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Recognition of Facial Expression by Digital Image Processing

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***Abstract*—** Facial expression recognition is an challenging problem, and important applications in many areas such as human–computer interaction. Facial language gives important information about emotions of a person. Understanding facial expressions accurately is one of the challenging duties. In this paper, a new method of facial expression recognition based on local binary patterns (LBP) to recognize seven different facial expressions of two individuals such as happy, angry, disgust, sad, fear and surprise. The face area is first divided into small regions from which Local Binary Patterns (LBP), histograms are exact and concatenated into a single feature vector. This feature vector forms an efficient representation of the face and is used to measure similarities between images. Our aim is to represent best techniques which work best for facial recognition.

Keywords- *local binary pattern (LBP), feature extraction, distribution, pattern recognition, histogram, feature vector.*

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Introduction

Facial expression is one of the most powerful, neural and Immediate means for human beings to communicate their emotions and indention. A human face carries a lot of important information while interacting to one another. In social communication, the most common communicative advice is given by one's facial expression. Recognition of facial expressions results in identifying the basic human affection like anger, fear, disgust, sadness, happiness and surprise. These expressions can vary in every individual. In communication indicated that 7% of message is conveyed by spoken words, 38% by voice accent while 55% of message is conveyed by facial expressions. Facial expression is one of the most powerful, natural and current means for human beings to communicate their emotions and intension. Face recognition is an interesting and challenging problem, and bang important applications in many areas such as identification for law enforcement, authentication for banking and security system access, and also personal identification among others automatic facial recognition systems now have a potential to be useful in any day-to-day application environments like in identifying suspicious persons in airports, railway stations and other places with higher threat of terrorism attacks.

Need for study

- To avoid difficulties in facial expression recognition (FER) due to the variation of leading expression across the human population.
- To analyze facial expression feature evocation methods.
- To compare the facial expression & types.

I. ARCHITECTURE OF FACIAL EXPRESSION RECOGNITION SYSTEM

The facial expression recognition system subsist of four steps. First is face detection phase that detects the face from a still image or video. Second is normal vision phase that removes the noise and normalize the face against brightness and pixel position. In third phase features are express and irrelevant features are eliminated. In the final step basic expressions are classified into six main emotions like anger, fear, disgust, sadness, happiness and surprise.

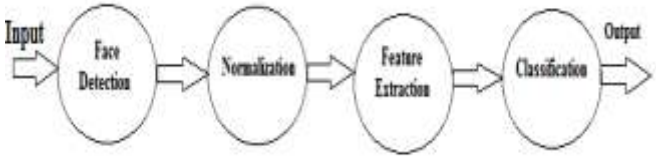

Figure 1. Architecture of facial expression recognition system.

Facial expressions show the motive, affective state, cognitive activity, psychopathology and personality of a person [2]. In face-to-face communication facial expressions convey many important communication cues. These cues help the listener to get the intended meaning of the spoken words.The facial expression recognition also has major application in areas like behavioural science, medicine, social interaction and social intelligence.[1]

II. TECHNIQUES USED FOR FACIAL EXPRESSION RECOGNITION

A. Principal Component Analysis (PCA)
B. Independent Component Analysis (ICA)
C. Gabor Filer Bank
D. Local Binary Pattern (LBP)

A. PRINCIPAL COMPONENT ANALYSIS (PCA):

Principal Component Analysis (PCA) is a technique that reduces the dimensionality of image and provides l.the effective face indexing and retrieval. It is also known as the Eigen face approach. Linear projection is used in PCA, which maximize the projected sample scattering. Imaging conditions like lighting and viewpoint should not be varied for better performance. PCA aims to produce a low dimensional

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representation of high dimensional data that preserves the greatest sources of variation within the data set.

Merits of PCA

- Principle component analysis techniques used for dimensionality reduction of image.
- PCA provides the effective face indexing and retrieval.
- In PCA Linear projection is usedwhich maximize the projected sample scattering.

Demerits of PCA

- PCA techniquesshould not be varied for better performance imaging conditions like lighting and viewpoint.

B. INDEPENDENT COMPONENT ANALYSIS

Independent Component Analysis (ICA) produces statistically independent basis vector while both PCA and LDA produces spatially global feature vectors.

ICA gives better performance than PCA but it is computationally expensive than PCA.

C. GABOR FILER BANK

Gabor Filer Bank is other technique that gives greater performance in terms of recognition rate than other methods.

This method has a major limitation that the maximum bandwidth is limited.

D. LOCAL BINARY PATTERN

In this paper we use Local Binary Pattern (LBP) one of the feature extracting method. This method Proposed by Ojala et al in 1996. The original local binary patterns (LBP) operator takes a local region around each pixel, thresholds the pixels of the part at the value of the central pixel and uses the resulting binary valued image patch as a local image descriptor. The operator labels the pixels of an image by more chiding a area of each pixel with the center value and considering the results as a binary number, and the 256-bin histogram of the LBP labels computed over a region is used as a texture descriptor. [4]

With LBP it is possible to describe the texture and shape of a digital image. This is done by isolating an image into several small AREA from which the features are extracted .These features consist of binary patterns that describe the neighborhood of pixels in the regions. The obtained features from the regions are connect into a single feature histogram, which forms a sample of the image.[3]

a. *Principles of Local Binary Patterns*

This operator works on the eight neighbors of a pixel, using the center pixel value as a threshold. If value of neighbor pixel has a greater gray value than the center pixel (or the same gray value) is assigned as one to that pixel, If value of the neighbor pixel has a smaller than the center pixel is assigned as zero. The LBP code for the center pixel is then produced by concatenating the eight ones or zeros to a binary code.

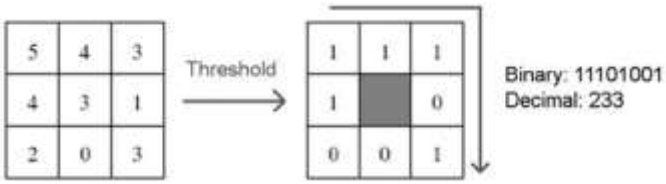

Figure 2. The Original LBP Operator

In other words, given a pixel position (xc, yc), LBP is defined as an ordered set of binary ratio of pixel intensities between the central pixel and its surrounding pixels. The arise decimal label value of the 8-bit word can be expressed as follows,

Histogram of the labeled image fi (x, y) can be defined as

$$\mathbf{Hi} = \sum_{\mathbf{x,y}} \mathbf{I(fi(x,y)=i)},\ \mathbf{i=0},\ldots\ldots\ldots,\mathbf{n-1}$$

Where n is the number of different labels produced by the LBP operator and

$$I(A) = \begin{cases} 1, & A \text{ is true} \\ 0, & A \text{ is false} \end{cases}$$

The basic LBP operator is limitation that its small 3×3 neighbourhood cannot capture the dominant features with greater scale structures. as a result, to deal with the texture at different scales, the operator was later extended to use neighbourhoods of different sizes. [5]

b. *Local Binary Patterns Extension*

In order to define textures at different scales, the LBP operator was extended to make use of neighborhoods at different sizes. Using circular neighborhoods and bilinear interpolation of the pixel values, any radius and number of samples in the neighborhood can be handled. Therefore, the following notation is defined: (P, R) which means P sampling points on a circle of R radius. The figure shows below some examples of different sampling points and radius:

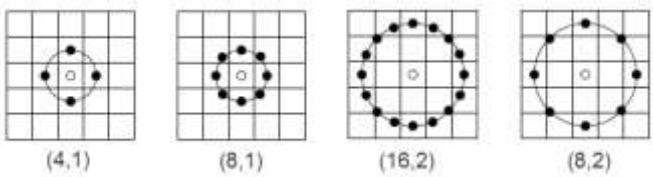

Figure 3. LBP different sampling point and radius examples.

In LBP (4.1) case, the reason why the four points selected correspond to vertical and horizontal ones, is that faces contain more horizontal and vertical edges than diagonal ones. When computing pixel operations taking into account $N \times N$ neighborhoods at the boundary of an image, a portion of the $N \times N$ mask is off the edge of the image.

c. *Uniform of Local Binary Patterns*

The Local Binary Pattern (LBP) is called uniform if it contains at most two bit-wise transitions from 0 to 1 or vice versa. It means that a uniform pattern has no transitions or two transitions. It is possible to use only a subset of the 2P local binary patterns to describe textured images. This subset is called uniform patterns or fundamental patterns. Each of these patterns has its own bin in the LBP histogram. The rest of the patterns with more than 2 transitions will be accumulated into a single bin.

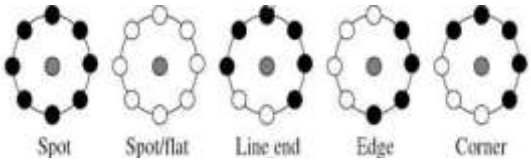

Figure 4. Different texture primitives detected by the LBP^u2P,R

Using only uniform Local Binary Patterns has two important benefits. The first one is that it saves memory. With non-uniform patterns there are $2p$ possible combinations. With $LBPP,Ru2$ there are $P\ (P-1)$ +2 patterns possible.

III. THE JAFFE DATA BASE

In this experiment we use the JAFFE (Japanese female facial expressions) database. The database contains seven Japanese females images. There are seven different facial expressions, such as neutral, happy, angry, disgust, fear, sad and surprise. Totally, there are 213 grayscale facial expression images in this database . Each image is of size 256×256. The two expressions comprising seven different facial expressions from the JAFFE database. [2]

Figure 5. Sample of two expressors containing seven different facial Expressions

IV. IMPLEMENTATION

All codes are written in MATLAB. It uses Graphical UserInterface (GUI). The JAFFE database has been used. In this paper we worked on 14 images of 7 facial expressions (Happy, Sad, Angry, neutral, fear,surprise and Disgust).[2]

V. RESULTS

This implementation we have collected the different faces of images, some of them collected from the database. In this paper we have to used the LBP method to extract feature in our face. We take face image as a input and we get the facial expression like happy ,angry ,sad, surprise, disgust, fear as a output.

VI. CONCLUSION

In this paper the facial expression recognition systems and various challenges are overviewed. It mainly consists of three parts, namely face detection, feature extraction and classification. Face detection to detect the face from image. The most useful and unique features of the face image are extracted in the feature extraction phase. In the classification the face image is classify the six basic expression like happy, sad , angry , disgust, surprise, fear . In this we presented a new method of facial expression recognition based on LBP. The LBP operator has been widely used in different applications such as texture classification, image retrieval.One key step in facial expression recognition is to extract the low dimensional features.

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