A Survey on Facial Recognition

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Abstract

This paper identifies various methods involved in recognizing the human face for determining the kind of emotions. We focus on the various methods that can be applied for facial recognition. The methods used are Local Binary Pattern (LBP), Median Ternary Pattern (MTP), Local Ternary Pattern (LTP), Space Representation Clarification (SPC), Local Directional Number Pattern (LDNP), Local Gaber Binary Pattern from three orthogonal planes (LGBP-TOP). These methods are appearance based approaches that are more efficient than geometric based approach. Each method uses different kind database to determine the efficiency. Two kinds of database are used FERET and JAFFE.

Keywords: Facial Recognition, Local Binary Pattern, Median Ternary Pattern, Space Representation Clarification, Local Directional Number Pattern

I. INTRODUCTION

Human face recognition has become more popular only because of its potential applications in the field of Bio-metrics, Security and also in human computer interaction. Although the work has been done, recognition in uncontrolled environment is still a challenging task. For this purpose, our recognition method must minimize the within-class variance and maximize the between class variance of the entire image in all the possible environments. Facial feature extraction can be done in two ways. One is using geometric based approach and other is using appearance based approach. the geometric based approach is entirely based on the geometric relationships and the facial components. But these two factors cannot be constant at all the environments. Hence this method deteriorates. Therefore we go for appearance based approach were, we use image filters on the entire image to extract facial features. The filter can either be applied on the whole image or on the part of the image. The local appearance based method mainly concentrates on the local regions of the image and shows a superior performance. Elastic bunch graph match (EBGM), Bayesian intra/ extrapersonal classifier (BIC), local feature analysis (LFA) and dynamic link architecture (DLA).

A. Median Ternary Pattern

The paper [1] describes the effective usage of a local texture pattern called median ternary pattern for constructing an appearance-based facial feature descriptor. Experimental result shows that MTP feature descriptor is far superior when compared to other appearance based methods. Working of the MTP operator is based upon the intensity values of the neighbours in each pixel used for encoding the texture information in local neighbourhood of the image. This process is carried out in three levels that is based on median and the threshold values. Here we use FERET face image database along with the template matching for evaluating the effectiveness of the method.

The method gives us a robust appearance based facial feature extraction. This is made possible by using the MTP operator that uses the median value. The main idea behind the method is that it quantizes each median values of the neighbour cells at three levels (-1,0,1). The major novelty of the method is the combination of advantages of Median Binary Pattern (MBP) and Local Binary Pattern (LBP) into single local texture pattern. The basic LBP operator selects a 3×3 local neighbourhood in all the pixels and generates an 8-bit binary code by using the intensity values of those pixels.

The MBP method is an extension of LBP method. Here, a 3×3 local neighbour is selected in each pixel and its median intensity value is calculated. It is denoted by M_C . Then an 8 bit code is generated by thresholding those intensity values. The usage of gray level for the quantization purpose improves robustness in presence of random noise. But the thresholding value is done at exactly median value and hence inconsistent code generation problem remains in the uniform regions. To overcome this we go for MTP.

The MTP method overcomes the problem of inconsistent code generation at the uniform regions by using a window that is defined to generate a 3 valued code instead of 2 valued code. This 3 valued code is called the ternary pattern.

The MTP code is splitted into two parts namely, positive and negative binary patterns called P_{MTP} and N_{MTP} . This process actually reduces the feature size from 3^8 to 2×2^8.

Applying MTP operator on the input image produces two encoded images namely positive MTP (P_{MTP})and negative MTP(N_{MTP}).Then the histogram part of each MTP is generated. The histogram part actually acts as the feature representation of the input image. This eventually determines the frequency of the MTP micro-patterns that gives us the details about the location information.

Face recognition is carried out using MTP by comparison of the feature vector of the input image with the feature vector of the all other images in the gallery. This process is carried out using Chi-Square dissimilarity method.

The performance measurement of the MTP operator method is done in accordance to CSU Face Identification Evaluation System. Here in the FERET database consists of 14,051 face images that represents 1,199 individuals. the variations in facial expressions, lightning, pose and aging brought FERET database to be divided into five sets as fa set-training set that contains frontal images of different people, fb set-contains images of alternative facial expression other than in fa images, fc set-photos that have been taken at different lighting conditions, dupI set-contains photos that are taken at later time. dupII set-it is a subset of the dupI set.

The performance of MTP is compared with LBP, MBP, LTP, EBGM and PCA using threshold values with the help of non-weighted method and also using weighted method

TABLE I
RESULT IN FERET DATABASE USING NON- WEIGHTED METHOD

Method	**Fb**	**Fc**	**Dup i**	**Dup ii**
MTP	0.95	0.78	0.65	0.61
LBP	0.91	0.74	0.57	0.52
MBP	0.92	0.76	0.60	0.56
LTP	0.93	0.77	0.63	0.58
EBGM	0.88	0.40	0.43	0.20
PCA	0.83	0.63	0.40	0.22

B. Local Binary Pattern and Gradient Direction Pattern

The paper [2] proposes an algorithm for facial expression recognition that is actually based on Gradient Direction Pattern (GDP), Local Binary Pattern (LBP) and Sparse Representation Classification (SRC). For the feature extraction process and then for deriving the final expression feature by concatenation method, we use GDP and LBP. Then for classifying the test samples we use SRC. And here we consider seven categories of samples. Here instead of FERET database we use JAFFE database for measuring the effectiveness of the method. and also it proves that it is far better than the other traditional methods.

In this type of facial expression recognition method also we use the LBP method that concentrates on the grey levels of the image. Also GDP descriptor is used that is based on the gradient direction values of the texture encoding of the image that is obtained by the LBP method. In this method we come across a new method called SRC that is widely used in image processing and for the first time it is used in the face recognition. It is mainly used to compress the high dimensional data. Here it is used for categorizing the expressions in seven different stages.

LBP method is used first on the input image. The method concentrates on the texture quantity of the pixel of the image and it forms the two input parts such as positive and negative input image. Then these inputs are processed to form their corresponding histogram values. This histogram values help us in making out the facial expression extraction.

GDP method concentrates on the angles of the gradient direction of the pixels. It first uses the texture value obtained from using the LBP method. this method involves a Prewitt operator that convolves horizontal and vertical kernel of the image that will produce the gradient vectors such as G_x and G_Y. The encoded form of the GDP is then partitioned into w×h regions. Then separate histogram is calculated for each regions using LBP. Then these histograms are concatenated to form the final GDP histogram. This will actually help in finding the facial expression feature vector.

The SRC method is exactly reconstructed from the small number of linear measurements of the sparse representations.

Here the algorithm that combines LBP, GDP and SRC is used. First in the algorithm, the input values are given in the matrix format for testing and then, secondly, LBP and GDP are applied to form the final histogram of the GDP method for feature vector. Thirdly, those histogram values are given as the input to the SRC method for processing. Then finally, then result is recognized.

The experimental results shows that the three methods on using them separately will give a moderate result and when we use them as a whole that is combination of LBP, GDP and SRC will produce 69.52% recognition rate.

C. Local Direction Number Pattern and Sparse Representation

The paper [3] offers a different approach for facial expression recognition. There are three main benefits concerning to the paper. They are, first it combines the regional compression with wavelet decomposition that can remove the interface. Secondly, it uses Local Directional Number Pattern (LDN) to extract facial feature. This method unlike LBP includes directional information with the intensity for encoding. Finally, here too we use the concept of sparse representation.

The traditional way of facial recognition uses the input image as a whole and there may be regions those are redundant that makes the accuracy come down. Hence this paper gives us a different method that avoids redundant regions by selecting the major regions for extraction process.

In this method we first admit the LDN method. First the input image is given to LDN and where the texture value is obtained from the combination of both directional information and the intensity values. Also, it includes only the selected regions for processing. Then in this paper we use another new feature called adaboost face detection, were it is mainly used to detect the human face very clearly. But this technique detects only the outline of the image. Hence it may create some problems and to solve them we use active shape model. This method detects 68 points in the image for feature extraction. These regions can be determined in four boundaries top, down, left and right. Region of fore head is calculated as follows,

Up=min (p[18] .y, p[19].y, p[24].y, p[25].y)

down=max (p[18] .y, p[19].y, p[24].y, p[25].y)

left=min (p[18] .x, p[19].x, p[24].x, p[25].x)

right=max (p[18] .x, p[19].x, p[24].x, p[25].x)

Wavelet decomposition is the method applied to the regions that are selected for processing. This method helps in decomposing the selected regions for finding the facial feature extraction vector.

Finally we use the SRC method for finding the facial recognition. Here the input is the test samples that are collected and they are feed to the SRC in the form of linear expressions. Using those linear inputs the process is carried out in SRC. Here each selected nodes are concentrated separately to form the result detection.

The experimental result shows that, this method uses the JAFFE database for the comparison with other method and to show its effectiveness. Also this method has identified happy, anger, fear, sadness, surprise, disgust and no expression. In this paper they have given their comparison with other tradition methods. And the final results shows that this method produces the recognition rate of about 65.2±5%

D. Local Gabor Binary Patterns from Three Orthogonal Planes

The paper [4] proposes a different method facial recognition as it uses a dynamic appearance based descriptor that is Local Gabor Binary Pattern from Three Orthogonal Planes (LGBP-TOP). This method combines the working of both spatial and dynamic texture with Gabor filtering to produce an effective result that matches with the real world. This method helps to overcome the problems in temporal and intensity analysis.

The LGBP-TOP considers three orthogonal planes such as x-y plane that is spatial, then x-t and y-t that are temporal planes. The LGBP is independently applied on these three planes. This method is more robust than the other simple LBP methods because in this method we use the smoothing effect.

The method LGBP-TOP splits the face video into space-time and video volumes. They both intersect the x-y, y-t and also x-y planes. A Gabor picture (GP) is the collection of number of Gabor filtering results. Each GP is the result of the original image. Here the Gabor is always followed by the LBP filtering technique. The final LGBP histogram of the image is composed by concatenating the histograms composed by each GP. With the help of LBP-TOP it is possible to combine motion and appearance analyse in one operator with the feature histogram length $3*2^8$.

In LGBP-TOP a video sequence is created for each block of frames in the GP. This video sequence is then processed using the LBP-TOP operator. Then the resulting combined histogram gives us the final emotion recognition for the specified input.

On the whole, the experimental result has sown that the efficiency of LGBP-TOP is improved when compared to LBP in terms of 2AFC score about 14% and in terms of Cohn-Kanada database usage, the performance has been improved for about 18%.

E. Comparison:

TABLE II
COMPARISON OF METHODS

Title	**Database**	**Approach**	**Method**	**Efficiency**
MTP-FR	FERET	Appearance based	LBP, MBP,MTP	72.53%
LBP, GDP-FR	JAFFE	Appearance based	GDP, LBP, SRC	69.52%
LDNP, SRC-FR	JAFFE	Appearance based	LDN, SRC	65.2±5%
LGBP-TOP-FR	Cohn-Kanada	Dynamic appearance based	LGBP-TOP,LGBP	71.22%

II. CONCLUSION

The paper describes the comparison and analysis between various methods involved in facial recognition. It also illustrates that there are many techniques or patterns that can be followed for recognising different kinds of emotions in a human face using the feature vector that has been extracted. This kind of comparison reflects that the efficiency of recognition process differs from each method. This paper shows the usage of MTP method of facial recognition using FERET database as the simple and efficient.

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