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Local Plastic Surgery Face Recognition using Multimodal Biometric Features

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ABSTRACT
Plastic surgery procedures provide a proficient and enduring way to enhance the facial appearance by correcting feature anomalies and treating facial skin to get a younger look. Apart from cosmetic reasons, plastic surgery procedures are beneficial for patients suffering from several kinds of disorders caused due to excessive structural growth of facial features or skin tissues. The security and privacy problem has been overcome. The proposed method deals better for overcoming such problems. Matching post-surgery images with pre-surgery images becomes an arduous task for automatic face recognition algorithms. In this system, Local binary pattern and principle component analysis is used to extracts feature from face image. Euclidean distance is used for comparing pre and post surgical facial images.
Keywords **-** Euclidean Distance, Face Recognition, Local Binary Pattern, Plastic Surgery, Principle Component Analysis

I. INTRODUCTION

The plastic surgery is experienced world-wide and is driven by factors such as the availability of advanced technology, affordable cost and the speed with which these procedures are performed. Facial plastic surgery is generally used for correcting feature defects or improving the appearance, for example, removing birth marks, moles, scars, correcting disfiguring defects and to get younger look [6][8]. Apart from cosmetic reasons, plastic surgery procedures are beneficial for patients suffering from several kinds of disorders caused due to excessive structural growth of facial features or skin tissues. Plastic surgery procedures amend the facial features and skin texture thereby providing a makeover in the appearance of face. Fig. 1 shows an example of the effect of plastic surgery on facial appearances. With reduction in cost and time required for these procedures, the popularity of plastic surgery is increasing. Even the widespread acceptability in the society encourages individuals to undergo plastic surgery for cosmetic reasons. According to the statistics provided by the American Society for Aesthetic Plastic Surgery for a year, there is about 9% increase in the total number of cosmetic surgery procedures, with over 500,000 surgical procedures performed on face [1].

Fig. 1 effect of plastic surgery on facial appearances

These facial plastic surgery changes shape or texture of a particular face region[8]. It is very difficult to predict which features are invariant (a region without surgery effects) with unavailable surgery information. The difficulty is further supplemented, when an individual undergoes more than a surgery. The existing face recognition algorithm are good in extracting one of feature from an image i.e. either shape or texture. Therefore, matching post-surgery images with pre surgery

images becomes an arduous task for automatic face recognition algorithms[1][3][4].

Again, due to privacy issues, the surgical details of a particular individual are not available and plastic surgery face database contains one pre-surgery image for training and a post-surgery image for testing. This further complicates feature extraction task in face recognition methods.

Therefore the proposed method is used to recognition of facial images that have previously undergone some feature modifications through plastic surgery. Under this creating the plastic surgery face database is an important task which contains one pre-surgery image for training and a post-surgery image for testing. In the real world, it is difficult to isolate individuals who have undergone plastic surgery and use special mechanism to recognize them. Therefore, face recognition algorithms should be robust to variations introduced by plastic surgery even in general operating environments. Considering such generality of face recognition, the second non-surgery face database is prepared by appending the plastic surgery face database. Images in the plastic surgery face database are collected from different sources on internet and have noise and irregularities. So some preprocessing done on those images. Then the shape and texture features are extracted from the images and on the basis of that features the classification is done.

Face recognition across plastic surgery is further become difficult, when a person undergoes more than a surgery. Cascading another biometrics [5] information will help in reducing false positives and false negatives. Obtaining other biometrics information for available plastic surgery face database is again an exigent task. Part of face image which can serve as another source of biometrics is more attractive. Recent work proves that the periocular regions are even invariant to age. These regions are influenced by spectacles, head angle, hair and expression. Thus, multi-modal biometrics can surpass the limitations encountered by uni-modal biometric system [5]. Fusing periocular region features with facial features can effectively overcome plastic surgery hurdle in face recognition. Again it have the advantage that the user doesn't have to provide two biometric, since the periocular region is obtain from face image as well as it is not required to processed all the biometric every times i.e. only when face recognition using proposed method fails to match then periocular biometric is used.

1. RELATED WORK

1.1 Component-Based Recognization System

A probabilistic approach using part-based matching has been proposed in for expression invariant and occlusion tolerant recognition of frontal faces. The global approaches and a component-based approach to face recognition and evaluate their robustness against pose changes have presented. The global method consists of a straight forward face detector which extracts the face from an input image and propagates it to a set of SVM classifiers that perform the face recognition.

1.2 Part-Based Face Recognition

We introduces a subscribes to part-based face recognition and proposes for its robust implementation a novel approach driven by boosting and transduction. Current face recognition biometric systems are particularly ineffective when temporal changes, involuntary or not occur. While faces can be partially occluded and/or disguised some of their parts remain unchanged and can still be properly detected and authenticated. Part-based recognition makes biometric processing and recognition easier because it does not seek for face invariance. Instead it employs flexible geometric modeling to compensate for image variability, pose changes and limited occlusion and temporal changes.

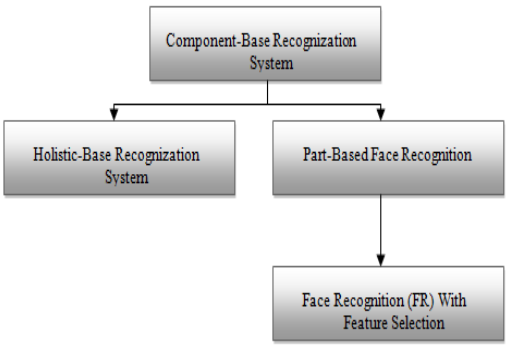

Fig. 2 Hierarchy of recognization system.

1.3 Face Recognition (FR) With Feature Selection

Face recognition (FR) has emerged as one of the most extensively studied research topics that spans multiple disciplines such as pattern recognition, signal processing and computer vision. This is due to its numerous important applications in identity authentication, security access control, intelligent human-computer interaction, and automatic indexing

of image and video databases. Feature extraction methods commonly represent the face images with a large set of features in which features do not contribute equally to the face recognition task. Feature selection (FS) in pattern recognition involves the derivation of the feature subset match from the raw input data to reduce the amount of data used for classification and simultaneously provide enhanced discriminatory power. The selection of an appropriate set of features often exploits the design criteria such as redundancy minimization and decorrelation, and minimization of the reconstruction error. Existing methods have the following drawbacks: It is not sufficient for improving the performance with single gallery evaluations, Offspring's are exactly similar to parents, Crossover is not performed and offspring's are generated randomly.

II. METHODALOGY

This paper proposes a new multimodal biometric using face and periocular biometric for the recognition of face invariant to plastic surgery. This method makes the use of different features from face and periocular region to match face images before and after plastic surgery. The block diagram of propose method is shown in Fig. 3. Feature is extracted from both face and periocular region with the help of local binary pattern and then dimension reduction is done with the help of PCA. Then for classification Euclidian distance is used. If face is not match, then periocular biometric is performed for face recognition under plastic surgery. The flowchart contains the following steps: Data Collection, Preprocessing, Feature Extraction, Classification, Periocular biometric.

1.4 Data collection

As the plastic surgey face database is not available, data required for face recognition across plastic surgery is collected from different sources on internet. This images have noise and irregularities. So some preprocessing like image contrast maximization, filtering is done. Using these images, the plastic surgery face database is created. This plastic surgery face database contains one pre- and post-surgery face image with frontal pose, proper illumination, and neutral expression.The database consists of different types of facial plastic surgery cases such as rhinoplasty (nose surgery), blepharoplasty (eyelid surgery), brow lift, skin peeling, and rhytidectomy (face lift). Face image from this database is used as a input to the proposed face recognition system.

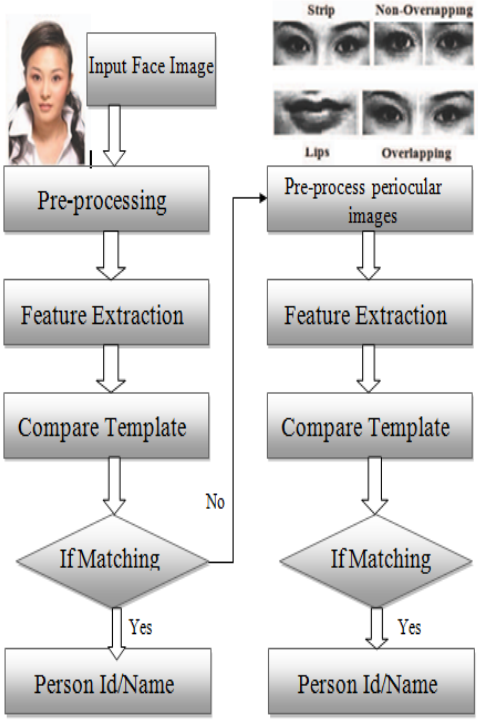

Fig. 3 block diagram of propose face recognization system

1.5 Preprocessing

The feature and information of face image should not be altered by local changes due to noise and illumination error [1]. Hence to satisfy the environmental conditions, preprocessing of the raw data is highly important [4]. Image capturing is a random process. The resolution of various image capturing devices may not be the same. This results in different resolution of the captured images. For accurate comparison of the features and to reduce the computational effort needed for processing, all the images should be scaled to a uniform size. So, first step of preprocessing is normalization in which face images are geometrically normalized and size of each image is uniform. Further alignment is done in which we achieve more accurate localization of face.

1.6 Feature Extraction

Another phase in face recognition is feature extraction. This is phase where the system does the localizing of the characteristics of face component (i.e. eyes, mouth, nose etc) in an image. In other words, feature extraction is a step in face recognition where the system locates certain points on the face

such as corner and centre of the eyes, tip of the nose, mouth, etc. it analyze spatial geometry of differentiate feature of a face. The result of this analyzing is a set of template generated for each face. The template consists of reduced set of data that represent the uniqueness of the face image. This proposed method uses the LBP and PCA for extraction of feature from face region.

1.6.1 Local Binary Pattern: Local Binary Patterns provides a powerful means of texture description [9]. LBP features are gray scale and rotation invariant texture operator. These features are more widely used for expression recognition. LBP features are also applied for face recognition task [5], [9]. LBP feature extraction is faster than any other feature extraction method and it provides good performance make this most researched features.

Consider a 3*3 pixels with (XC , YC) intensity value be GC and local texture as T = t(G0, G1, G2, G3, G4, G5, G6, G7) where Gi (i =0, 1, 2, 3, 4, 5, 6, 7) corresponds to the grey values of the 8 surrounding pixels.These surrounding pixels are thresholded with the center value GC as t(s(G0 - GC), s(G7 - GC)) and the function s(x) is defined as,

$$s(x) = \begin{cases} 1 & ,x \geq 0 \\ 0 & ,x \leq 0 \end{cases}$$

Then the LBP pattern at the given pixel is defined as an ordered set of the binary comparisons and the resulting value can be obtained using following equation. An example of LBP operator is shown in Fig. 4.

$$LBP(x_c, y_c) = \sum_{i=0}^{7} s(g_i - g_c)2^i$$

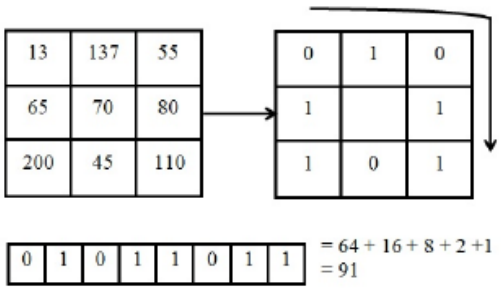

Fig. 4 feature extraction using LBP.

LBP feature extraction is performed on a face image and the resulting features are shown in Fig. 5 along with the feature histogram. To increase the feature strength and to get more details, the face images are divided into number of blocks. Fig. 6 shows the face divided into 5 blocks (totally 25 blocks) and its feature histogram. When a test image is given as input the LBP histogram features are extracted which then used for classification purpose.

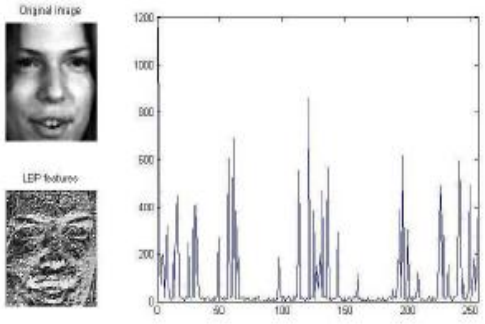

Fig. 5 LBP histogram features for a face image.

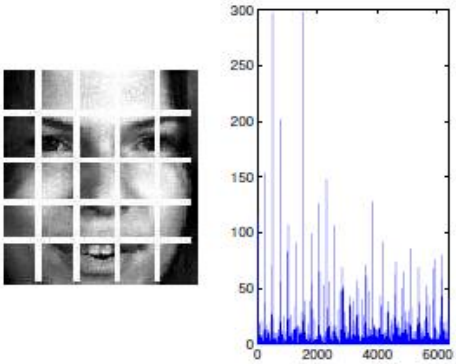

Fig. 6 LBP histogram features for a face image with 5 blocks.

1.6.2 Principal component analysis (PCA): PCA for face recognition is based on the information theory approach. It extracted the relevant information in a face image and encoded as efficiently as possible. It identifies the subspace of the image space spanned by the training face image data and decorrelates the pixel values. The classical representation of a face image is obtained by projecting it to the coordinate system defined by the principal components. The projection of face images into the principal component subspace achieves information compression, decorrelation and dimensionality reduction to facilitate decision making. In mathematical terms, the principal components of the distribution of faces or the eigenvectors of the covariance matrix of the set of face images, is sought by treating an image as a vector in a very high dimensional face space[5][10].We apply PCA on this

database and get the unique feature vectors using the following method .Suppose there are P patterns and each pattern has t training images of m x n configuration.

- The database is rearranged in the form of a matrix where each column represents an image.
- With the help of Eigen values and Eigen vectors covariance matrix is computed.
- Feature vector for each image is then computed. This feature vector represents the signature of the image. Signature matrix for whole database is then computed.
- Euclidian distance of the image is computed with all the signatures in the database.
- Image is identified as the one which gives least distance with the signature of the image to recognize.

2. CLASSIFICATION

Classification will be executed on the base of defined features i.e. it required some features such as density, texture or shape feature for classification of object. There are various classification techniques available, but I use Euclidean distance [5]. It is used as the classifier to identify which training set image belongs to the given test image. Classification is performed by comparing C from each training set image with the test image C$test$ using Euclidean distance, εi

$$\varepsilon i^2 = (\| \text{Ctest} - \text{Ci} \|)^2$$

Where, Ci is a shape texture parameter of the ith face image in training set. Test image is classified as belonging to image i when minimum of εi is below some chosen threshold value θ. Threshold value, Θ = 1/2 max(|| Cj – Ci ||) where i and j are images from same class.

III. PERIOCULAR BIOMETRICS

Eye lids, eye brow and eye surrounding area is called as periocular region[2] which is considered to be more discriminative in nature There is no database available with periocular region images. Only way to fetch this is using available face image[7]. Periocular biometric is a process in which the periocular region feature can be used for the classification. Periocular biometrics [7] is performed in three different ways such as overlapping, Non-overlapping and Strip [5]. All this three different types of periocular regions are obtained using four significant points in the eye region and lips are shown in Fig. 7. LBP is used for feature extraction and PCA is used for dimension reduction.

Fig. 7 Different types of periocular regions.

IV. CONCLUSION

Plastic surgery has emerged as a new covariate of face recognition and its allure has made it indispensable for face recognition algorithms to be robust in matching surgically altered face images. This paper presents an approach for recognition of surgically alter human face. This paper proposes a system which extracts features from face and periocular region.feature is extracted with the help of local binary pattern and principle componant analysis which represents a face image in more meaningful way than any other feature extractor. The periocular biometric improving the overall system performance.

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