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Automatic Facial Expression Recognition Using Fusion of Feature Extraction Techniques

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ABSTRACT

With the increasing immersion of computers in our everyday life, the gap between computers and humans becomes increasingly apparent. Face plays significant role in social communication. This is a 'window' to human personality, emotions and thoughts. Facial expressions, resulting from movements of the facial muscles, are the face changes in response to a person's internal emotional states, intentions, or social communications. The three stages of facial expression recognition are pre-processing, features extraction and classification. Feature extraction plays an important role in facial expression recognition. To enhance the recognition accuracy of the facial expression recognition we adopt the merging approach which combines different feature extraction technique for local feature extraction improvement. In this paper, we are evaluating 2DPCA+LBP for facial representation. To improve the accuracy of the system we have applied 2DPCA on LBP images in place of original images. The proposed system has achieved the recognition rate of 97.25 % for 2DPCA+LBP.

KEYWORDS: **LBP, M2DPCA, Euclidian Distance, Cohn-kanade database dataset, Facial Expression recognition**

1. INTRODUCTION

Facial expressions, resulting from movements of the facial muscles, are the face changes in response to a person's internal emotional states, intentions, or social communications. there's a substantial history related to the study on facial expressions. Darwin (1872) was the primary to explain in details the precise facial expressions related to emotions in animals and humans, UN agency argued that every one mammals show emotions dependably in their faces. Since that, facial features analysis has been a space of nice analysis interest for activity scientists (Ekman, Friesen, and Hager, 2002). Psychological studies (Mehrabian, 1968; Ambady and Rosenthal, 1992) recommend that facial expressions, because the main mode for non-verbal communication, play a significant role in human communication.Facial expression recognition needs a lot of delicate and discriminative feature extraction as compare to alternative recognition ways. facial features recognition has 3 stages of pre-processing, feature extraction and classification as shown in fig. 1.

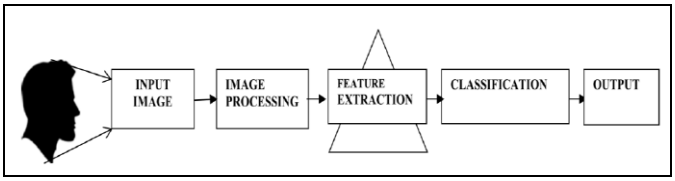

Figure 1: Facial Expression Recognition

Image-Processing includes removal of noise and unwanted data from input image. we tend to area unit mistreatment normal dataset that doesn't contain noise in pictures. to extend the popularity rate we've got applied 2DPCA on LBP pictures in situ of original pictures. we are using Euclidean distance as a classifier. The experiments area unit performed on Cohn-Kanade dataset.

2. LOCAL BINARY PATTERNS

The original LBP operator, introduced by Ojala, could be a powerful technique of texture description. Figure 2.1 is showing however LBP code is calculated in a very 3×3 neighborhood that contains total nine grey values. For all pixels in a picture, a code is created by scrutiny its neighborhood with the worth of the picture element. As shown in Figure 2.1, picture elements peripheral the central pixel arelabeled one if their values are bigger than or adequate to

the worth of the central pixel; zero, otherwise. The LBP code of the center picture element consists of these labels anticlockwise. Finally, the native binary pattern for center picture element is obtained by changing the code into a decimal one.

The native binary pattern (LBP) operator is outlined as a grey-scale invariant texture live, derived from a general definition of texture in a very native neighborhood. Through its recent extensions, the LBP operator has been created into a very powerful live of image texture, showing glorious ends up in several empirical studies. The LBP operator is seen as a unifying approach to the historically divergent applied math and structural models of texture analysis. Maybe the foremost necessary property of the LBP operator in real-world applications is its exchangeability against monotonic grey level changes. Another equally necessary is its process simplicity that makes it doable to research pictures in difficult time period settings [12]. The LBP technique and its variants have already been employed in an oversized variety of applications everywhere the planet.

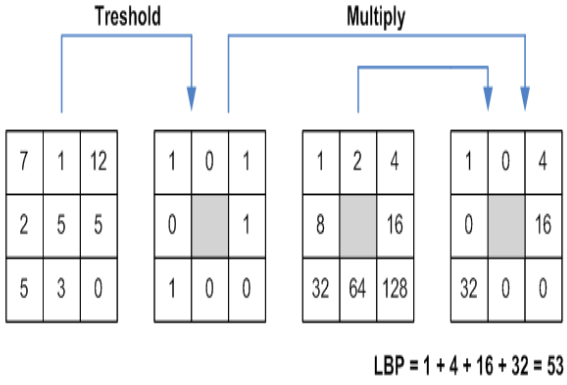

Figure 2.1: Calculations of Local Binary Patterns

The recent emergence of native Binary Patterns (LBP) has LED to important progress in applying texture strategies to numerous pc vision issues and applications. the main target of this analysis has broadened from 2nd textures to 3D textures and spatiotemporal (dynamic) textures. Also, wherever texture was once used for applications corresponding to remote sensing, industrial examination and medicine image analysis, the introduction of LBP-based approaches have provided outstanding ends up in issues concerning face and activity analysis, with future scope for face and face expression recognition, biometrics, visual police investigation and video analysis [13]. Pc Vision victimization native Binary Patterns provides a close description of the LBP strategies and their variants each in special and spatiotemporal domains.

This comprehensive reference additionally provides a wonderful summary on however texture strategies are used for resolution totally different types of pc vision and image analysis issues. Supply codes of the fundamental LBP algorithms, demonstrations, some databases associate degree a comprehensive LBP list is found from an related computing device. Topics include: native binary patterns and their variants in special and spatiotemporal domains, texture classification and segmentation, description of interest regions, applications in image retrieval and 3D recognition - Recognition and segmentation of dynamic textures, background subtraction, recognition of actions, face analysis victimization still pictures and image sequences, visual speech recognition and LBP in varied applications. Skilled engineers and graduate students in pc vision, image analysis and pattern recognition.

3. TWO DIMENTIOAL PRINCIPAL COMPONENT ANALYSIS

Feature extraction reduces the spatial property of the Original image that expeditiously represents informative elements of a picture as a compact feature vector. Principal part analysis may be a wide used feature extraction methodology within the areas of pattern recognition, image process and pc vision.

The conception is to scale back the spatial property of a knowledge whereas retentive the variations within the dataset the maximum amount as potential [4,6]. Recognition supported PCA needs a metamorphosis of 2nd face image into 1D image vectors, column by column or row by row. However, concatenating 2nd matrices into1D vector typically ends up in a high-dimensional vector area, wherever it's tough to gauge the variance matrix accurately thanks to its giant size. Moreover, computing the eigenvectors of an oversized variance matrix is incredibly long [7]. 2DPCA was projected by Jian principle et.al in 2004 [8]. 2DPCA directly computes eigenvectors of the image variance matrix with none conversion from matrix to vector.

Let A be a mxn image matrix and X be a n-dimensional projection vector. Matrix A is projected onto X to urge a projected vector Y of dimension m.

A projection vector X is to be resolve, such trace of variance matrix fashioned by Y vector is largest.

$$Y=AX \quad (1)$$

A projection vector X is to be finding out, such that trace of covariance matrix formed by Y vector is maximal.

3.1 EUCLIDIAN DISTANCE

Euclidian Distance is used very often especially when measuring the distance in the plane; According to the Euclidean distance formula, the distance between two points in the plane with coordinates (x, y) and (a, b) is given by

$$\mathbf{Dist}_{ED}\ \mathbf{((x,\ y),\ (a,\ b))} = \sqrt{\mathbf{(x-a)^2 + (y-b)^2}} \quad (2)$$

The source of this formula is in the Pythagorean Theorem. It is shown in figure 3. The horizontal distance between the points is 4 and the vertical distance is 3. Let's introduce one more point (-2, -1). With this small addition we get a right-angled triangle with legs 3 and 4. By the Pythagorean Theorem, hypotenuse² = base² + perpendicular², which gives the length of the hypotenuse as 5, same as the distance between the two points according to the distance formula.

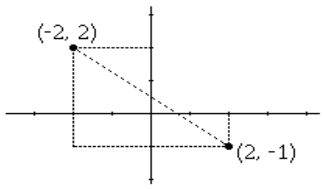

Figure 3: Euclidian distance calculation

This is of course always the case: the straight line segment whose length is taken to be the distance between its endpoints always serves as a hypotenuse of a right triangle. The performance of ED depends on the circumstances. For example, in the plane – since the Earth is round, this means within relatively small areas of surface – it is pretty good, provided the distance is exactly what you want to estimate. [6]

4. COHN-KANADE DATABASE DATASET

Cited in concert of the biggest in public on the market countenance databases, this information was created by Associate in Nursing knowledge base analysis cluster consisting of psychologists and pc scientists at the University of urban centre. This is often associate in Nursing AU-Coded information which implies that FACS Action Units square measure applied to supply interested teams with the power to use FACS secret writing for classification. Facial behaviour was recorded in 210 adults between the ages of eighteen and fifty years. From this cluster thirty first were male and sixty nine feminine.

The ethnic eighteen backgrounds include Euro-American eighty one, Afro-American thirteen, and another class of 6 June 1944. Subjects were recorded exploitation 2 Panasonic WV3230 cameras connected to a Panasonic AG-7500 video recorder. One camera was positioned directly before of the topic, whereas the opposite were positioned thirty degrees to the themes right. The space was lighted exploitation 3 high-intensity lamps. One amongst the lamps was accustomed illuminate third of the space, whereas the opposite 2 lamps were fitted with reflective umbrellas to make sure uniform lighting among the space. Figure 5.8 shows a sample of pictures contained during this information.

SU	5.5	**94.5**	0	0	0	0
SA	0	0	**100**	0	0	0
AN	0	0	0	**94.5**	5.5	0
DI	0	0	0	0	**100**	0
HA	0	0	0	0	0	**100**

Figure 5.8: Some of the expressions available in the Cohn-Kanade database

5. EXPERIMENTS AND RESULTS

We have performed experiments on Cohn-Kanadedataset.The dataset is divide in 2 elements, twenty fifth is employed for coaching and seventy fifth for testing. Experiments for analysing the performance of LBP+2DPCA in facial features recognition square measure performed. The results of various findings square measure shown in termsof confusion matrices.

6. PERFORMANCE ANALYSIS OF LBP+2DPCA IN EXPRESSION RECOGNITION

Firstly, we have a tendency to applied LBP on coaching and testing pictures to urge LBP pictures and applied 2DPCA on LBP pictures. Finally we applied Euclidean distance classifier to urge resultant expression. Confusion matrix for this is often shown in Table a pair of.

Table1.a pair of Confusion Matrix for 6 Expressions victimization Lbp+2dpca

Expressions	FE	SU	SA	AN	DI	HA
FE	**94.5**	5.5	0	0	0	0

The recognition rate for LBP+2DPCA is 97.25%.The accuracy of LBP+2DPCA is higher than LBP, and the complexity is also comparatively high, as first we take LBP and then apply 2DPCA.

7. CONCLUSION:

The complete study concludes that; to take care of the equilibrium in choosing helpful info and reducing unwanted info or lower face regions, we've got any applied Adaboost methodology to urge the foremost necessary info from a face image i.e. the central region of the face composed of Eyes, Nose and Mouth. To derive the importance of facial elements we've got used the foremost necessary elements of face as module of 2DPCA. it's not solely four elements of face image however these are four identification pillars that are Left and Right Eye, Nose and Mouth.

Moreover, few expressions appear to be a tough to properly classify. This principally results from the actual fact that the performance of expressions varies among subjects. The experiments demonstrate that that facial half plays necessary role in classification of explicit expression. as an example, angry expression are often recognized properly with facilitate of 2 facial elements i.e. Eyes and Mouth .In same manner we tend to known the facial elements that have significance in recognition of expressions. the whole work has been simulated and evaluated by MATLAB.

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