FACE RECOGNITION SYSTEM FOR MOBILE PHONE USING PCA

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Abstract : Automated security systems are essential at present environment. These days most of the personal and official records and banking transactions statements, use of personal gadgets like mobile, and tablets are frequently performed using automated security system for identification. Face recognition systems accomplish the task through face acquisition, facial feature extraction and feature Matching. In the proposed face recognition system using PCA for matching of reference image with all images of database and create a suspect list. Then FFT is use to match reference image with faces in suspect list created by PCA. The result shows that proposed system provides higher accuracy in all the conditions in comparison to PCA based systems, while run time is slightly increased.

IndexTerms **– PCA, FFT, Run time.**

I. INTRODUCTION

Face has been used for over a century for person identification. Today it is widely used form of biometric identification with accuracy and its user friendly system. The face recognition is much better than the other biometric identifiers because face recognition has ease of use, user acceptance, accuracy as compared to others. Thus our government and public are spends for face recognition system. Here given below a pie chart (figure 1.1) which describes that government spending for biometric technology especially facial recognition.

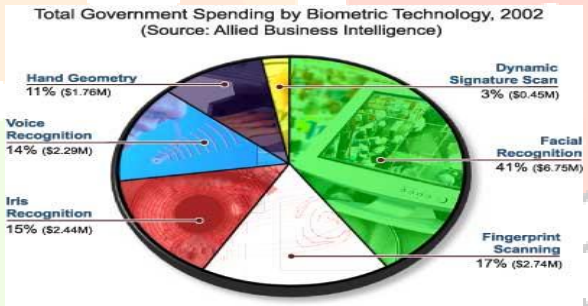

Figure 1.1 Total Governments Spend (Source: Allied Business Intelligence, USA)

Face recognition system is subdivided as face detection and face identification. Face detection is locating and recognition is identifying a human face in sequence of images regardless of size, position, and skin colour [1, 2] and shape of the eyes, nose, cheekbones, and jaw [3]. Face identification involves facial feature extraction and feature matching with the database templates. Usually, face recognition systems accomplishes the task through face detection, facial feature extraction and feature matching (figure 1.2).

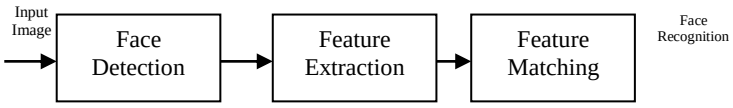

Figure 1.2 Face Recognition Process

Face recognition is a complex pattern recognition problem. It is challenging to design accurate algorithms capable of extracting salient features and matching them in a robust way, especially in poor quality face images and when low cost acquisition devices with small area are adopted. The real challenge in matching face is affected by: (i) Facial expression (ii) Head movement (iii) Illumination [4] variations. These challenges reduce the performance, robustness, transparent face recognition. There are many types of techniques used in face recognition where some techniques give higher accuracy but at the cost of increased complexity of the system, more memory for database. There system requires high processing power and memory and are not suitable for resource constrained application where memory and processor is limited like mobile phones. For resource constrained application face recognition techniques is required which provide optimum accuracy in real time scenario. In this paper, a face recognition system is proposed which uses PCA [5, 6] algorithm to use feature extraction. Although PCA algorithm is moderately accurate but their matching time is less due to which it can be applied in resource constrained application. To enhance, proposed system we have used FFT [7, 8, 9] algorithm for matching in suspect list generated by PCA algorithm resulting in slightly more run time. Thus accuracy is improved and run time is not affected for real time performance. The proposed system is suitable for resource constrained device like mobile and hand held devices.

II. PROPOSED TECHNIQUES USED IN FACE RECOGNITION

Here a face recognition system provides a mobile security system. This face verification is very useful for identification as mobile gadgets are now used to save personal and official records and banking transactions statements. Face recognition security system contains face detection, feature extraction, and feature matcher. Face detector detect the face in person image and this face image send to the feature extractor block where it is done extract the feature from face and feature matcher block matches the already stored faces. There are PCA and proposed techniques are tested individually, and their performances and improvement are compared relative to changes in facial expression, illumination and head movement for still images. The databases and reference database are self made which is constructed using the mobile camera for work on real platform which is low definition face image and quality is low. In this paper, mainly the effect of utilizing 3 pre-processing steps is examined: Resizing, Image Format change, and Normalization. These pre-processing techniques are applied on database in the order of Resizing, Image Format change, and Normalization. *PCA is a dimensionality reduction technique based on extracting and desired number of principle component of the multi-dimensional data. The purpose of PCA is to reduce the maximum amount of information obtained in the smallest number of dimension of feature space in which the required matching time is less which makes it easier for mobile processor.* Then FFT is use to match reference image with faces in suspect list created by PCA. The technique is based on the Fourier spectrum of facial images, thus it relies on a global transformation every pixel in the image contributes to each value in the spectrum.

Figure 2.1 Sample of face image of self made database (captured by mobile camera)

The self made database (figure 2.1) of 20 persons has been analysed. All the still face images in this database are taken by mobile camera which is low definition face image and quality is low which is represented in figure 4.2. This database has face image of 20 persons. In database one sample of each person in normal mode has been included which gives the information about whole face.

Figure 2.2 Sample of reference face image in different variations (captured by mobile camera)

In reference face image (figure 2.2) which includes different facial expression, head movement, and lighting effect which is also taken by mobile for the same 10 persons which exists in database. The face images are in different pose, alignment of head, and lighting effect. There are 10 persons each have 4 samples for above three types of variations means in total 40 face images for each variation. Where first image is head movement second image as facial expression condition and third image is in illumination condition.

III. RESULTS

The results have been evaluated by the algorithm over database made by us. As mentioned earlier, this Database consists of twenty face images of twenty different people (including male and female). In this paper we train the face image for recognition system of one face image of each person. That is, we utilize one face image as training face image and different variations of face image of each person (12 photos of each person.) as query face images have been taken. If query face image gives the best match for the face image of the same person, it is declared to be a correct match otherwise it is a false match. The described experiment yields different percentage accuracy with different variations. Now analysis of our approach for facial expression is tabulated below here along with some other conditions of face images which are challenges of face recognition. The matching performance between query face image and database face image. The matching performance in percentage form when database is of 20 persons with single sample when query face image has different conditions. The result in tabulated form is given below for normal, facial expression, illumination, and head movement conditions.

Table 3.1 Matching Performance (%) in all conditions with PCA and proposed technique when database of 20 persons

Person (four sample per person)	For normal (%)		For facial expression (%)		For illumination (%)		For head movement (%)	
Technique	PCA	Proposed technique	PCA	Proposed technique	PCA	Proposed technique	PCA	Proposed technique
Person 1	100	100	75	75	0	75	50	25
Person 2	100	100	50	50	0	0	25	50
Person 3	100	100	100	100	0	50	75	75
Person 4	100	100	75	100	0	0	25	50
Person 5	100	100	0	25	25	50	50	25
Person 6	100	100	0	50	0	0	50	75
Person 7	100	100	100	100	0	0	50	50
Person 8	100	100	0	0	0	0	0	25
Person 9	100	100	100	100	0	50	25	50
Person 10	100	100	100	100	0	75	75	50
Average Result	**100**	**100**	**60**	**70**	**2.5**	**30**	**42.5**	**47.5**

The final result of PCA and proposed technique for different variations is given in table 3.1. The results of matching performance between queries face image and database face image with different conditions is shown. The matching performance when database is of 20 persons with single sample when query face image is in normal, facial expression, illumination, and head movement condition. There two techniques are used PCA and proposed technique. In the last table it is seen that matching performance is improved with proposed technique with respect to only PCA algorithm in different conditions. Thus the results for normal conditions using PCA is 100% and after using proposed technique it's also 100%, for facial expression PCA gives 60% result and after using proposed technique its improved to70%, for illumination PCA gives only 2.5% which improved to 30% using proposed technique, and for head movement PCA gives 42.5% and after using proposed technique it's enhanced to 47.5%. Over all Analysis of the above experimental results shows that the developed system is capable of matching the same face image using the proposed technique in different conditions which is not more effective only if PCA algorithm is used. But in some matching results our approach shows dip over PCA due to FFT is not highly efficient transformation techniques. It is basic transformation techniques but overall performance is high compare to PCA techniques. To get a better view on how the two groups are separated, the data is plotted in the matched face image with only PCA algorithm and proposed technique both for all condition. The plotted data is viewed in figure 3.1.

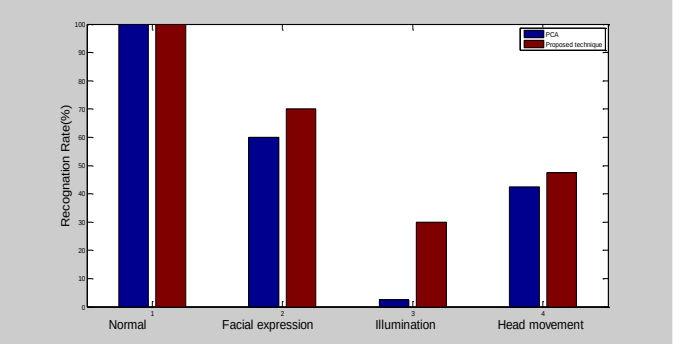

Figure 3.1 Comparison of PCA & proposed technique face image in all conditions

In the last table 3.2 the run time performance of our approach and PCA approach is compared. Our approach where database have 20 persons face image each has one sample it gives the overall run time 2.63s with our proposed technique. In our paper PCA algorithm takes only 1.61s. There is no more difference between in our proposed technique over PCA algorithms.

Table 3.2 Run time performance (second) with PCA and proposed technique

Run time performance (For all conditions)	
PCA (Second)	**Proposed technique (Second)**
1.61	2.63

IV. Conclusion

Face verification system can be used by mobile phones and hand held devices to confirm identity of the user. The face recognition system can be easily adopted in mobile phone to other techniques. In face recognition system extra circuitry it is not require because the camera available in mobile can be used for the same. Thus only software algorithm is to be synchronized with its camera. Face recognition is easier and user friendly and gives better accuracy system compare to other techniques while run time is slightly increased. Therefore face recognition system is dominant over other techniques for mobile security.PCA technique limits the storage size and enhances accuracy.

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