A MOTION-BASED APPROACH FOR FACE RECOGNITION

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Abstract

Face recognition is essential in many organizations. The objective of this work is to identify the face even in motion. This paper proposes a novel approach for face recognition using motion characteristics. This approach identifies motion in each pixel and classifies according to the motion pixel count. The proposed work is tested with ORL database by varying the number of training images. Experiments were carried out for different motion and the results proved that the proposed work achieves better recognition rate.

Index Terms: Motion Vector, Optical Flow, features

I. INTRODUCTION

In the last two decades, Face recognition has been the more intensive research in the research world. It has been used in many security applications. Face recognition is identifying the face captured in the current situation by using the already stored face images in the database. It is a challenging issue because the captured face image may vary in lighting, pose, gesture and motion. The conventional face recognition consists of two phases namely feature extraction and classification. There are various approaches for extracting features [1]: Geometry-based, Template-based, Appearance-based and Color-based approach.

In the Geometry-based technique, features are extracted using the size and the relative position of important components of the images. This approach is applied in two different ways. First, this approach calculates the direction and edges of important component feature vectors are built from these edges and direction. Canny filter and gradient analysis usually applied in this direction. Second, it used gray scale difference of unimportant components and important components. Haar-like feature block are calculated Adaboost method [2] to change the grayscales distribution into the feature. In LBP [3] method, every face image divides into blocks and each block has its corresponding central pixel. Then this method examine its neighbor pixels, based on the grayscales value of central pixel it changes neighbor to 0 or 1. After that a histograms is build for every region and then these histograms are combined to a feature vector for the face image [4], [5].

In the Template-based approach, facial features are extracted using appropriate energy function. This approach [6] creates templates in the first phase. Templates may include eye, nose, mouth etc. These parameterized templates enable a priori knowledge about the expected shape of the features to guide the detection process [6]. An energy function is defined to links peaks, edges, and valleys in the image intensity with corresponding properties of the template. After this process, the template matching is done with the images, thereby deforming themselves to find the best fit. In the Template based approach, first an eye template is used to detect the eye from the image. Then a correlation is found out between the eye templates with various overlapping regions of the face image. As eye region have a maximum correlation with the template [5], it is used first.

In the Appearance-based approach, the image is processed as two dimensional patterns. Any extracted characteristic from the image is

referred to a feature. This approach seems to be performer in facial feature extraction because it keep the important information of image and reject the redundant information. Method such as principal component analysis (PCA) and independent component analysis are used to extract the feature vector. The main purpose of PCA is to reduce the large dimensionality of observed variable to the smaller dimensionality of independent variable without losing much information [7]. It has been observed that many natural signals, including speech, natural images, are better described as linear combinations of sources with super-Gaussian distributions.

In the color-based approach, RGB skin region is detected [8] [9]. The image obtained after applying skin color is subjected to binarization. Initially, it is transformed to gray-scale image and then to binary image by applying suitable threshold. All this process is done to eliminate the color and saturation values and consider only the luminance part. After this process, the luminance part alone is transformed to binary image with some threshold because the features for face are darker than the background colors. After thresholding noise is removed by applying some opening and closing operation. Then eyes, ears, nose facial features can be extracted from the binary image by considering the threshold for areas which are darker in the mouth than a given threshold. After getting the triangle, it is easy to get the coordinates of the four corner points that form the potential facial region [5] [10].

This paper proposes a new approach for face recognition by identifying the motion in the faces. The idea behind this approach is that only few pixels in the face have some motion in the same class, whereas if the query image is compared with different classes, more number of pixels will have motion. The count of the pixel that has the motion is used for classification.

Section II describes the overall system architecture. Section III elaborates the method of identifying motion and classification. Section IV demonstrates the experiments and its analysis. Section V concluded with future work.

II. System Architecture

The conventional Face recognition consists of two phases: Feature Extraction and classification. This paper identifies the motion in the first phase instead of feature extraction. In the second phase, the query image is classified according to Motion Pixel Count (MPC). Since the face image is to be compared with all the images in the database, the image is resized to 128 x 128 and converted to gray-scale images. After this pre-processing step, motion is estimated by comparing the query image with all the images in the database. The overall system architecture is shown in Fig. 1. The motion in the face image is identified using Optical Flow method [11].

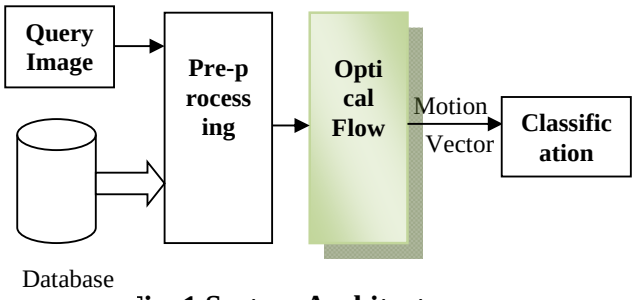

Fig. 1 System Architecture

III. Proposed Method

Every face image in the database is of different sizes. In the pre-processing step, the image is resized to 128 x 128 and converted to gray scale images. After the pre-processing step, the first phase in this work extracts the motion vectors using Optical Flow method. The motion between the query image and all the images in the database are calculated. The Optical flow method calculates motion for each pixel in the image. Thus each pixel in the query image will have motion vector as (Vx, Vy). From this phase, Motion vectors of the query image when compared with the images in the database are obtained.

This is defined as

$$(〚Vx〛_i, 〚Vy〛_i) = \text{OpticalFlow}(Q, I_i), \quad \forall \text{ images } i \text{ in the database} \qquad (1)$$

where Q is the query image and I_i is image in the database.

This motion vector is used for further analysis. If the image has no motion with the images in the database, then the motion vector will be (0, 0). The pixel with large motion is counted and the face is identified based on the count MPC.

The pixel is said to have large motion if it achieves a threshold (T).

$$MPC = \begin{cases} 1 & |(Vx,Vy)| \geq T \\ 0 & otherwise \end{cases} \quad (2)$$

The average Motion Pixel Count for each MPC is calculated as

$$Average\ MPC\ (i) = \frac{MPC(i)}{r \times c} \quad (3)$$

where r and c are number of rows and columns of the image. The image with small motion with the query image is identified and the query image is classified to that particular class. It is given as

$$class = \min\ (Average\ MPC(i)) \quad (4)$$

The classification procedure is shown in Fig. 2. The threshold is calculated by manual testing and the results for each threshold are analyzed in section IV.

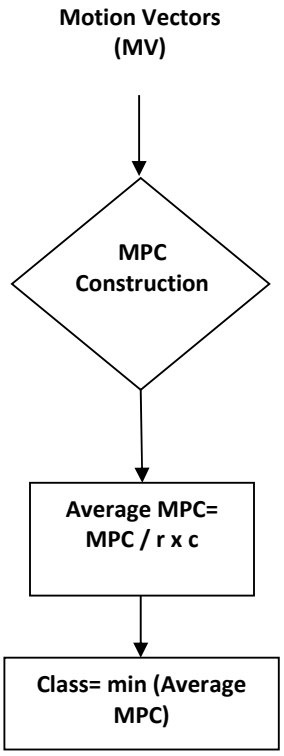

Fig. 2 Classification Procedure

IV. EXPERIMENTAL RESULTS

Experiments are conducted for various motions in ORL database. The ORL standard face database consists of 400 face images attained from 40 people. Each people have 10 images of different expression or gesture. The resolution rate of the image is 112×92 and the gray scale is 256. Recognition rate is used for measuring the performance of the proposed method. It is given as

$$Recognition\ Rate = \frac{No.of\ correctly\ classified\ face\ images}{Total\ no.of\ images} \times 100 \quad (5)$$

The amount of motion is calculated by having various threshold values. The results are shown in Table I which is tested with 5 training images. From the Table I, the threshold value of 2 achieves maximum recognition rate. It is pictorially shown in Fig.

TABLE I
Recognition rate obtained for various threshold values

Threshold	Recognition Rate (%)
1	98.12
2	99.25
3	91.87
4	90.4
5	89.33

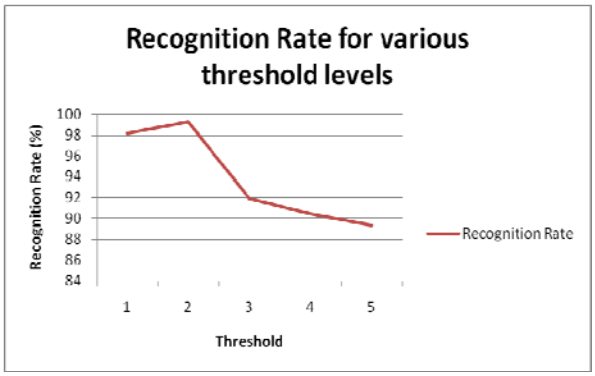

Fig. 3 Line Chart as a function of Threshold value and Recognition rate

The number of images used for training is varied from 1 to 5. The recognition rate is shown in Table II. During testing, images with various gestures are also chosen. The proposed method correctly classified most of the images given as input. Fig shows some of the input images given for testing.

Fig. 4 Various motions in ORL database

Table II
Recognition rate obtained for different number of training images

N*	Recognition Rate (%)
1	88.23
2	90.54
3	93.6
4	98.2
5	99.25

*N = Number of training images

V. CONCLUSION

Face recognition has many challenging issues. The proposed method solves an important issue of motion in the face images. The pixel with small number of motion is counted. The minimum count image is identified as the correct class. It uses Optical flow method to identify the motion of the query image. Experiments are conducted for various motions in the ORL database. It is proved to achieve better recognition rate.

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