A New Technique for Face Matching after Plastic Surgery in Forensics

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Abstract: A new problem in face matching is plastic surgery. Popularity of plastic surgery has increased over the past few years and its keeps growing. This work proposes a facial feature based system to determine the original image from a post-surgery image. The system generates facial components from three different feature extraction techniques. Uniform LBP serves as the classifier Dimensionality reduction techniques such as LDA and PCA are also used. The normalized values are compared and score fusion rule is applied to retrieve the results. On the plastic surgery image portraits, the proposed system yields high recognition accuracy.

Keywords: Face matching, Plastic surgery, ULBP, Forensics.

I. INTRODUCTION

Facial recognition is one of the most important task that forensic examiners execute manually while their investigation. This work focuses on analysing the effect of plastic surgery in face recognition algorithms. It is imperative for the subsequent facial recognition systems to be capable of addressing this significant issue and accordingly there is a need for more research in this important area.

II. RELATED WORK

There are different face matching and face identification methods which uses various image processing steps, different filters, different feature descriptors and fusion methods to achieve high accuracy for the system, the merits and demerits of the systems and methods can be into account. Human face image searching system using sketches are one of the main technique. Yuen *et al.* [1] developed an investigation into face image searching, the system work in two main steps sketch to mugshot matching and human face image searching using relevant feedback. In the sketch to mugshot matching there the facial feature matching algorithm is used with local and global features. Second one is the feed back part it is also known as a human in the loop system, this feed back algorithm employs subspace linear discriminant analysis. LDA projection matrix is generated based on the feedback samples. Han,*et al.* [2] proposed a technique to give importance to the software generated sketches and to find the similarities between mugshot photos and composite sketches. Technique used here for measurement is CBR (component based representation) approach. working is like first automatic detection of facial land marks, then feature extraction then fusion of the scores. CBR method converts all color images into gray scale images, multi scale local binary pattern is used for the feature extraction and for facial component localization active shape model is used. Similar to this method other methods are also proposed to prove that the component based techniques works more powerful than that of the holistic based

approaches. Kathryn*et al.* [3] proposed a method which give importance to component based techniques and also uses both software generated and hand drawn face sketches.In this work with active shape model and multiscale local binary pattern a technique for alignment and cropping is introduced and it is called as procrustes analysis. Scott*et al.* [4] developed a standalone software for automatic matching between facial composites to mugshots and improve the effectiveness of face matching system. The system was developed to address the lack of a fully automatic means to match facial composites to mugshots.This system take advantage of both the holistic and component based algorithms also principle component analysis and linear discriminant analysis are used for the feature selection and feature extraction.

Our method deals with advantages of feature extraction and ULBP. LDA and PCA is used for the feature extraction, matching and selection. Finally the scores are compared and fused together to get an accurate match.

III.FACE MATCHING SYSTEM AFTER PLASTIC SURGERY

A new challenge to face recognition is facial plastic surgery, it is recommended for patients with destructive burn or trauma the procedure is very useful for patients. But plastic surgery can also be exploited by individuals who are trying to veiled their identity with the intention to commit fraud or escape the law enforcement. Post-surgery images are given as the input into the system and the facial features of the input image is extracted. Three main techniques like STASM, horizontal and vertical components are used for extracting facial features from the given portrait image. 25 facial components are extracted from this step. Each of the components are given into uniform local binary pattern for classification and extraction. After that with the help of eigen vector to find a linear combination and for dimensionality reduction LDA is calculated for the above LBP. Followed by that with the help of eigen value to find the component values
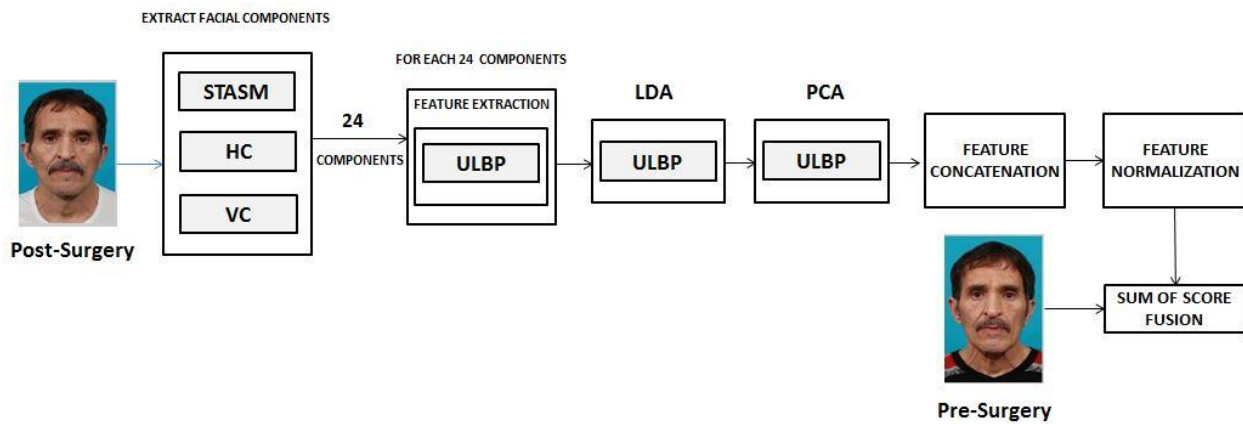
Fig. 1. System for Face Matching after Plastic Surgery

and dimensionality PCA is applied for the LBP used. Then the feature vector is concatenated and normalized. The images are compared and matched, finally sum of the score fusion is used and the resulting pre surgery portrait image is recognized. Figure shows the working.

A. Steve's active shape models (STASM)

Steve's active shape models is a reference implementation of ASM algorithms (C++). ASMs is used for face feature localization. ASM search algorithm in C++ is implemented by Stephen Milborrow. This software is called STASM (Steve's ASM) and its code is publicly available under the GNU, General Public License. It is a library that can be used well for detecting the boundaries of a whole face, i.e. exactly what it was designed to do. However, its performance localizing the precise lip borders is rather poor which was also pointed out in. The STASM library is highly complex and designed specifically for finding features of the whole face. STASM is a C++ software library for discovering features in faces. Give face image to STASM and it returns the position of the facial features. In the component-based algorithm, facial components are automatically limited by detecting landmarks with an active shape model (ASM) via the STASM library. With the help of bounding box the facial features are sliced and extracted separately.
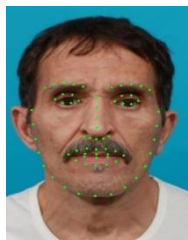

Fig. 2. STASM Land marks

B. Horizontal and Vertical Components

The vertical and horizontal components give exibility to variations in inner and outer facial regions. It utilizes the bond between horizontal and vertical elements to face the plastic surgery procedures which lead to variations in chin, forehead, ears, and cheeks.
The extraction of horizontal and vertical components are depicted in fig 3 and fig 4.
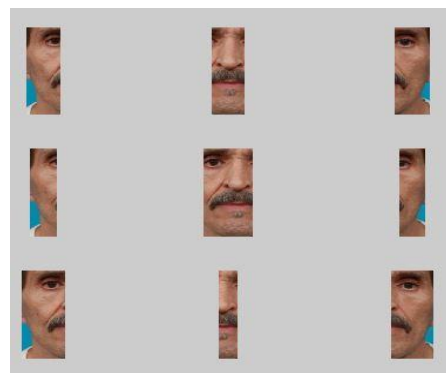

Fig.3. Extracted horizontal Components

Fig. 4. Extracted Vertical components

C. Uniform Local Binary Pattern

This is a type of feature used for classification. LBP features are gray scale and rotation invariant texture operator, these are more generally used for expression recognition. LBP features are also used for face recognition task. LBP feature extraction technique is faster than any other techniques and it contribute good performance. A local binary pattern is also termed uniform if the binary pattern hold at most two bit wise transitions from 0 to 1 or with the order reversed, when the bit pattern is studied circular. In the generation of the LBP histogram, uniform patterns are adopted so that the histogram has a independent bin for every uniform pattern and all non-uniform patterns are assigned to a single bin.

There are 58 possible uniform patterns in neighborhood of 8 sampling points.

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D. LDA and PCA

LDA stands for Linear Discriminant Analysis, and it is used to find a linear combination of features. It is used separately with the Uniform LBP used in the system. LDA encodes discriminatory information in a linear divisible space of which bases are not necessarily orthogonal. PCA stands for Principle Component Analysis, it is an appearance-based algorithms which is used to form feature vector and dimensionality reduction. PCA is applied to the feature vector to reduce template size. PCA is also used with the Uniform LBP used in this system.

E. Feature Concatenation

Concatenation combines two feature vectors by their numerals. This functions goal is to glue or concatenate data of different images together and manage it in a single file. This can be useful when comparing the images (especially of different dimensions) among themselves. In this system the images are concatenated in the intention of saving space or so that they can be addressed as a single item.

F. Feature Normalization

Normalization is an act that switch the range of pixel intensity values. Normalization is consistently called contrast stretching or histogram stretching.

G. Sum of Score Fusion

Even if information fusion in the system can be done at various levels, assimilation at the matching score level is the most common way due to the lack of difficulty in accessing and accumulating the scores generated by different matches.

IV. EXPERIMENTAL RESULTS

All input test images are composite photographs. The data for face recognition was taken from reliable sources. Portrait images before and after surgery are taken .The composite portrait after plastic surgery is selected as the input and the matching portrait image is retrieved from the pre surgery database gallery. 1500 post plastic surgery faces were taken for the experiment. Example of composite portrait faces after plastic surgery is given below in fig.5. This experiment matches the post-surgical faces to the pre surgical faces. Composite portrait faces before plastic surgery which is in the database are ranked by combining distance from local and global feature matching and it is displayed through a graphics interface.

Example of composite portrait before plastic surgery is given in fig.6.

The composite portrait images after plastic surgery is given into the system input images are then extracted and classified using Uniform LBP and dimensionality reduction techniques such as LDA and PCA are applied and then concatenated and normalized finally results obtained are compared and the best match is retrieved as the result. The resulting image is a composite portrait before plastic surgery. The analysis is done with the

selected facial components like Proposed STASM, Horizontal components and vertical components.

Fig.5. Example Portrait Images after Plastic Surgery

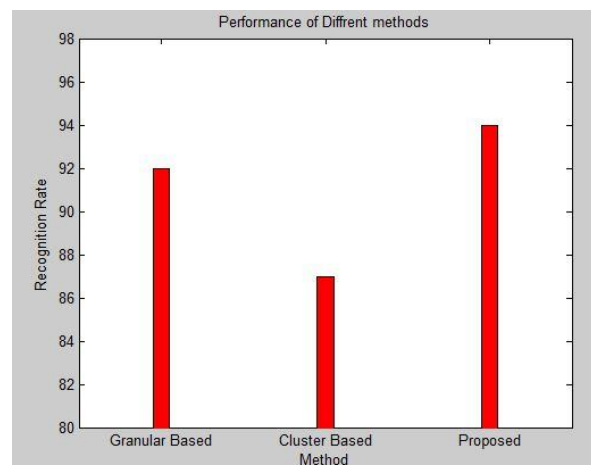Fig.6. Example Portrait Images before Plastic Surgery

Fig.7 Performance of different methods

Finally fig.7 shows the performance of different methods the last bar shows the proposed method and middle one clustering based method and first bar shows the performance of granular based method. The main problem with the clustering method is sometimes it is not able to recognize the difference between female and male images. Working with different images the method showed the same error frequently.

V. CONCLUSION

This system helps to make effective use of a pre and post plastic surgery database that contains face images with

both local and global surgeries. The post-surgery face images are selected and they are processed and the features are extracted reduced and classified. The face recognition and matching system have the strength of Uniform Local Binary Pattern, LDA and PCA it helps to improve the accuracies. In this method the data is investigated and trained with Uniform LBP algorithms and again it is associate with LDA and PCA to find the accurate match.

The study shows that PCA,LDA, ULBP, algorithms when used together with an effective combination they are able to effectively mitigate the variations caused by the plastic surgery procedures. Also this work reviewed the various Challenges to face recognition algorithm after plastic surgery and types of facial plastic surgery. Finally a system for Face recognition and matching with more significant results and fast processing time was developed.

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