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Face Recognition using Local Ternary Pattern for Low Resolution Image

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Abstract: ***Face Recognition system is one of an effective system which is used for the identification of a person from a video frame or a digital image. The concept of FRS is primarily used in the field of security systems and hence can be get compared to other systems which are biometric in nature such as IRIS Recognition or Fingerprint systems. Apart from these techniques, Local Binary Patterns (LBP) also plays a vital role for the image recognition as well as texture recognition purposes based on Texture Spectrum Model. But, it can only develop the feature matrix from 0 and 1 on the basis of centre pixel value only. Hence, to compute upper and lower binary codes of regions, the concept of Local Ternary patterns (LTP) is being implemented in this paper. LTP is an extension to LBP which used a threshold value for selection of upper and lower binary code. In this paper, the simulations have been carried out to achieve a better improvement in the blurred images by using Discrete Wave Transformation (DWT) and LTP techniques. DWT and LTP approach for face recognition provides better FRR, FAR and Accuracy than other approaches used for low resolution images.***

Keywords: Face Recognition System, Local Binary Patterns, Local Ternary Patterns, Discrete Wave Transformation

1. Introduction

An image is two dimensional function can be represented as f(x, y), where x and y are spatial coordinates. Amplitude at any pair of coordinates is known as intensity level of the image at that particular point [1][2] [3][4]. When the value of x, y, and amplitude are obtained as a discrete finite values then the image is known as digital image. The digital image field processing is done by digital computer. The digital image is compiled of fixed number of elements and each element has exact location and value [5][6][7][8]. These elements can be picture elements, image elements and pixels. Pixel is used to denote the fundamentals of digital image with the help of vision. As vision is the only most sensible sense which plays a vital role in human perception [9-15]. There are various components of image processing system.

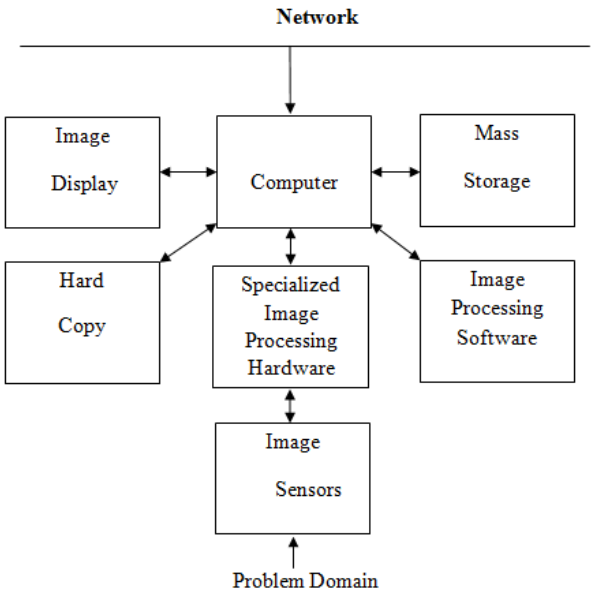

Figure 1: Components of Image Processing System

Figure 1 shows the flow chart of components of image processing system. In Local binary pattern various computer vision applications have utilized because of its simplicity and strength to clarify variations. However, its sensitivity to noise restricts the performance. The pixel difference is encoded between the center pixel and the neighboring pixel into a ternary code for global ternary pattern. The ternary code is divided into two binary codes first is positive LTP and second is a negative LTP to diminish the dimensionality [16][17][18].

Local ternary pattern (LTP) is more sensitive to noise as compared to LTP because of encoding the small pixel difference into a separate state. The small pixel difference may be easily inundated by noise. Thus, it is difficult to precisely determine its sign and magnitude. Although, considerable information loss is obtained after the division of ternary code into a positive and negative LTP code yet histograms strongly related with these positive and negative LTP codes gives valuable information [19-22].

An eminent issue with LBP is that it is susceptible to noise in the near-uniform image areas. Numerous three-valued coding proposals have been proposed to formulate LPB more discriminant and less responsive to noise. Local Ternary Patterns (LTP), proposed in the year 2007 which utilizes a thresholding function around zero for the evaluation of local gray-scale difference [23]. The divergence d connecting the gray value of the pixel x from the gray values of one in its locality u is encoded by the three values according to the following threshold rule, τ:

$$d = 1 \text{ for } u \geq x + \tau$$
$$d = 0 \text{ for } x - \tau \leq u < x + \tau$$
$$d = -1 \text{ otherwise}$$

From a computational point of view, a ternary pattern is split into two binary patterns by considering its positive and negative components. The histograms computed from these two descriptors are then concatenated. Hence, in this paper,

we have implemented the LTP scheme for the low resolute images so that the face can be recognized using LTP [23] [24] [25].

After introducing face recognition method by using LTP, the rest of the paper is organized as follows. The section II discusses the concept literature survey and section III focuses on the proposed methodology. Simulation Results and Discussion are explained in the section IV. The conclusions and future scope is discussed in the last section.

2. Literature Survey

Yang et al proposed a new two dimensional PCA for the presentation of image and is suitable for problems which are small sized. 2DPCA shows higher accuracy rate of recognition as compared to PCA. Also 2DPCA is based on 2D image matrices rather than 1D vector so the image matrix does not need to be altered into vector proceeding to feature extraction. The applications of 2DPCA techniques are diverse and can be implemented on the various data bases such as ORL, AR and YALE [26].

Amani1 et al reported another approach to recover the face recognition exactness. This method is based upon image contrast and the local visualization which get enhanced by using digital filtering and histogram of the pixel values over whole image. In this method primarily the face images are changed into a high-frequency domain and after that local thresholding method is implemented to the image. For the diminution of dimension and also feature extraction principle the linear method such as two dimensional principle component analysis (2DPCA) and two dimensional linear discriminate analysis (2DLDA) has been opted. Samaria and Harter gave model for Human Face Identification. In this model the database is in the PGM format. 40 different images of individuals have been considered under various illuminations for this model. The dimension of the image dataset is 92 x 112 Also another author Baker proposed CMU Pose, Illumination, and Expression Database accompanied with the color images of the 68 unique peoples. The size of image is 640 x 486 and the database in this method is in the form of PIE based [27].

Yuan et al represents face recognition by using independent component analysis (ICA). In this work IC selection algorithm has been designed to find subset of ICs for recognition. In this paper a least-squares solution method using Householder Transformation is applied [28].

3. Proposed Methodology

In this section, the methodology of the proposed work is shown. The whole of the work has been carried out on MATLAB. The database has been created of the face images and the texture features get extracted from the face images by the implementation of Local Ternary Pattern scheme by applying 3*3 masks on the image. After this, the histograms have been calculated for each region of an image. The whole of the process is shown in a flowchart manner as shown in the figure.

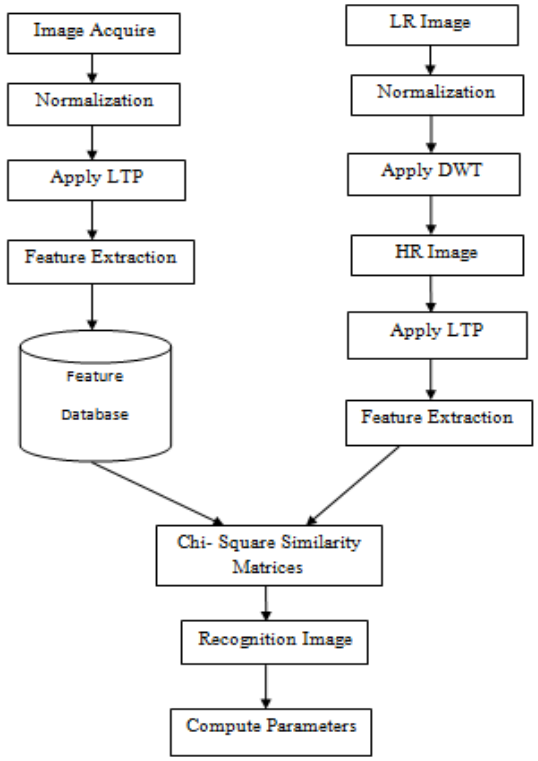

Figure 2: Flow of Work

Figure 1 explains the flow of work which elaborates the idea of implementing the proposed scheme of face recognition using the local ternary pattern scheme for the images which are low resolution in nature. The whole of the methodology is explained in numerous steps in which the low resolution image is being loaded consisting of 32*32 dimensions. The integration of DWT scheme on the low resolution image is done in the step 2 which decompose the whole of the image into four diverse set of bands. The bands formed are low-low, low-high, high-low and high-high types of bands. The purpose of DWT is to enhance the sharpness of the low resolute image. This results in the extraction of better features from the image. At this step, after the implementation of DWT scheme, the LTP technique is then applied to the obtained image. The LTP then computed the values of histograms by using the different values used for computation.

Hence, at the end, the DWT and LTP schemes then applied to the blurred faced images to achieve superior performance by decreasing the values of false acceptance rate and false rejection rate.

4. Simulation Results and Discussion

In this section, the simulation results have been carried out by using core i3-2330 processor and 2GB of RAM. All the simulations have been carried out on MATLAB simulator. The recognition rate and parameters like FRR and FAR is being computed in this section. Recognition Rate has been analyzed using ORL data base which contains 400 images of 40 individuals with different resolutions and different poses.

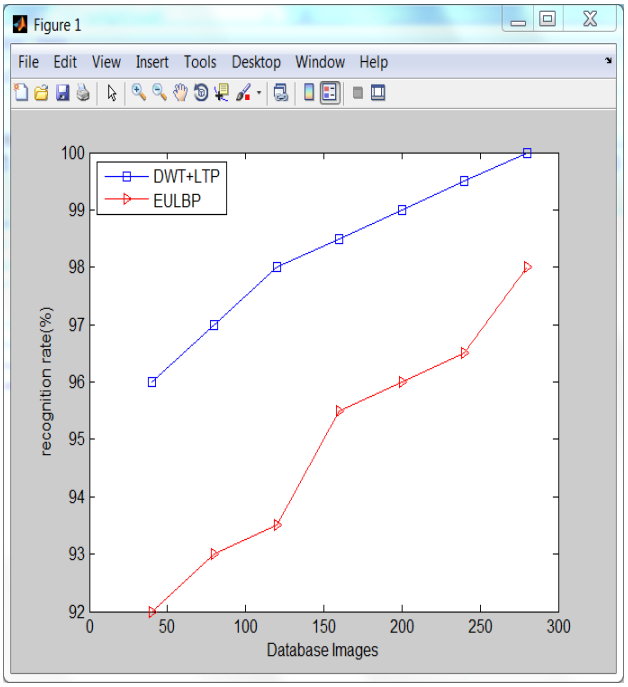

Figure 3: Recognition Rate

Figure 3 shows the graphical depiction of recognition rate of local ternary pattern and consistent local binary pattern. Recognition rate has been calculated on the basis of the number of images that have been recognized precisely coordinated with the database images. The recognition accuracy is computed on the basis of accurate results that have been computed by an algorithm for the diverse set of LR images.

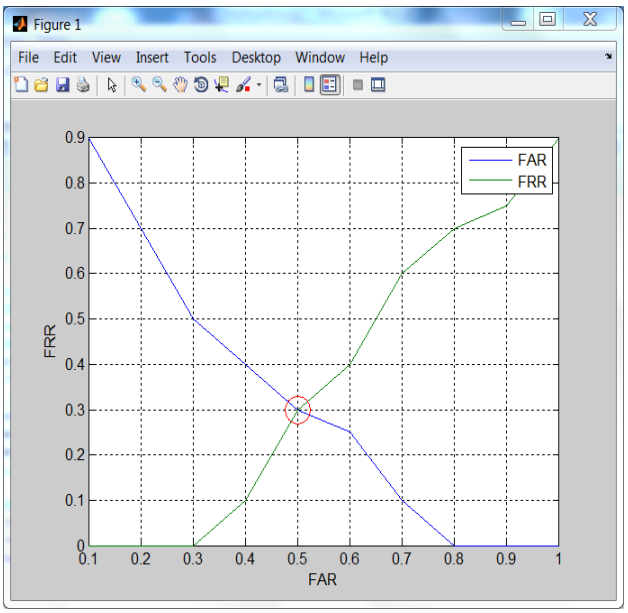

Figure 4: Parameters FRR and FAR

Figure 4 represents the parameters which have been evaluated for the performance of biometric system. FAR is represented by blue line which is cutting the green line of FRR at coordinated 0.3 and 0.5 respectively. Equal Error Rate (ERR) is defined by the red circle at shown at the point where the FAR and FRR crosses each other.

The accuracy of the presented work is calculated by examining the finest match prepared by the work anticipated. The presented approaches DWT and LTP are used for the computation of number of images matched. The diverse levels of resolution have been utilized for the analyzation of images. The investigation of images is carried out at low and high resolutions which are shown in TABLE I.

Table 1: Comparison of Accuracy

Resolution of Test Image	DWT+LTP Accuracy	EULBP Accuracy
112 X 92	85 %	91.25 %
64 X 64	87.5 %	92.50 %
32 X 32	84.37 %	88.70 %

5. Conclusion

In this section, we can easily conclude that the proposed scheme of recognizing the face in the image of low resolution using DWT and LTP schemes comes out to be more effective and efficient than that of conventional EULBP method. The proposed scheme provides the best false acceptance rate and false rejection rate. The scheme introduced in this work is implemented on the images having the resolution of 32*32. Hence, at the end we can conclude that the proposed approach outperforms the conventional scheme for the enhancement of image recognition in the images having low resolution.

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