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# COSMETIC SURGERY FOR AGING EFFECTS ON FACE IMAGES-A PROPOSED METHOD

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***Abstract:*** Cosmetic surgery was intended and typically reserved as a repair mechanism to assist wounded and deformed soldiers in war. Soldiers returning from war with missing limbs and shrapnel torn faces entrusted their appearance to the hands of skilled surgeons of the time. The development of cosmetic surgery received a push for movement from the need to repair gross deformities sustained in war to the need to change normal and typical physical appearances. Early surgeons intended cosmetic surgery for surgical repair of congenital or acquired deformities and the restoration of contour to improve the appearance and function of tissue defects.

Throughout history, women have been fed the notion that beauty is all that matters in their life. Today, in the 21st century, women are the basic targets of the media industry. Media manipulation shows women's perspectives related to their appearance routinely occurs, as media moguls persist to work hand in hand with the cosmetic industry, feeding society with unattainable ideals, encouraging women to mutilate themselves for psychological reasons, often with lethal consequences usually hidden in final print.

Facial plastic surgery is generally used for correcting feature defects or improving the appearance, for example, removing birth marks, moles, scars and correcting disfiguring defects in the face.

This paper describes a system that replaces an individual's facial features with corresponding features of another individual possibly of different skin colour and fuses the replaced features with the original face, such that the resulting face looks natural.

The results also suggest that it is imperative for future face recognition systems to be able to address this important issue and hence there is a need for more research in this important area.

**Key Words:** Face recognition, Plastic surgery, Stack and Segmentation

## INTRODUCTION

Plastic surgery, on the other hand, is perceptually considered as a arduous research issue. However, it can also be misused by individuals to conceal their identities with the intent to commit fraud or evade law enforcement. To the best of our knowledge, there is no study that demonstrates any scientific experiment for recognizing faces that have undergone local or global plastic surgery. In face recognition problem in which several approaches have been proposed to address the challenges of illumination, pose, expression, aging and disguise, the use of plastic surgery introduces a new challenge to designing future face recognition systems [6-9].

The concept of Image fusion has been used in wide variety of applications like medicine, remote sensing, machine vision, automatic change detection, biometrics etc. With the emergence of various image-capturing devices, it is not possible to obtain an image with all the information. Sometimes, a complete picture may not be always feasible since optical lenses of imaging sensor especially with long focal lengths, only have a limited depth of field.

Image fusion helps to obtain an image with all the information. Image fusion is a concept of combining multiple images into composite products, through which more information than that of individual input images can be revealed. The goal of image fusion is to integrate complementary multi sensor, multi temporal and/or multi view data into a new image containing more information. With the availability multiple image sources, image fusion has emerged as new and promising research area. Many algorithms and image fusion software's are developed in recent years using various approaches for various applications.

Advances in computer modelling have allowed pre-surgical observation and simulation of the effects of such operations, thus reducing the risk of unwanted results. Researchers showed that symmetries and proportions of a frontal face play a fundamental role in our concept of beauty. As a result, in this work we have tried to focus on fine tuning the frontal, two dimensional images that result from replacement of patient facial features with those of the model.

The actual fusion process can take place at different levels of information representation. A generic categorization is to consider the different levels as, sorted in ascending order of abstraction: signal, pixel, feature and symbolic level. The

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lowest possible technique in image fusion is the pixel level, is called as nonlinear method, in which the intensity values of pixels of the source images are used for merging the images. The next level is the feature level, which operates on characteristics such as size, shape, edge etc. The next highest level called decision level fusion deals with symbolic representations of the images [1].

Currently, most of the image fusion has been performed using pixel based methods [2-3]. A new multi-focus image fusion algorithm, which is on the basis of the Ratio of Blurred and Original Image Intensities, was proposed in [4].

A multi focus image fusion method using spatial frequency (SF) and morphological operators was proposed in [5].The advantage of the pixel level image fusion is that images contain original information. Furthermore it is easy to implement. Image fusion methods based on wavelet transform have been widely used in recent years. A simple image fusion algorithm based on wavelet transform is proposed in reference [6].

A new multi-focus image fusion scheme based on wavelet contrast is given in reference [7].A novel multi focus image fusion algorithm based on contour let transform and region statistics was proposed in [8]. A simple yet efficient algorithm for multi focus image fusion, using a multi resolution signal decomposition scheme was proposed in [9]. A paper given in reference [10] presents an overview on image fusion techniques using multi resolution decompositions. A paper in reference [11] is image fusion tutorial based on wavelet decomposition, i.e. a multi resolution image fusion approach. Paper in reference [12] presents the use of balanced multi wavelets for image fusion.

A new method is developed to merge two spatially registered images with different focus based on multi-resolution wavelet decomposition and evolutionary strategy (ES) [13]. A multi focus image fusion algorithm using the Haar transform is presented in the paper [14]. Paper[15] proposes a method for multi-focus image fusion using pulse coupled neural network (PCNN).The application of artificial neural networks to this pixel level multi focus image fusion problem based on the use of image blocks is explained in [16]. A novel adaptive multi-focus image fusion algorithm is given in this paper, which is based on the improved pulse coupled neural network(PCNN) model, the fundamental characteristics of the multi-focus image and the properties of visual imaging[17].

In addition to the classical problems of face finding and feature detection, our system addresses and solves the problem of fusing a face with facial features belonging to another individual -possible of different colour. This is required in order to achieve a natural looking result.

## REVIEW WORKS

When an individual undergoes plastic surgery, the facial features are reconstructed either globally or locally. In general, this process changes the appearance. Until now, no attempt has been made to study the effect of local and global plastic surgery on face recognition. Researchers investigate different aspects related to plastic surgery and face recognition.

In general, face recognition algorithms can be classified into three categories: appearance-based, feature-based, and texture-based algorithms. Appearance based algorithms such as Principal Component Analysis (PCA) [10], Independent Component Analysis (ICA) [11], and Fisher Discriminant Analysis (FDA) [10] usually rely on the global semblance of features. Feature-based algorithms [12] generally establish a relationship among facial features and perform matching. Texture-based algorithms are on the other hand relying on the facial texture information to recognize an individual. Most of the existing face recognition algorithms have predominantly focused on mitigating the effects of pose, illumination and expression, while the challenges of face recognition due to aging and disguise still remains.

As these procedures become more and more prevalent, future face recognition systems will be challenged to recognize individuals after plastic surgery has been performed. The major reasons for the problem not being studied are:

• Due to the sensitive nature of the process and the privacy issues involved, it is extremely difficult to prepare a face database that contains images before and after surgery.
• After surgery, the geometric relationship between the facial features changes significantly and there is no technique to detect and measure such type of alterations.

## Proposed Method

Blending and replacing facial features needs a two level processing. On one hand, it is required that the shape of the original shape be changed to that of the desired face, and on the other hand it is desired that the colour of the replaced feature be same as the original feature. The final requirement is crucial if we are to achieve a seamless transition from the replaced feature to the underlying face.

In general, plastic surgery can be divided into two distinct categories.

A. Disease Correcting Local Plastic Surgery (Local Surgery): This is the kind of surgery in which an individual undergoes local plastic surgery for correcting defects, anomalies, or improving skin texture. Example of disease correcting local plastic surgery would be surgery for correcting jaw and teeth structure, nose structure, chin, forehead, and eyelids. Although the global approach may look similar, this type of surgery usually leads to varying amount of changes in the geometric distance between facial features. Such changes may cause errors in automatic face recognition and degrade the system performance.

B. Plastic Surgery for Reconstructing Complete Facial Structure (Global Surgery): Apart from local surgery, plastic surgery can be done to completely change the facial structure which is known as full face lift. This medical procedure is recommended for cases such as patients with fatal burn or trauma. In this type of surgery, the appearance,

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texture and facial features of an individual are reconstructed and are usually not the same as the original face. The procedure is very useful for patients, but it can also be misused by criminals or individuals who want to remain elusive from law enforcement. Thus using this procedure, the face recognition system can be easily manipulated and made ineffective.

When an individual undergoes plastic surgery, the facial features are reconstructed either globally or locally. In general, this process changes the appearance. In this paper, we performed an experimental study to visualize the effect of both local and global plastic surgery on face recognition. We obtained face images before and after plastic surgery from different plastic surgeons and prepared a plastic surgery database. This database contains a wide variety of cases such as Rhinoplasty (nose surgery), Mentoplasty (chin surgery), Brow lift, Malar augmentation (cheek implant), Skin peeling, and Rhytidectomy (face lift).

In most of the test cases, for global surgery, differences between pre and post- surgery images of the same individual is very large. In other words, facial feature and texture is drastically altered after surgery and hence the algorithms do not yield good performance.

For few test cases of skin resurfacing that have relatively closer resemblance in pre and post- surgery images, most of the recognition algorithms are able to perform correct classification. However, with major skin resurfacing such as surgeries to look younger, none of the algorithms are able to correctly classify the faces.

The first step is to detect faces in the input images. The face detection is based on using a stored template of a generic face. Next the following algorithm detects three rectangular regions containing the left eye, the right eye and the lips. Using this information proposed method replaces the eyes and lips of the original face with those of the model face. Figure below shows the outcome of these operations performed on two sample faces.

**Algorithm:**

Input: Input Facial Image and Model Facial Image

Output: Replace the segmented stored Input facial region by the segmented (already stored) model facial region.

Step 1. Scan the facial image from the Left side of the image to locate the leftmost pixel of the face.

Step 2. Draw a vertical line along this pixel from top to bottom representing the Left baseline or boundary.

Step 3. Scan the facial image from the right side of the image to locate the rightmost pixel of the facial region.

Step 4. Draw a vertical line along this pixel from top to bottom.

Step 5. Partition the obtained rectangle horizontally into segments and start with the first row of the first segment.

Step 6. Scan the enclosed rectangle from the right side to left, from the first row of the segment.

Step 7. Obtain a pixel that has similar/near similar pixel value, traverse the pixel path by considering all the surrounding pixels in a clockwise mannar and replace the corrosponding pixels by the pixels of model face.

Step 8. Stack to be used only if the traversal process reaches a dead end.

Step 9. If a dead end is reached, pop out from the stack a lesser priority pixel and continue with the traversal process.

Step 10. Store the pixels traversed for plotting.

Step 11. Traversal continues to the next pixel till it reaches the left baseline or the bottom of the image or the start position is reached.

Step 12. If the traversal is terminated, the plotting list is erased and continues from Step7.
Else plot pixels from the Plotting List.

Step 13. Continue to Step6 till all model pixels are traversed.

Step 14. Move to the first row of the next segment and continue from Step6 to Step11 for all rows and then exit.

**Output is given below:**

Fig 1: Before and After Processing (Lip and Chin)

**CONCLUSIONS**

Current face recognition algorithms mainly focus on handling pose, expression, illumination, aging and disguise.

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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.

Apart from ethical and social issues, several engineering challenges play a vital role in developing algorithms to handle variations due to facial plastic surgery. In our opinion, the first engineering challenge is to develop an algorithm to classify the variations in face due to facial plastic surgery from the variations due to other covariates such as aging and disguise.

Even if somehow it is identified that a particular human face has undergone plastic surgery (e.g. manually), matching a post-surgery image with a pre-surgery face image is an arduous task. Hence, another engineering challenge would be to design an algorithm to correlate facial features in pre and post-surgery images. Local facial regions such as nose, chin, eyelids, cheek, lips and forehead play an imperative role in face recognition and small variations affect the recognition performance. Further, a combination of local plastic surgery procedures may result in a fairly distinct face from the original face.

**REFERENCES**

[1] S. Li, R. Chu, S. Liao, and L. Zhang, "Illumination invariant face recognition using near-infrared images", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 29,
no. 4, pp. 627–639, 2007.

[2] R. Singh, M. Vatsa, and A. Noore, "Improving verification accuracy by synthesis of locally enhanced biometric images and deformable model", Signal Processing, vol. 87, no. 11,pp. 2746–2764, 2007

[3] V. Blanz, S. Romdhami, and T. Vetter, "Face identification across different poses and illuminations with a 3d morphable model", in Proceedings of International Conference on Automatic Face and Gesture Recognition, 2002, pp. 202–207.

[4] X. Liu and T. Chen, "Pose-robust face recognition using geometry assisted probabilistic modeling", in Proceedings of International Conference on Computer Vision and Pattern Recognition, 2005, vol. 1, pp. 502–509.

[5] R. Singh, M. Vatsa, A. Ross, and A. Noore, "A mosaicking scheme for pose-invariant face recognition", IEEE Transactions on Systems, Man and Cybernetics - Part B, vol. 37, no.
5, pp. 1212–1225, 2007.

[6] A. Lanitis, C.J. Taylor, and T.F. Cootes, "Toward automatic simulation of aging effects on face images", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 24,
no. 4, pp. 442–450, 2002.

[7] N. Ramanathan and R. Chellappa, "Face verification across age progression", IEEE Transactions on Image Processing, vol. 15, no. 11, pp. 3349–3362, 2006.

[8] N. Ramanathan, A.R. Chowdhury, and R. Chellappa, "Facial similarity across age, disguise, illumination and pose", in Proceedings of International Conference on Image Processing, 2004, vol. 3, pp. 1999–2002.

[9] R. Singh, M. Vatsa, and A. Noore, "Face recognition with disguise and single gallery images", Image and Vision Computing, vol. 27, no. 3, pp. 245–257, 2009.

[10] P.N. Bellhumer, J. Hespanha, and D. Kriegman, "Eigen faces vs. fisher faces: recognition using class specific linear projection", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 17, no. 7, pp. 711–720, 1997.

[11] M.S. Bartlett, J.R. Movellan, and T. J. Sejnowski, "Face recognition by independent component analysis", IEEE Transaction on Neural Networks, vol. 13, pp. 1450–1464, 2002.

[12] I.J. Cox, J. Ghosn, and P.N. Yianilos, "Feature-based face recognition using mixture-distance", in Proceedings of International Conference on Computer Vision and Pattern Recognition, 1996, pp. 209–216.

[13] Li Ming; Wu Yan; Wu Shunjun ,"Multi-focus image fusion based on wavelet
decomposition and evolutionary strategy**"** Neural Networks and Signal Processing,
2003. Proceedings of the 2003 International Conference on Volume 2, Issue , 14-17 Dec.
2003 Page(s): 951 - 955 Vol.2.

[14]. Toxqui Quitl,Carina,Padilla,Vivanco,Alfonso Urcid Serrano, Gonzalo,"Mutlifocus image fusion using the Haar wavelet transform", Applications of Digital Image Processing
XXVII. Edited by Tescher, Andrew G. Proceedings of the SPIE, Volume 5558, pp.
796-803 (2004).

[15] Wei Huang, Zhongliang Jing "Multi-focus image fusion using pulse coupled neural network" Pattern Recognition Letters Volume 28, Issue 9 (July 2007) Pages:
1123-1132 Year of Publication: 2007.

[16] Shutao Li, James T. Kwok, Yaonan Wang "Multifocus image fusion using artificial
neural networks" Pattern Recognition Letters Volume 23, Issue 8 (June 2002) Pages: 985 -
997 Year of Publication: 2002 ISSN:0167- 8655 .

[17] Qiguang Miao ,Baoshu Wang ,Xidian Univ. (China*)"* A novel adaptive multi-focus image fusion algorithm based on PCNN and sharpness" Proceedings of SPIE -- Volume
5778 Sensors, and Command, Control, Communications, and Intelligence (C3I) Technologies for Homeland Security

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and Homeland Defense IV, Edward M. Carapezza, Editor, May 2005, pp. 704-712.

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