ISSN:0975-9646

Review of Perceptual Resemblance of Local Plastic Surgery Facial Images using Near Sets

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***Abstract*-- Plastic surgery is becoming prevalent due to advances in technology, and the speed with which these procedures are performed. Many efforts are being made by various researchers to address the challenges of human face detection and recognition. Variations in pose, expression, illumination, aging and disguise are the important challenges in this domain. Research focus is now shifted to plastic surgery of human faces. In this paper, review of Perceptual resemblance of local plastic surgery of facial images using Near Sets is proposed. We find different aspects related to plastic surgery and face recognition. When an individual undergoes plastic surgery, the facial features are reconstructed in both ways either globally or locally. Generally, this process changes the appearance of an individual. As these procedures become more and more prevalent, future face recognition systems will be challenged to recognize individuals after plastic surgery has been performed. However, to alleviate the problems of face recognition after local plastic surgery of faces, we are using near set theory to identify resemblance between pre-surgical and post-surgical faces.**

***Keywords* -- Plastic Surgery, Resemblance, Local plastic surgery, Near sets theory.**

I. INTRODUCTION

Plastic surgery is a very popular operational technique that is used across the world for improving the facial look. Plastic surgery can be used to acne scars, to become white, to remove dark circles and many more. Plastic surgery is divided into two different categories such as global plastic surgery and local plastic surgery. In Global surgery the complete facial structure changes whereas in local plastic surgery certain parts of faces are changed. Here we are dealing with local plastic surgery based face recognition. Local facial regions such as nose, chin, eyelids, lips play an vital role in face recognition and small variations affect the recognition performance.

Here Near set theory is used for comparing faces before and after plastic surgery. The basic idea is to apply face recognition algorithm only to those facial images that have undergone a local plastic surgery [4]. When the features will be extracted a feature database will be formed. Using this feature values near set theory provides a method to established resemblance between objects contained in a disjoint set.

This paper is organized as follows. In section II we introduce Overview of Plastic surgery, Geometric feature extraction and Near set theory. In section III, we discuss related work carried in the same field and conclusion is discussed in section IV.

II. OVERVIEW OF PLASTIC SURGERY, GEOMETRIC FEATURE EXTRACTION AND NEAR SET THEORY

In this section, we are presenting the brief overview of the Plastic surgery, Geometric feature extraction and Near set theory.

A. Overview of Plastic surgery

Plastic surgery is a very well known area of surgery. In plastic surgery, the reconstruction of specific areas of the body that may have been damaged due to birth defects, burns or even disease takes place. With respect to face recognition plastic surgery is divided into two different category.

Global Plastic Surgery: In this category, the complete facial structure changes after surgery. The appearance, texture and facial features of an person are reconstructed in such a way that the surgical faces are different than the original one. Well known example is Michael Jackson from Hollywood.

Local plastic surgery: Local plastic surgery is used to correct certain defects, anomalies and can also be used to improve skin texture. It also correct several features on face such as teeth structure, jaw, nose structure, chin, cheek, forehead and eyelids. There are several types of local plastic surgery procedures such as Rhinoplasty (nose surgery), Blepharoplasty (eyelid surgery), Brow lift (forehead surgery), Genioplasty/Mentoplasty (chin surgery), Cheek implant, Otoplasty (ear surgery), and Lip augmentation.

B. Geometric FeatureExtraction

Feature extraction is nothing but obtaining features that are fed into a face recognition system (such as lines or fiducially points, or facial features such as eyes, nose, and mouth). A face can be recognized when the details of the individual features such as eyes, nose and mouth are no longer resolved. The idea is to extract relative position and other parameters of distinct features such as eye, mouth, nose and chin.

Following geometric features can be extracted :

- Nose vertical position and width
- Mouth vertical position, height and width

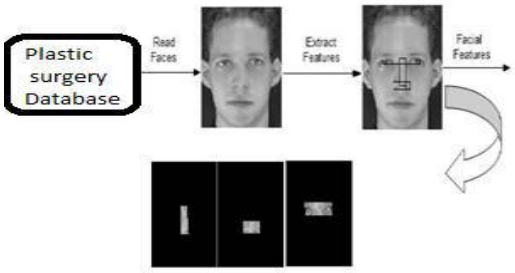

Fig 1. Geometric Facial Feature Extraction [17]

These features are mainly focused on the internal area, the internal features are more important for recognition than external features. After the feature is accurately extracted, a set of complex vectors is obtained by calculating the complex coefficients in the feature points. The face is represented by these vectors.

C. Overview of Near sets theory

James Peter in the year 2006 presented the idea of Near set theory [20]. In near set theory, each and every object is described by a list of feature values. The word feature means an observable property of physical objects in our environment. For example, for a feature such as lips on a human face, lips length or lips width will be the feature values. Comparing this list of feature values, we can find out similarity between objects and can be grouped together in a set, called as near set. Thus near set helps us in determining the observation, comparison and recognition or classification of objects. One set *X* is near to another set *Y* such that objects in both sets X and Y should have atleast one matching description. The property of near set theory is object description and the classification of objects by means of features.

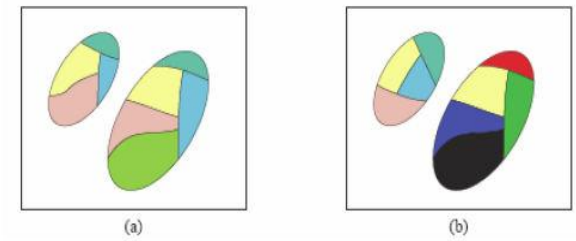

Fig 2 - (a) High degree of nearness (b) Low degree of nearness Tolerance Nearness Measure [1]

III. RELATED WORK

There is a lot of research work being done in the domain of face recognition for plastic surgery facial images. Many researchers have addressed this field with various research methodologies. In this section, we are presenting a research work of some authors who works in the same field.

K.S.Patnaik el at [1], introduces perceptual resemblance of plastic surgery facial images using near sets. Here Near set theory is used to identify similarity between pre-surgical and post-surgical images. Near sets are disjoint sets that resemble each other. Similarity between disjoint sets occurs whenever there are observable similarities between the objects in the sets. The main aim is to measure the degree of resemblance of facial images before and after plastic surgery. Blepharoplasty (Eyelid surgery) and Rhinoplasty (Nose surgery) is being considered for work due to the maximum number of individuals and easy to differentiate faces before and after plastic surgery. Nearness measure is being used to measure the degree of resemblances between plastic surgery images. It can also be used in increasing the efficiency of any face recognition system containing plastic surgery images.

Aggarwal, Gaurav, et al [3], propose a new approach to addrss the challenges involved in automatic matching of faces across plastic surgery variations. A part-wise approach that is based on the observation that appearance of one or more facial features may not change much across plastic surgery procedures is used. Most sparse representation based face matching approaches require several images of each subject in the gallery. To deal with the problems of variations in facial appearance, the part-wise framework is combined with the sparse representation approach to improve face matching performance across plastic surgery variations.

Bhatt, Himanshu S, et al. [7], Presents an evolutionary granular method for finding similar face images that have been altered by plastic surgery procedures. It starts with generating non-disjoint face granules with each face granule having different information at varying size and resolution. Uniform Circular Local Binary Pattern (UCLBP) and Speeded up Robust Features (SURF) feature extractor, are used to obtain different information from face granules. Also different responses are combined in an evolutionary manner using genetic algorithm for improved performance. The algorithm extracts perceptive information from non-disjoint face granules obtained at different levels of granularity. Pre and post surgery face images are processed at the first level of granularity, to obtain face granules at varying resolutions. Now, Face image are divided into horizontal and vertical face granules of different size and information content at second level of granularity. Face image is then tessellated into non overlapping local facial regions at the third level.

Sun, Guoxia, Liangliang Zhang, and Huiqiang Sun, et al. [8], Presents a novel symmetrical weighted principal component analysis (SWPCA) space for feature extraction and its application to face recognition. Firstly SWPCA applies mirror transform to facial images, and the odd and even symmetrical images based on the odd-even decomposition theory are obtained. Weighted PCA is then performed on the odd and even symmetrical training sample sets respectively to extract facial image features. There are few drawbacks in PCA-based face recognition methods, such as the discriminate ability of PCA features, and their sensitivity to the illumination, facial expression and pose. In order to solve these problems, PCA feature space is converted into weighted PCA feature space and extracted face image features in the WPCA space. This

improved the robustness against the variance of illumination and facial expression.

Singh, K. R, and M. M. Raghuwanshi, et al. [9], present Rough set approach in face recognition. Advances in rough set theory, helps in making decisions about face recognition. To classify a new face image with the chosen representation issue, Rough Neural Network (RNN) is used Which acts as face recognizer. In a given set of points belonging to two classes, Rough Set finds the indiscernible relation that separates the largest possible fraction of points of the same class. The methodology used here is that after face pre-processing, rough set theory are used on decision tables for generating face classification rules.

Nor'aini, Abdul Jalil et al. [11], Present an approach of face recognition using discrete orthogonal moment namely Krawtchouk moments (KMs) and Tchebichef moments (TMs). Both these moments does not require numerical approximation and coordinate space normalization. KMs and TMs are better compared to continuous orthogonal moments in terms of preserving the analytical properties needed to guarantee minimal information redundancy. Due to these properties, KMs and TMs are well suited as pattern features in the analysis of two dimensional images. In recognition stage, Euclidean square distance or Nearest Neighbour (NN) is used as the classifier.

Singh Richa, Mayank Vatsa, and Afzel Noore et al. [14], Present an approach to quantitatively calculate the performance of face recognition algorithms on a plastic surgery database that contains face images. It shows that PCA, FDA, GF, LFA, LBP and GNN algorithms are unable to effectively alleviate the variations caused by the plastic surgery procedures. Therefore advanced techniques are required that account for the challenges due to plastic surgery and increase the efficiency of face recognition.

Ting, Jie Liu Xu-bo Yang et al. [16], A novel method for plastic surgery prediction is presented. This method takes a pre-operative frontal facial picture as an input. Landmarks of the face are then extracted and constitute a distance vector. As a set of facial parameters, such a vector is entered into either a support vector regression (SVR) predictor or a k-nearest neighbor (KNN) predictor which is trained on a set of pre- and post-operative facial distance vectors of former cases. After the predicted distance vector generated, new landmarks positions are updated and the final result is generated in terms of changes between predicted landmarks and the original ones Several experiments are carried out and the results show a great accuracy of prediction, which proves that this method is of high validity.

S. Gupta, K.S.Patnaik, et al. [17], Support Vector Machines application is used in (SVMs) in face recognition. The face recognition systems consist of two major phases feature extraction and classification. An automated facial feature extraction procedure is used to extract feature and make use of Near set approach to choose the best feature among the considered one which improves face recognition efficiency of SVM.

R. Singh, M. Vatsa, A. Ross, and A. Noore et al. [19], Describe a face mosaicing scheme which generates a merged face image during enrollment based on the evidence provided by frontal and semiprofile face images of an individual. In this scheme, the side profile images are aligned with the frontal image. Face mosaicing scheme, offers significant benefits by accounting for the pose variations that are commonly observed in face images. The primary goal is to demonstrate the role of face mosaicing in enhancing the matching performance of a face recognition system.

Rabi, Seyed Alireza, and Parham Aarabi et al. [24], Present face fusion an automatic approach for virtual plastic surgery. It described details of a system that achieves fusion of a face with facial features belonging to another individual possibly of different skin color. To detect faces, it combine aspects of two well-known face detection algorithms by utilizing the color information as well as using a generic face template. In the facial feature module it have used vertical and horizontal projection of edges in a face to find the exact location of features such as eyes and lips. This information was also used to construct probability distribution functions, which is used to fuse the replaced features within the original face. It also deals with the problem of facial feature fusion.

IV. CONCLUSION

We have rigorously reviewed the different research methodologies used by various researchers for Local Plastic surgery face recognition. The comparative study of reviewed work is presented in the summarized form. In this paper, we have presented the outcome of the rigorous study of research work conducted by various researchers for plastic surgery face recognition. It is observed that there is a scope of further research in the same field by using Near Set theory.

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