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Outlandish Technique for Facade Recognition in Images

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ABSTRACT

Today, the Biometric world was mostly ruled by the face recognition technique. Large image database are need to be searched in order to match the images with the original or input image. Face plays a vital role in recognizing a person.. The input image of face may distinct in their appearance, pose and lighting conditions. Some images may hide behind the others so the face needs to be detected correctly. The given input image may have some unwanted information along with the face .So the faces are detected using the algorithm called Viola-Jones face detection algorithm. Developing an automatic system for search, retrieval, or classification of images from the database is a critical issue. Local binary pattern are computed for local regions of the detected face image and the local features are joined to form the global image representation. The face images are divided into 3x3 regions and the histogram was constructed for local regions. The local characteristics was concatenated to form the global feature .These concatenated feature are used to measure the likeness and divergence in an image. LBP is considered as the non directional first-order local pattern operator and it is extended to higher orders called the LDP. Local Derivative pattern was based on the directions of the pixels. LDP describes the distinct features of an image effectively when compared to other LBP. LTrP computes the features of the image based on the difference between the pixels in distinct directions. By, experimenting with the different face images LTrP provides better result when compared to other algorithms.

Keywords: Local Binary Pattern, Local Derivative Pattern, Local Tetra Pattern

INTRODUCTION

Face recognition has attracted much attention due to its potential value for applications and its theoretical challenges. In real world, the face images are usually affected by different expressions, poses, occlusions and illuminations, and the difference of face images from the same person could be larger than those from different ones.

Therefore, how to extract robust and discriminate features which make the intra person faces compact and enlarge the margin among different persons becomes a critical and difficult problem in face recognition.

Up to now, many face representation approaches have been introduced, including subspace based holistic features and local appearance features Typical holistic features include the well known principal component analysis (PCA)[2] linear discriminate analysis (LDA)], independent component analysis (ICA), etc. PCA provides an optimal linear transformation from the original image space to an orthogonal Eigen space with reduced dimensionality in sense of the least mean square re-construction error. LDA seeks a linear transformation by maximizing the ratio of between-class variance and within-class variance. ICA is a generalization of PCA, which is sensitive to the high-order relationship among the image pixels.

Furthermore, in order to handle the nonlinearity in face feature space, the nonlinear kernel techniques (e.g., kernel PCA, kernel LDA etc.) are also introduced. Local appearance features, as opposed to holistic features like PCA and LDA, have certain advantages. They are more stable to local changes such as illumination, expression and in-accurate alignment.

Gabor and local binary patterns (LBPs)[11] are two representative features. Gabor wavelets capture the local structure corresponding to specific spatial frequency (scale), spatial locality, and selective

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orientation which are demonstrated to be discriminative and robust to illumination and expression changes.

LBP operator[4] which describes the neighboring changes around the central point, is a simple yet effective way to represent faces. It is invariant to any monotonic gray scale transformation and is, therefore, robust to illumination changes to some extent.

Recently, some work has been done to apply LBP on the Gabor responses to obtain a more sufficient and stable representation. The global and local descriptors are presented, respectively, and finally used for face representation. These combinations of LBP[4] and Gabor features have improved the face recognition performance significantly compared to the individual representation. Combining information from different domains is usually beneficial for face recognition.

Recent biological studies indicate that retinal position; spatial frequency and orientation selectivity properties have an important role in visual perception. Face Recognition are classified into Face verification(one to many) and Face identification(one to one).There are three main face recognition technologies which include Holistic Matching methods, Feature Based matching methods, Hybrid methods.

RELATED WORK

As one of the most successful applications of image analysis and understanding, face recognition has recently received significant attention, especially during the past few years. There are at least two reasons for this trend; the first is the wide range of commercial and law enforcement applications and the second is the availability of feasible technologies after 30 years of research. In addition, the problem of machine recognition of human faces continues to attract researchers from disciplines such as image processing, pattern recognition, neural networks, computer vision, computer graphics, and psychology. The strong need for user-friendly systems that can secure our assets and protect our privacy without losing our identity in a sea of numbers is obvious.

Timo Ahonen, Abdenour Hadid, and Matti Pietik[8] proposed that the face images are represented using the method known as Local Binary Pattern. In this method, the input images are divided into several regions and they are computed locally based on their intensity values. The centre pixel values are compared with the neighbourhood pixels and their values are replaced by zero's and one's .Then the binary values are converted into decimal values and that values are replaced with centre pixel. Xiaofei He, Shuicheng Yan, Yuxiao Hu, Partha Niyogi[10] proposed an appearance based face recognition method called the Laplacian face approach. By using Locality Preserving Projections (LPP), the face images are mapped into a face subspace for analysis.

Different from Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) which effectively see only the Euclidean structure of face space, LPP finds an embedding that preserves local information, and obtains a face subspace that best detects the essential face manifold structure. Timo Ojala, Matti Pietikainen, Senior Member, IEEE, and Topi Maenpaa proposed Multiresolution Gray-Scale and Rotation Invariant Texture Classification with Local Binary Patterns. In this paper the method is based on recognizing that certain local binary patterns, termed uniform, are fundamental properties of local image texture and their occurrence histogram is proven to be a very powerful texture feature. The proposed approach is very robust in terms of gray-scale variations since the operator is, by definition, invariant against any monotonic transformation of the gray scale.

The advantage is computational simplicity as the operator can be realized with a few operations in a small neighborhood and a lookup table. The operators are used to characterize the spatial configuration of local image texture and the performance can be further improved by combining them with rotation invariant variance measures that characterize the contrast of local image texture. Shamla Mantri, Kalpana Bapat[7], proposed a label Self-Organizing Map (SOM) to measure image similarity. Facial recognition is then performed by a probabilistic decision rule. This paper presents a novel Self-Organizing Map (SOM) for face recognition. The SOM method is trained on images from one database. The novelty of this work comes from the integration of Images from input database, Training and Mapping. Face Recognition using unsupervised mode in neural network by SOM. SOM has good feature extracting property due to its topological ordering.

PROPOSED SYSTEM

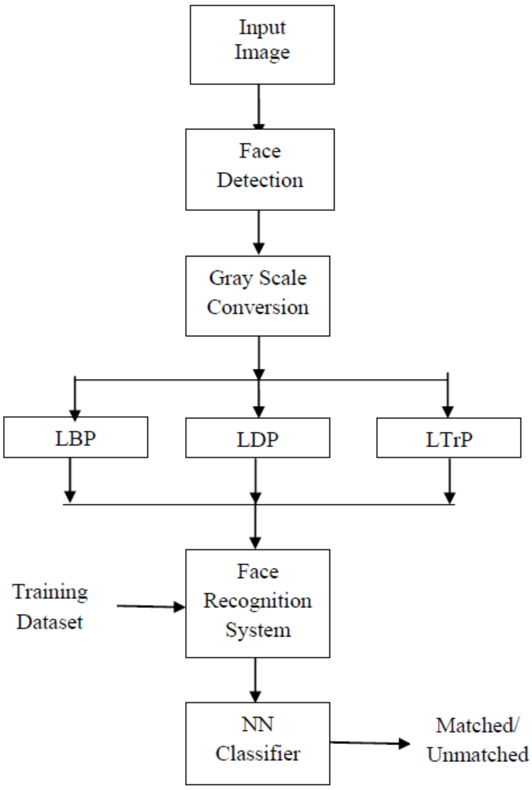


Figure1. *Block Diagram of Proposed System*

From figure 1,the input images were given as input and the face was detected from the image using Viola-Jones face detection algorithm. The goal is to distinguish faces from non-faces (face **detection** is the first step in the **identification** process).

Algorithm1

Step1: Integral image for feature extraction

Step2: Ada-Boost for face detection

Step3: Attentional cascade for fast rejection of non-face sub-windows

In the gray scale conversion step, the face detected images are colored but for extracting features using LBP, LDP, LTrP gray scale images are required. So the color images are converted to gray scale and given as input to other methodologies.

Local Binary Pattern

Local Binary Pattern (LBP)[4] is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. Another important property is its computational simplicity, which makes it possible to analyze images in challenging real-time settings.

$$LBP_{P,R} = \sum_{p=1}^{P} 2^{(p-1)} \; X \; f_1(g_p - g_c),$$

Where $f_1(x) = \begin{cases} 1, x \geq 0 \\ 0, else \end{cases}$

Algorithm2

Step1: A 3x3 mask window is placed over the image.

Step2: In the resulting 3x3 subimage the value of the center pixel g_c is compared with the neighbouring pixels.

Step3: If the neighbouring pixel has a value greater than the center pixel, then the neighbouring pixel value is replaced by 1.

Step4: If the neighbouring pixel has a value less than the center pixel, then the neighbouring pixel value are replaced by 0.

Step5: In this way all the neighbouring pixels will be replaced by either 0 or 1, combining which we get an eight digit binary number.

Step6: This eight digit binary number is converted into decimal and the decimal value is used to replace the center pixel

Step7: The above steps are repeated for all pixels and the resulting output is the Local Binary Pattern of the original image.

Since LBP is calculated for each pixel, the resulting LBP outputis NxN for an NxN input image.

Local Derivative Pattern

Local Derivative pattern explains the feasibility and effectiveness of using high-order local patterns for face representation. An LDP operator is proposed, in which based on a binary coding function (n-1) th order derivative is calculated. LBP encodes all-direction first-order derivative binary result while LDP encodes the higher-order derivative information which contains more detailed discriminative features that the first-order local pattern (LBP) cannot obtain from an image.

Algorithm3

Step1: The center pixel values are subtracted from their neighbors based on the angles.

Step2: If the values are horizontal then their difference are computed as

$I^1_{0^\circ}(g_c) = I(g_h) - I(g_c)$

Step3: If the values are vertical then their difference are computed as

$I^1_{90^\circ}(g_c) = I(g_v) - I(g_c)$

Step4: To calculate the n^{th} order LDP, the $(n\text{-}1)^{th}$ order derivatives are calculated along 0^0, 45^0, 90^0,and 135^0 directions, denoted as

$I_\alpha^{(n-1)}(g_c)\Big|_{\alpha=0^o,45^o,90^o,135^o}$ **Step 5:** Finally, n^{th} -order LDP is calculated as

$$LDP_\alpha^n(g_c) = \sum_{p=1}^{P} 2^{(p-1)} x f_2(I_\alpha^{(n-1)}(g_c), I_\alpha^{(n-1)}(g_p))\Big|_{P=8}$$

$$f_2(x,y) = \begin{cases} 1, if x, y \geq 0 \\ 0, else \end{cases}$$

Step6: The above steps are repeated for all pixels and the resulting output is the Local Derivative Pattern of the original image.

Local Tetra Pattern

The idea of local patterns (the LBP, the LDP, and the LTP) proposed above has been adopted to define LTrPs (Local Tetra Patterns).The local tetra patterns (LTrPs)[6] describes the spatial structure of the local texture using the direction of the centre gray pixel It encodes the relationship between the referenced pixel and its neighbors, based on the directions that are calculated using the first-order derivatives in vertical and horizontal directions.

Algorithm4

Step1: The center pixel values are subtracted from their neighbors based on the angles.

Step2: If the values are horizontal then their difference are computed as $I^1_{0^\circ}(g_c) = I(g_h) - I(g_c)$

Step3: If the values are vertical then their difference are computed as $I^1_{90^\circ}(g_c) = I(g_v) - I(g_c)$

Step4: It is evident that the possible direction for each center pixel can be 1, 2, 3, or 4, and eventually, the image is converted into four values, i.e., directions and the direction of the center pixel can be calculated as

$$I_{Dir.}^{1}(g_c)=\begin{cases}1, & I_{0^\circ}^{1}(g_c)\geq 0 \text{ and } I_{90^\circ}^{1}(g_c)\geq 0\\ 2, & I_{0^\circ}^{1}(g_c)<0 \text{ and } I_{90^\circ}^{1}(g_c)\geq 0\\ 3, & I_{0^\circ}^{1}(g_c)<0 \text{ and } I_{90^\circ}^{1}(g_c)<0\\ 4, & I_{0^\circ}^{1}(g_c)\geq 0 \text{ and } I_{90^\circ}^{1}(g_c)<0\end{cases}$$

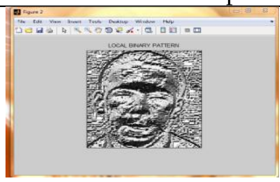
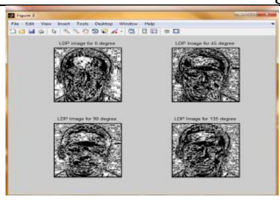
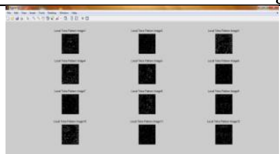
Step6: The above steps are repeated for all pixels and the resulting output is the Local Tetra Pattern of the original image.

In NN classifier, our system operates in two stages. It first applies a set of neural network-based filters to an image. Then it uses an arbitrator to combine the outputs. The filters examine each location in the image at several scales. Looking for locations that might contain a face. The arbitrator then merges detections from individual filters and eliminates overlapping detections. The network has a single, real-valued output, which indicates whether or not the window contains a face.

Pseudo Code for Proposed System

1. Read Input image from the database
2. Face detected from the original image(algorithm 1)
3. Features are extracted using different algorithms such as LBP(algorithm 2), LDP(algorithm 3), LTrP(algorithm 4)
4. Extracted features are given as input to the NN classifier
5. Face are recognized and results are displayed with their execution time

EXPERIMENTAL RESULTS

Input Image		 Face Detected from the input image
Algorithm	LBP	 LBP Feature Extracted Image
	LDP	 LDP Feature Extracted Image
	LTrP	 LTrP Feature Extracted Image
Output/ Recognized Image		 LBP,LDP, LTrP Based Recognition

The above results indicated that the execution time of the LTrP is less when compared to LBP, LDP.

Table1. *Execution time computation*

	LBP	LDP	LTrP
Image 1	15.71	0.0789	0.03
Image 2	13.9	0.345	0.07
Image 3	22.71	0.171	0.14
Image 4	19.54	0.768	0.13
Image 5	28.934	0.0456	0.0145

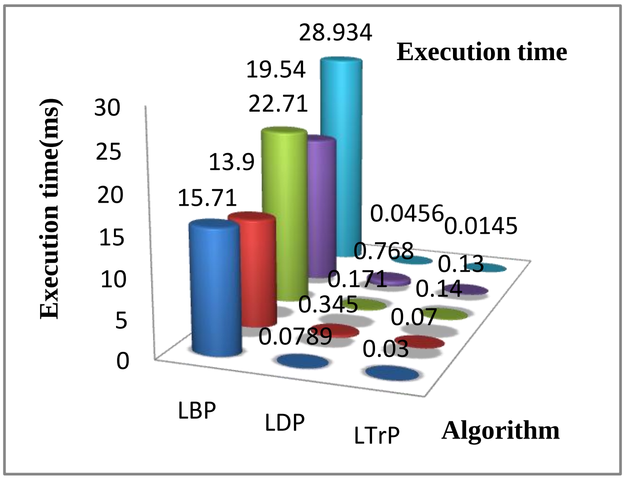


Figure2. *Execution time of the algorithm*

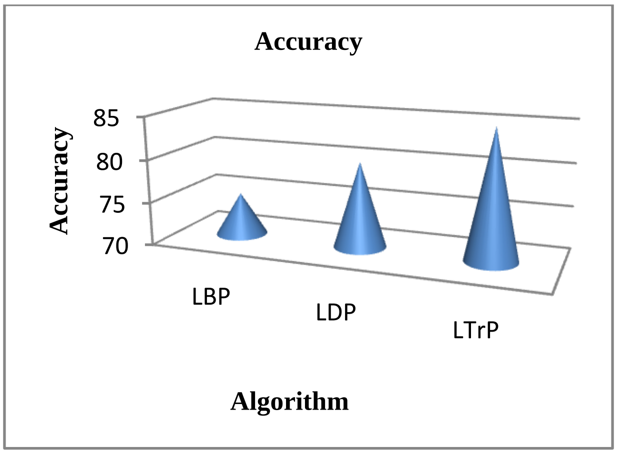


Figure3. *Accuracy of the algorithm*

The above figure 3 indicates that the accuracy of the LTrP is high when compared to other algorithms.

CONCLUSION

LBP, LDP, LTrP are devised and investigated for generating effective and powerful representation for use in face recognition. Though the images variant in their pose, illumination, rotation Viola – Jones face detection algorithm was used to detect the face accurately. The above methodologies mainly deal with the binary features of the image. The NN classifier called back propagation Neural Network was used to recognize the faces. Gabor Wavelet was combined with LBP to improve the accuracy in recognizing face. Gabor Wavelet transform yields forty images for magnitude and phases and the images are combined to form a single image. The accuracy of the proposed method was high and it takes less time to execute. The graph indicates that LTrP recognize the face accurately and it takes only less time to execute.

FUTURE WORK

In my future work, instead of images, videos are given as input. Video may have multiple faces with different pose and occlusion. In the video, the faces are detected using the Viola-Jones face detection algorithm and feature vector are constructed using LVP and uniform statistical pattern. These extracted feature vectors are compared with the features that are extracted from trained dataset. The similarity are measured and then it is recognized.

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