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FACIAL FEATURE EXTRACTION USING LBP WITH GABOR FILTER

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ABSTRACT
A Facial Feature Extraction approach is proposed here using LBP. The system first pre-processes the input image for illumination changes and noise invariance with the help of Adaptive Histogram Equalization. Then Face detection is proposed and Gabor filter is also applied to produce magnitude pictures. Finally, the proposed LBP is used to extract features of the facial image.

KEYWORDS: Image Pre-processing, Adaptive Histogram Equalization, Face Detection, Feature Extraction, Gabor Filter, LBP, Matlab.

INTRODUCTION

Feature extraction is one of the most vital steps involved in image description. Every feature extraction technique has its own merits and demerits. For a particular application a carefully worked fusion of features, extracted using different techniques, can enhance their image description capabilities [1].
This paper proposes a facial feature extraction system using Local Binary Pattern (LBP). In this system first the image is acquised. Then the input image is preprocessed for illumination changes. The pre-processing is performed using Adaptive Histogram Equalization. Face-detection system detects face and crops face portion. A 2D Gabor filter is applied to get particular features. Then the proposed LBP is used to extract features of the input image.
Local binary patterns (LBP) is a type of visual descriptor used for classification in computer vision. LBP is the particular case of the Texture Spectrum model proposed.
The LBP feature extraction is performed in the following three steps:

1) Divide the examined window into cells.
2) For each pixel in a cell, compare the pixel to each of its 8 neighbors (Clockwise or Anti-clockwise).
3) Then with the help of 8-digit binary number, local binary pattern is calculated.

PROPOSED METHODOLOGY

BLOCK DIAGRAM:

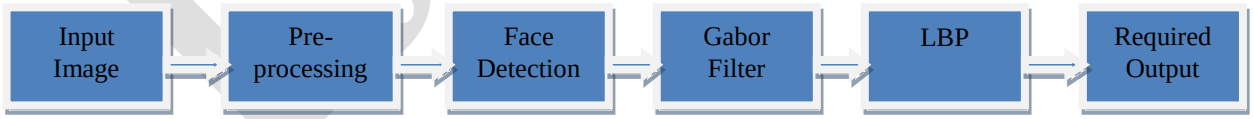

Figure1: Block Diagram of proposed system

PROCEDURE:

The Facial Feature Extraction as shown in the block diagram is as follows;

1) Acquisition of Image: Image is acquised i.e. the image input is taken.
2) Preprocessing: In this stage preprocessing is done for illumination changes. First of we apply histogram equalization and bilateral filter to compensate illumination variations and reduce noise in the input image [2].
3) Face Detection: Here Face detection is processed where the face is detected and it is cropped in particular size.

4) Gabor Filter: Here Gabor magnitude image generation is performed i.e. a 2D Gabor filter is applied to produce magnitude pictures [2].
5) Local Binary Pattern (LBP): In this stage LBP feature extraction is performed due to which facial features are extracted.

A. PRE-PROCESSING USING ADAPTIVE HISTOGRAM EQUALIZATION

The Adaptive Histogram Equalization is different from ordinary histogram equalization i.e. it computes several histograms, each corresponding to a distinct section of the image, and use them to redistribute the lightness value of image.
It enhances the contrast of the grayscale image. It is therefore suitable for improving the local contrast and enhancing the definitions of edges in each region of image.

B. GABOR FILTER

The Gabor filter (Gabor Wavelet) represents a band-pass linear filter whose impulse response is defined by a harmonic function multiplied by a Gaussian function. Thus, a bi-dimensional Gabor filter constitutes a complex sinusoidal plane of particular frequency and orientation modulated by a Gaussian envelope [8]. It achieves an optimal resolution in both spatial and frequency domains. Our approach designs 2D odd-symmetric Gabor filters for face image recognition, having the following form of equation [1]:

$$G_{\theta_k, f_i, \sigma_x, \sigma_y}(x,y) = \exp\left(-\left[\frac{x_{\theta_k}^2}{\sigma_x^2} + \frac{y_{\theta_k}^2}{\sigma_y^2}\right]\right) \cdot \cos\left(2\pi f_i x_{\theta_k} + \varphi\right), \qquad (1)$$

where,

$$x_{\theta_k} = x\cos\theta_k + y\sin\theta_k, \quad y_{\theta_k} = y\cos\theta_k - x\sin\theta_k,$$

i f provides the central frequency of the sinusoidal plane wave at an angle k θ with the x – axis, x σ and y σ represent the standard deviations of the Gaussian envelope along the two axes, x and y. We set the phase ϕ = π / 2 and compute each orientation as k,

$$\theta_k = \frac{k\pi}{n},$$

Where, k = {1,..., n} .
The 2D filters k , f , x , y Gθ σ σ , given by relation (1), represent a group of wavelets which optimally captures both local orientation and frequency information from a digital image. Each face image is filtered with k , f , x , y Gθ σ σ at various orientations, frequencies and standard deviations [1].

C. LBP (LOCAL BINARY PATTERN)

Local binary pattern is created in the following manner:

- Initially it divides the examined window into cells (e.g. 16*16 pixels for each cell).
- For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc). Follow the pixels along a circle, i.e. clockwise or counter-clockwise.
- Where the center pixel's value is greater than the neighbor's value, write "0". Otherwise, write "1". This gives an 8-digit binary number (which is usually converted to decimal for convenience).
- This gives the facial feature of the image.
- The value of the LBP code of a example pixel (x_c, y_c) is given by;

$$LBP_{P,R} = \sum_{P=0}^{P-1} s(g_p - g_c)2^p \qquad s(x) = 1, \text{ if } x \geq 0 \; ; \; s(x) = 0, \text{ otherwise.}$$

example		
6	5	2
7	6	1
9	8	7

thresholded		
1	0	0
1		0
1	1	1

weights		
1	2	4
128		8
64	32	16

- Pattern = 11110001
- LBP = 1+16+32+64+128
  = 241
- C = [(6+7+8+9+7)/5] – [(5+2+1)/3]
  = 4.7

RESULT AND DISCUSSION

STEP 1: Take any input image with the title original image. We have taken an image as shown below;

Figure 2: Input Image

STEP 2: Here Pre-processing is performed using AHE;

Figure 3: Adaptive Histogram Equalization

STEP 3: Here Face is detected and extracted from the input image;

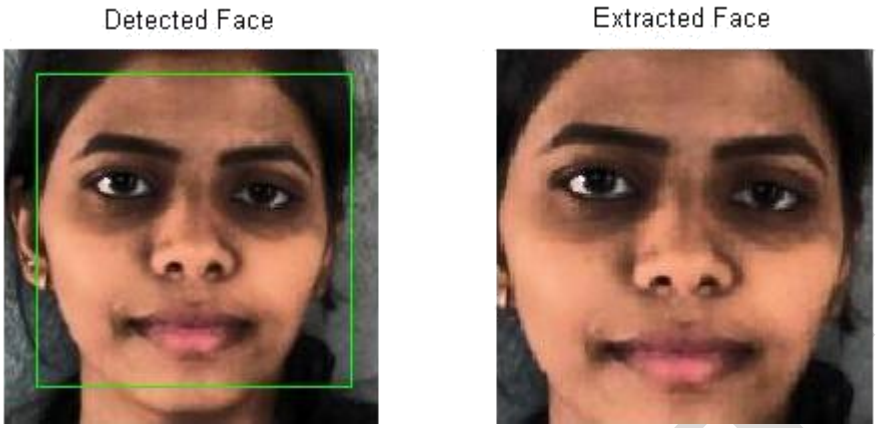

Figure 4: Detected Face

STEP 4: Gabor magnitude image generation (Gabor Filter)

Figure 5: Gabor Magnitude Image Generation

STEP 5: Features of extracted face are obtained using LBP feature extraction technique as shown below;

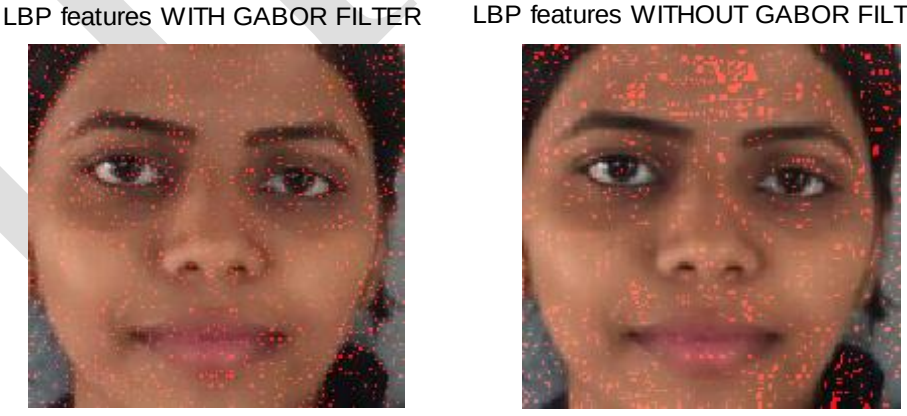

Figure 6: LBP Feature Extraction with & without Gabor Filter.

CONCLUSION

This system uses image processing tools in matlab, extracts the Facial Features of the input image. By developing this system we are providing feature extraction using LBP (Local Binary Pattern).
With all this in view, we have proposed a system in this for feature extraction using LBP which is widely used for classification in computer vision.

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