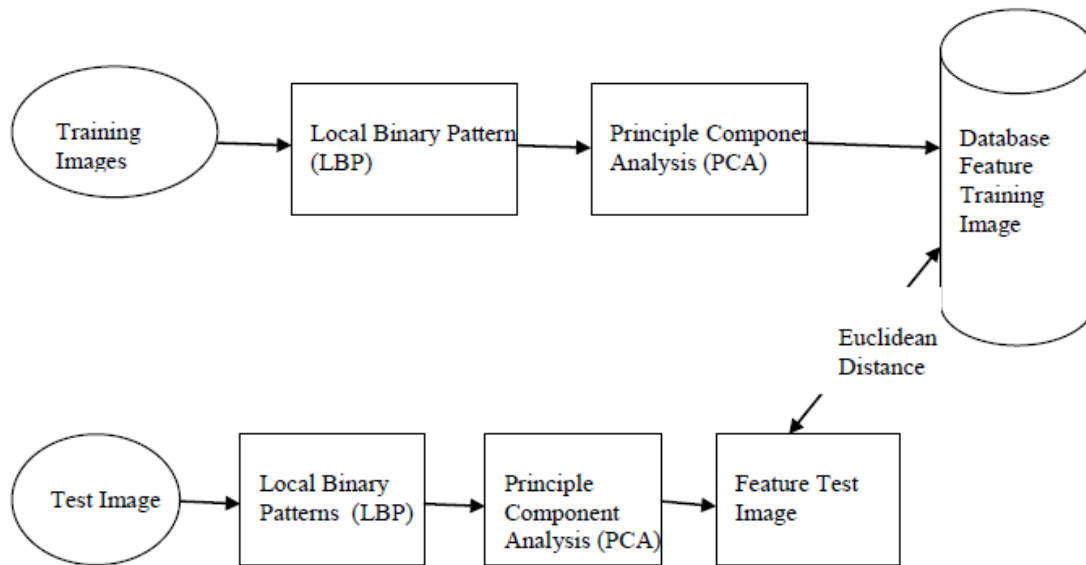
#### **Advantages of LBP**

- It preserves the essential's of the picture due to its invariance to differences in light and its dependability in image classification.
- LBP also has the benefit of creating an 8-bit descriptor for every pixel as well as being sensitive to picture rotation.
- Simple and computationally efficient.
- Robust to illumination changes.
- Widely used in various applications like face detection, object recognition, and texture classification.

#### **Limitations:**

- LBP uses circular patterns, which may not be ideal for capturing anisotropic (direction-dependent) features, such as those found in facial regions like eyes and mouth.
- LBP may not capture fine details and micro-features effectively.

Face recognition is performed using the classification principle, the data is divided into training data and test data. The term combined in this study refers to a series method using LBP and PCA. The sample images from the test set are armoured with local characteristics using the LBP operator, the results are used as inputs of PCA method. Classification is done by using PCA to compare the results with that of using LBP operators. In general, the proposed method is summarized in the scheme in Figure below.



**Fig 1: Proposed Method**

In the method described above, the LBP operator, produce eigenface of each input Image in training set, as shown in Fig 2, and one the “most nearest” image is found from them. The “nearest” image is calculated using the Euclidean distance formula in equation. The final output of the classification method is the accuracy rate. Accuracy rate compute by dividing the number of all correct predicted items in test set with the number of items in test set.



**Fig 2: Output of LBP Operator**

**IV. CLASSIFICATION RESULT**

The results show that on average, the facial image in the test set is better recognized by the method using a combination of LBP and PCA.

	Methods			Accuracy Rate		
	Test 1	Test 2	Test 3	Test 4	Test 5	Average
PCA	50%	62.5%	62.5%	50%	75%	60%
LBP+PCA	75%	62.5%	50%	75%	37.5%	60%

**CONCLUSION AND FUTURE WORK**

Considering 8 Test images for the above experiment ,the LBP images of test images, are taken as inputs for the PCA method, so that we get the vectors whose the elements are corresponding to the 8 images in the training set. The nearest or most similar ones to the test images are considered. The calculation results on the average accuracy of each case of randomization of the test set gives a conclusion that the LBP combined with PCA method gives the best recognition result than PCA independently. To improve the classification results in the future, we can do image enhancement first to input image, modify PCA, or use LBP-8 and LBP 16 combined to any other classifiers.

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