USING MULTIMODAL BIO-METRIC FEATURES SURGICALLY ALTERED FACE IMAGES RECOGNITION

Ms. Abha R. Gulhane*

Dr. S. A. Ladhake*

ABSTRACT –

Face recognition is an active area of research since 1980s. The increasing acceptability of the face as a biometric for recognition is due to the fact that it is non-intrusive. This makes it more suited to application areas of surveillance, border control and authentication. The task of successfully matching face images obtained before and after plastic surgery is a challenging problem. The challenge that plastic surgery imposes on the recognition system is enormous, considering the fact that the images are geometrically and structurally degraded by surgery amidst other degrading factors such as illumination, pose and expression. The degree to which a face is altered depends on the type and number of plastic surgeries performed, and it is difficult to model such variations. Existing approaches use learning based methods that are either computationally expensive or rely on a set of training images. Altering facial appearance using surgical procedures has raised a challenge for face recognition algorithms. Facial plastic surgery can also be misused by individuals who are trying to conceal their identity with the intent to commit fraud or evade law enforcement. These procedures amend the facial features and skin texture thereby providing a makeover in the appearance of face.

Basically, plastic surgery procedure introduces skin texture variations between images of the same person (intra-face) thereby making recognition more difficult than in normal scenario. Since the shape of significant face features such as eyes, nose, eyebrow and mouth remains unchanged even after plastic surgery, making use of these parameters face recognition algorithm can be designed. This paper focuses on analyzing the effect of plastic surgery in face recognition algorithms and a multimodal bio-metric feature extractor algorithm is proposed therefore to match face images before and after plastic surgery.

Keywords: Face recognition, plastic surgery, skin texture, facial features, bio-metric feature.

* Department of Electronics & Telecommunication Engineering, Sant Gadge Baba Amravati University, Amravati, Maharashtra

1. Introduction

Face is special as it provides information such as identity, gender, age and expression. Also, face recognition is possible with available resources as it is easier to get a photograph of a person (especially in case of suspected criminals) rather than his finger print or iris pattern information. However, even after decades of research, face is still an active topic because of the variability observed in face due to illumination, pose, expression and occlusion. A new challenge to face recognition is facial plastic surgery. These surgeries alters facial features to such an extent that even human beings often struggle to identify a person's face after surgery. The number of people undergoing these plastic surgeries is increasing every day. These surgeries can be used by evaders to mask their identity and roam without any fear for face recognition systems.

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. These procedures amend the facial features and skin texture thereby providing a makeover in the appearance of face. 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.

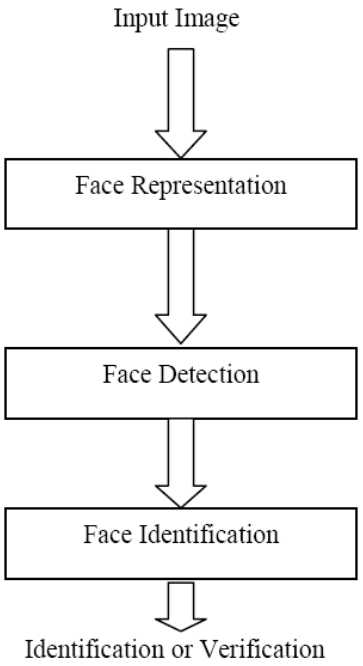

Fig.1 Flow chart

1.1 Face recognition system

A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. Facial recognition systems at a very high level work by recognizing a human face from scene and extract it. The system then measures nodal points on the face, distance between eyes, shape of the cheekbones and other distinguishable features. Face recognition has been an intensely researched field of computer vision for the past couple of decades.

1.2 Plastic Surgery

The acceptance of cosmetic surgery in society has saturated modern culture through television programs, news articles and advertisements for elective procedures that promise the fountain of youth and happiness. This increased media fascination has generated a greater public awareness for cosmetic procedures that propagates an ideal beauty standard that is not attainable by natural .The over abundance of elective surgical messages has led to a pervasive message that the body can be "easily" modified to conform to a permanent youthful image or conform to unrealistic beauty standards. The result is the normalization of certain body images, unrealistic expectations in regard to plastic surgery, as well as unethical practices within cosmetic surgery marketing.

Plastic surgery can be classified into two distinct categories.

1) Disease correcting local plastic surgery (Local surgery):

This is a kind of surgery in which an individual undergoes local plastic surgery for correcting defects, anomalies, or improving skin texture. Local plastic surgery techniques can be applied for possibly three different purposes:

1) to correct by-birth anomalies,

2) to cure the defects that are result of some accident, and

3) to correct the anomalies that have developed over the years.

2) Plastic surgery for reconstructing complete facial structure (Global surgery):

Apart from local surgery, plastic surgery can be performed to completely change the facial structure which is known as full face lift. Global plastic surgery is recommended for cases where functional damage has to be cured such as patients with fatal burns or trauma. Furthermore, global plastic surgery may also be used to entirely change the face appearance, skin texture and other facial geometries. Therefore, it can also be misused by criminals or individuals who want to remain elusive from law enforcement.

2. Proposed Work

Transmuting facial geometry and texture increases the intra-class variability between the pre- and post-surgery images of the same individual. Therefore, matching post-surgery images with pre-surgery images becomes an arduous task for automatic face recognition algorithms. Therefore, a multimodal biometric feature extractor algorithm is proposed to match such pre-surgery and post-surgery face images to identify authentic users. Following figure shows the generalized block diagram of face recognition algorithm.

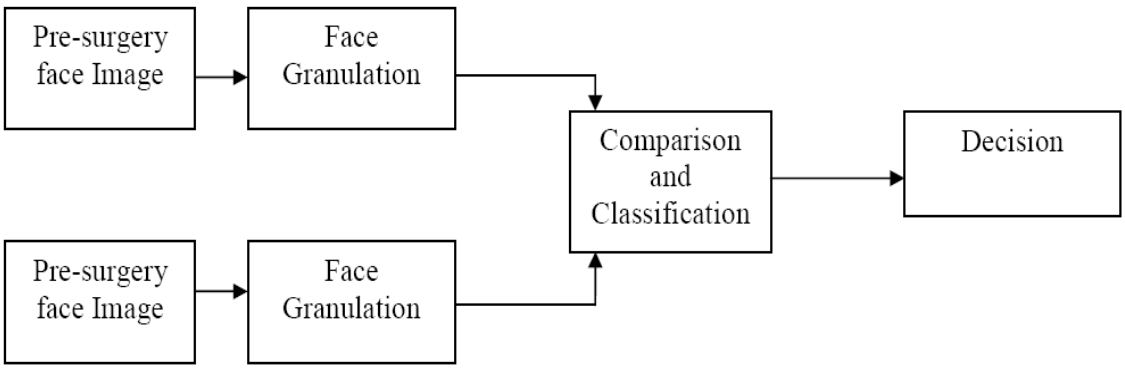

Fig.2 Generalized Block diagram

The face plays a major role in our social intercourse in conveying identity and emotions. The human ability to recognize faces is remarkable. We can recognize thousands of faces learned

throughout our lifetime and identify familiar faces at a glance even after years of separation. The skill is quite robust, despite large changes in the visual stimulus due to viewing conditions, expressions, aging, and distractions such as glasses or changes in hairstyle. But developing a computational model of face recognition is quite difficult, because faces are complex, multidimensional, and subject to change over time.

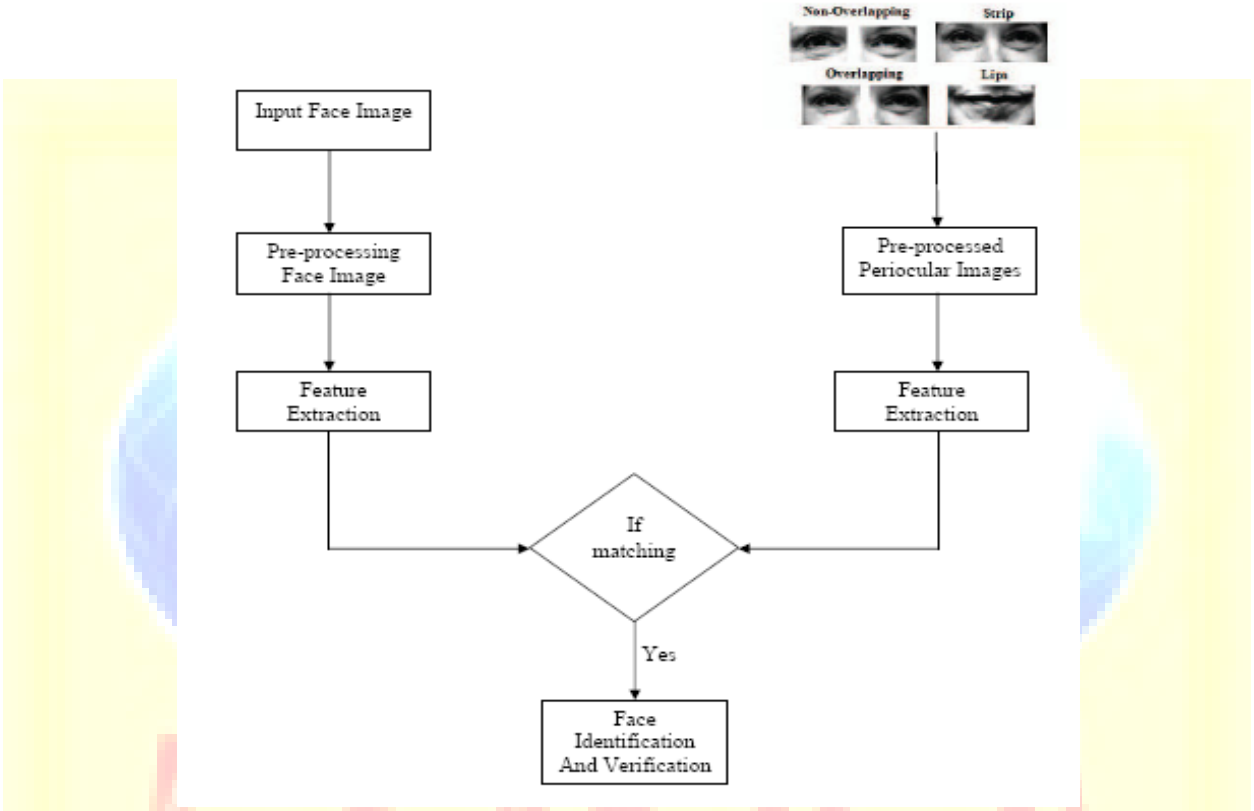

Fig. 3 Block diagram illustrating different stages of the proposed algorithm.

2.1 Input Face Image

The face image to be detected after alteration is given as an input face image. This is the Query image. This face image i.e. post-surgery image has to be matched with the pre-surgery image. And the image with which it has to match is the training sequence. This forms the training data base.

2.2 Pre-processing Face Image

After the input image is taken, in the preprocessing step each and every neighborhood pixel of an input image should have a new brightness value corresponding to the output image. Such

pre-processing operations are also known as filtration. Types are enhancement (image enhancement for shape detection), image restoration, image compression (search for a way to eliminate redundant information from images given to the preprocessing).

2.3 Facial Feature Extraction

In the extraction process the input image data will be segmented and then the input data will be transformed into a reduced represented set of features. It is useful on a selection of situations where it helps to stem data information that is not important to the specific image processing task (i.e. background elimination). Transforming the input data into a particular set of features is called as feature extraction. In our proposed system we will be using Local Binary Pattern (LBP) and modified Principal Component Analysis (MPCA) for feature extraction.

1) Local Binary Pattern:

Local Binary Pattern provides a powerful means of texture description. 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. LBP feature extraction is faster than any other feature extraction method and it provides good performance, makes this most researched features.

2) Modified Principal Component Analysis:

Principal component analysis (PCA) is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. PCA is a method of identifying patterns in data, and expressing the data in such a way so as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the advantage of graphical representation is not available, PCA is a powerful tool for analyzing data. The other main advantage of PCA is that once these patterns in the data have been identified, the data can be compressed by reducing the number of dimensions, without much loss of information. It plots the data into a new coordinate system where the data with maximum covariance are plotted together and is known as the first principal component.

Similarly, there are the second and third principal component and so on. The maximum energy concentration lies in the first principal component.

3. Conclusion

Face recognition is an active area of research since 1980s. Current face recognition algorithms mainly focus on handling pose, expression, illumination, aging and disguise. This paper formally introduces plastic surgery as another major challenge for face recognition algorithms. Plastic surgery is becoming prevalent due to advances in technology, affordability, and the speed with which these procedures can be performed. The procedures can significantly change the facial regions both locally and globally, altering the appearance, facial features and texture. Existing face recognition algorithms generally rely on this information and any variation can affect the recognition performance. This paper proposes a multimodal biometric system which extracts features from face and periocular area using local binary pattern operator and modified principal components. Compared to existing approaches, the proposed approach will not be learning based and will help to reduce computational requirements.

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