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Using Deep-Learning Algorithm to Determine Safe Areas for Injecting Cosmetic Fluids into the Face: A survey

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ABSTRACT

Cosmetic surgery has been more prevalent in the world in recent years. A beautiful and flawless face is everyone's dream. Aging, environmental factors, disease, or poor diet are among the factors that influence body wrinkles. Various methods are used to reduce these lines. It can be said that the simplest and most effective solution is to inject cosmetic fluids into these areas. But, due to the increase in facial injections using cosmetic fluids, considered toxins, the risk of injury to the surrounding facial nerves and injury to one of the main facial nerves is increasing, creating a catastrophe or deformation in the face irreversibly. Deep learning algorithms have been used to determine whether cosmetic fluids are injected. Deep Convolutional Neural Networks (CNNs), VGG16, ResNet....etc. Deep learning algorithms have demonstrated excellent object detection, picture classification, and semantic segmentation performance. All the suggested approach consists of three stages: feature extraction, training, and testing/validation. Deep learning technology trains and tests the system with before and after photographs. Numerous investigations have been carried out using various deep-learning algorithms and databases. The main goal is to attain maximum accuracy to ensure that injected cosmetic fluids by specialists have been injected in safe areas, in addition to facial recognition and determining whether or not the person received an injection. The most used databases are IIITD plastic surgery and HDA_Plastic Surgery.

1. Introduction

Biometrics plays a significant role in numerous fields of life, including facial recognition systems, particularly after the spread of plastic surgery that alters facial features.
However, sometimes it is impossible to identify a person due to the popularity of plastic surgery, particularly injections, because they are safe, inexpensive, and performed quickly by those undergoing plastic surgery. A person's appearance and facial features can change dramatically due to their locally and globally actions. One preoperative photo for training and testing purposes is included in the surgical details of specific individuals for

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whom the plastic facial surgery database is unavailable due to privacy concerns. Without access to surgery information, predicting static features (Areas without surgical effects) is very challenging. Cosmetic surgery may additionally be used for persons who attempt to conceal their identity to engage in or evade the law. The current face recognition algorithm effectively extracts a feature from an image. This procedure also makes it possible to steal freely without worrying about being recognized by a facial recognition system, which could result in the rejection of actual users. Fig. 1 shows an example of the effect of plastic surgery on facial appearance resulting from plastic surgery (before and after pictures of plastic surgery).

Figure1. Shows pictures of people before and after plastic surgery

2. Related work

Most facial recognition research has been devoted to creating algorithms that can handle the difficulties presented by various circumstances, including the size of the lighting and others. And one of the primary drivers of interest in face-matching techniques, including matching faces with various plastic surgeries, is deep learning.

2.1. Face Recognition

C. Chude-Olisah, et al. (2013) this research article uses a Gabor representation technique based on edges to recognize surgically changed faces. They use cutting-edge information based on the forms of important facial features to address issues with texture differences due to plastic surgery operations. The experimental results in the database of plastic surgery (blepharoplasty, rhinoplasty, blepharoplasty) showed that the proposed strategy is effective remarkably well compared to the current cosmetic surgery, where the accuracy rate of Rhytidectomy was 88.24%. Rhinoplasty 94.27% Blepharoplasty 95.43% [1].

X. Liu, et al. (2013) The first section of this paper includes a detailed study on facial recognition after plastic surgery (FRAPS), carefully examining the impact of plastic surgery on facial appearance and the obstacles of face identification. A partial matching-

the based plastic surgery detection method is suggested to detect four types of surgery: eyelid surgery, nose surgery, forehead surgery, and face-lift surgery. Our Dermabrasion Method 81.25% Forehead surgery 86.67% Local ear surgery 90.50% Eyelid surgery 89.52% Nose surgery 81.77% Others 73.21% Global skin peeling 97.26% Facelift 86.68% Overall 86.11% [2].

M. De Marsico, et al. (2015) The proposed methods carry out the area-based approach in various ways. FARO (Facial Recognition Against Occlusions and Expression Changes) divides the face into sections related parts (left eye, right eye, nose, mouth) after that, encodes them independently using discrete processing of the function system (PIFS). When compared to previous trials reported in the literature, our experimental results suggest that our methods are superior and perform significantly superior to cutting-edge algorithms. The recognition rate is 86% when the average result obtained using FACE with a proper normalization approach (NP2) is computed across all cases [3].

A. Ali, et al (2016), the authors of this work, presented a facial identification system after plastic surgery that integrates dozens of algorithms based on features and textures. The feature-based algorithm is the most popular general image descriptor GIST and the texture-based approach uses the local binary pattern (LBP) of quiet points. The proposed system outperformed several existing systems' latest facial recognition technologies with a maximum validation accuracy of more than 91% percent after plastic surgery [4].

M. Nappi, et al (2016) said that as the average cost of these increases in the next years procedures rises, the exponential expansion in the number of facial plastic surgery procedures (from minimally invasive procedures to actual surgeries) that has been noted over the previous two decades could become even more widespread. Treatments are

becoming less common, and the desire to "beautify" has merged with the world's artistic sensibility. Describe the fundamental characteristics of each of the most statistically significant therapies currently available, and then summarize them using a synthetic table. To the best of the authors' ability, the paper offers a summary of each method that has been proposed in the area thus far. An indication of the plastic surgery data set up to this point is comparing stated performance with modern treatments when applied to the face. This book is concluded with a critical analysis of the outcomes attained thus far and an understanding of the difficulties still to be overcome [5].

A. Sable, et al. (2017) this research describe a new technique for accurate face identification following plastic surgery termed Entropy-based SIFT (EV-SIFT). The matching feature extracts the scale-space structure's important points and volume, from which the information rate is calculated. The EV- SIFT approach, on the other hand, gives both contrast and volume information. Thus, EV-SIFT outperforms PCA, regular SIFT, and V-SIFT in terms of feature extraction performance PCA 86 %, SIFT 87% VSIFT 55% EVSIFT 71% [6].

Y. Zhai. et al. (2019) in this essay. First, a multiband network is used to enhance face feature discrimination. Second, MFM (max-feature-map) is used as an activation function to lessen the multiband design's computational load. The proposed approach is superior to the most recent methods, which may achieve a classification accuracy of 67.48%, according to extensive trials on LSFBD [7].

Y. Zhai, et al. (2020) this research use a CNN approach based on transfer learning use, including several channel characteristics. The performance of the suggested CNN was then lessened by employing the data augmentation approach and the transfer learning strategy. A multi-channel feature inclusion technique is last investigated to enhance the suggested CNN model. Experimental findings demonstrated that the proposed approach is more effective than the conventional learning strategy in addressing FBP among Asian women [8].

M. Ebadi, et al. (2020) this article present a new face recognition algorithm using multi-correction learning under plastic surgery conditions when there is only one training model per registered person. In the presented method, the image of a face is divided into a set of patches that have no overlap and are bifurcated. Next, we model face recognition under plastic surgery conditions using a single-per-person model as a multiplex and multiple-matching problem to maximize the macular bifurcation margin. A full empirical investigation is conducted using the plastic surgery database, AR 80.1%, and the facial databases 90.6% FERET. The experimental results indicate the superiority of the presented algorithm in recognizing faces in single-sample databases [9].

C. Rathgeb, et al. (2020), the new Hochschule Darmstadt (HDA) Plastic surgery database is presented in this paper pre- and post-operative facial images. The HDA Plastic Surgery Database, the IIITD Plastic Surgery Database, and the IIITD Plastic Surgery Database the Non-Surgical For validations and comparative validations, ICAO-compliant subsets of the FRGCv2 and FERET datasets are used, as are commercial Cognitec FaceVACS system as well as the open source ArcFace system. Significant performance improvements have been made. By Cognitec FaceVACS above non-surgery 99.89 percent of the time HDA cosmetic surgery a hundred percent Plastic surgery at IIITD 99.16% and by ArcFace Non-surgery 99.0% HDA plastic surgery 99.84% IIITD plastic surgery 99.51%, indicating the fact that Plastic effect surgery has a less significant impact on deep face recognition systems than previously tested methods [10].

T. Sabharwal et al. (2021) this paper debate what they proposed as a methodology by linking the current facial recognition system with data obtained from the face markers. To do so, fix the recognition rate between the previous post photos that have been surgically altered, humans. The mechanism proposed is performed on a surgical plastic face data set. Widespread trials are being conducted to demonstrate the effectiveness of predictive facial marker detection and the advantages of using facial marker statistics over the usual facial recognition schemes. The above methodology has not yet been performed on surgically changed facial image samples. Facial mark manual 99.2%, Facial mark Canny 99.3%, Facial mark Sobel 99.0%, and Facial mark SURF 99.8% [11].

R, Khedgaonkar et al. (2021) this chapter presented an empirical assessment of performance from the CNN model that has been proposed. Overall

performance was obtained utilizing several training photos and test images. The CNN model proposed has been PSD, and ASPS datasets were used to analyze procedures such as rhinoplasty, blepharoplasty, and lip augmentation. It employs the CNN model. Performance metrics have been thoroughly analyzed. When applied to two types of facial databases, the acquired accuracy ranges from 90% to 100% for the three types of procedures. The nine-layer CNN model was compared to another algorithm for recognizing faces. Examples include PCA, FDA, GF, LFA, LBP, and GNN. Prove stated the success rate of rhinoplasty was 93.96%, rhinoplasty achieved an accuracy of 99.09%, and lip augmentation reached precisions of 100% [12].

Table 1. List the methods used for facial recognition on plastic surgery images and the corresponding results.

No.	Author name	Research name	Dataset used	Method used	Result
1	A. Ali, et al [4]	Proposed face recognition system after plastic surgery	face plastic surgery database	A feature-based algorithm is the image GIST global descriptor and the texture-based algorithm is the local binary pattern (LBP)	91%
2	A. Sable, et al [6]	EV-SIFT-an extended scale invariant face recognition for plastic surgery face recognition	Pre-surgery and post-surgery face	PCA SIFT VSIFT EV-SIFT	86% 87% 55% 71%
3	C. Rathgeb, et al [10]	surgery: An obstacle for deep face recognition?	non-surgery HDA -plastic surgery face database IIITD-plastic surgery	FaceVACS ArcFace	99.89% 100% 99.16% 99.0% 99.84% 99.51%
4	R, Khedgaonkar, et al [12]	10.1 Introduction.	Rhinoplasty Lip augmentation	CNN	99.09% 100%
5	T. Sabharwal, et al [13]	Deep facial recognition after medical alterations	local surgery global surgery	Deep forward neural network	97.89% 98.24%
6	R. Bansal, et al [14]	A Deep Learning Approach to Recognize Telugu Handwritten Numerals	IIITD-Plastic surgery	CNN	100%

The suggested method of T. Sabharwal, et al. (2022) employs a deep forward neural network to recognize surgically changed faces. The novelty is found in updating the weight during back-propagation, resulting in improved computational difficulty, and therefore less education reveals the effect of vital facial features necessary for identification. Rank recognition rates (RR) were empirically obtained from bootstrapping experimenting with a 95% face cosmetic surgery confidence level data set. The obtained RR values are 97.89% and 98.24% for global. This data set is unbalanced with unbiased measures (Unbiased RR and MSE (mean square error) measures (F and R score (The regression coefficients)) are also investigated. The obtained recognition outcomes

align with existing deep models that are computationally demanding and require a substantial amount of processing power [13].

R. Bansal, et al. (2022) this paper present a method with minimal computational requirements and the least time complexity for identifying and recognizing surgically altered faces. The recognition is done by entering a simple CNN to extract facial features, followed by a classification task. Over plastic surgery photos, results on a neural network for facial identification with a training accuracy of 100% percent and a validation accuracy of 82% percent were obtained [14].
The discussion shows that deep learning algorithms achieve higher accuracy than the other algorithms used in facial recognition after plastic surgery. The most recent studies have shown that the use of deep learning algorithms Convolutional Nurall Network (CNN) has attained a high accuracy of up to 100% relative to the rest of the algorithms used in other studies. Table 1 shows the details of previous works.

3. Plastic surgery

Corrective plastic surgery procedures offer a thorough and efficient way to enhance facial appearance. It treats and brightens facial skin to make you look youthful. Plastic surgery treatments are helpful for patients with various disorders brought on by excessive structural development of facial features or skin tissues, in addition to treating patients for cosmetic reasons. These treatments alter the skin's texture and facial contours, enhancing the face's appearance. Plastic surgery is becoming more and more common due to the decreased cost and time needed for these procedures. Even general acceptance in society encourages people to get cosmetic plastic surgery. One of the most common facial plastic surgeries is injecting cosmetic fluids.

4. Cosmetic Surgery

A complex combination of internal and external elements across numerous face layers causes aging. Combining cosmetic treatments aimed at different indications of aging often yields better results than utilizing just one therapy. The vast majority of people have become obsessed with finding a magical lamp that would offer them eternal youth and health, and they are hunting for ways to restore it using Botox and fillers. Because of the thicker skin and three-dimensional architecture, filling presents challenges in the brow region. The growing popularity of facial beauty rejuvenation. Cosmetic face rejuvenation primarily aims to restore volume and smooth out facial wrinkles. Botulinum toxin injection Dermal fillers are used for volume enhancement and the treatment of fixed rhytides. The injection regions are depicted in Figure 2. (The facial muscles to be injected and the muscles to be avoided).

Numerous substances enhance appearance, conceal wrinkles and other signs of aging, and create the illusion of youth. Furthermore, taking such actions can alter one's facial characteristics. The most frequent substances used in such injection procedures are:

4.1. Botulinum toxin (Botox)

Botulinum toxin, or Botox, is named after the Latin word "botulus," which means "sausage." It is a bacterial extract that functions at the synapse level [15]. Botulinum neurotoxin, popularly known as Botox or BTX, is a multifunctional medicine. It is routinely used to treat wrinkles, blepharospasm, cervical dystonia, hyperhidrosis, torticollis, and spasmodic dysphonia, among other cosmetic facial issues [16]. Botulinum toxin has long been employed in various medical sectors as a neuromuscular organ-blocking agent. After the Food and Drug Administration (FDA) approved botulinum toxin for cosmetic use in 2002, it quickly became the most well-known cosmetic surgery in the world [17].

4.2. Dermal Fillers

Dermal fillers are a non-surgical approach to improving the volume of the face or the structure of other body parts. It is also a rejuvenating therapy for looking younger. Lipodystrophy treatment is becoming increasingly important [18]. Dermal fillers are becoming increasingly popular as a cosmetic technique for facial rejuvenation. Injections were generally recognized as safe as the number of injections increased, and the rate of multiples increased [19].

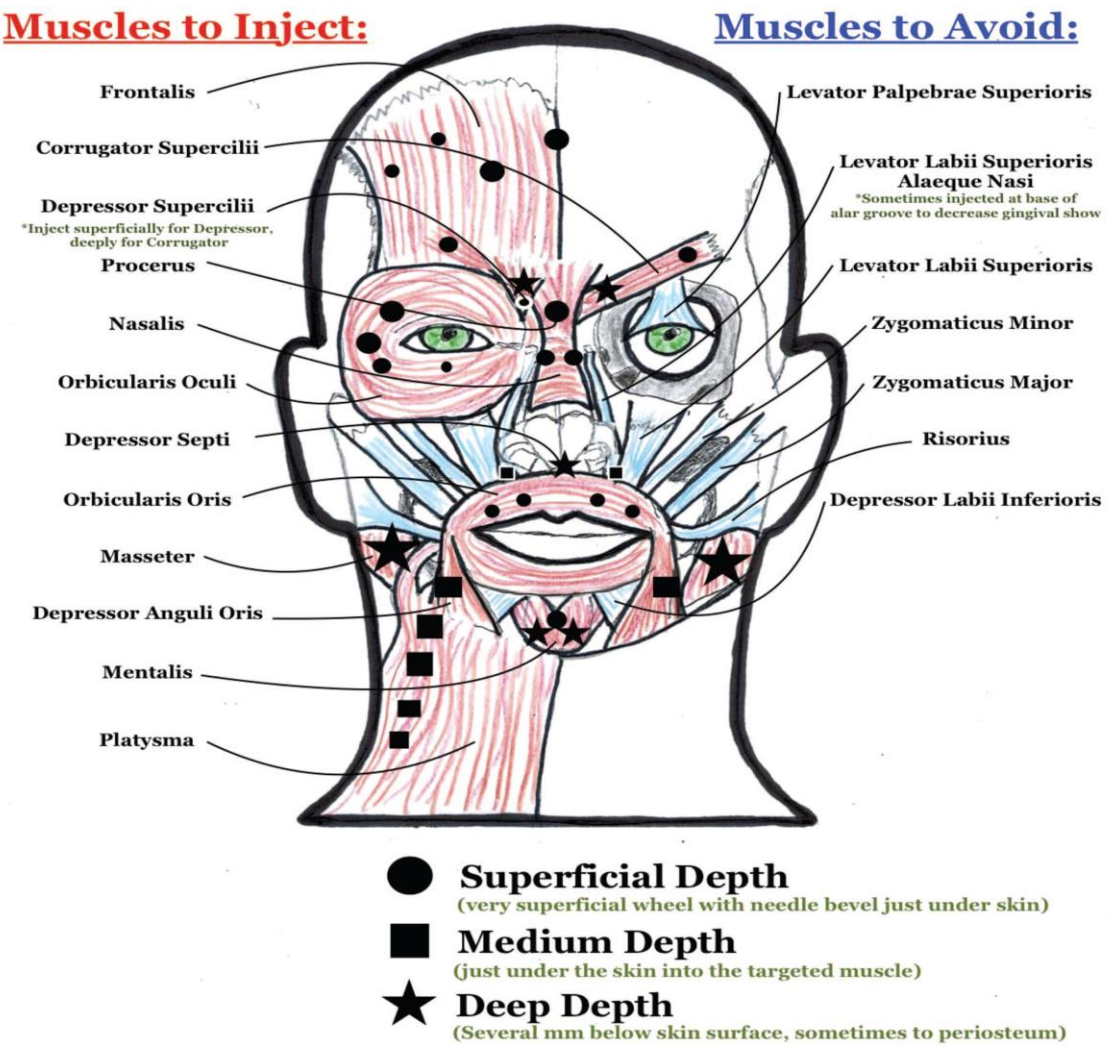

Figure 2. An example of a figure.

5. Conclusion and future work

Plastic surgery has become increasingly popular, particularly facial and non-surgical plastic surgery, which has multiplied its appeal. Statistics indicate that it has been rising over the past few years. Some people have cosmetic surgery for health reasons, while others get it to look younger or to improve their appearance. The treatments present a significant problem for facial recognition systems since they can significantly alter certain parts of the face, changing the look and some fundamental traits. In recent years, deep learning has been utilized to accomplish facial identification after plastic surgery by extracting features, among other emerging technologies and algorithms. It can handle both naturally categorized photos and images that have undergone surgery. In the future, a robust identification system can be created using real-time deep learning algorithms and implement these systems further by merging two deep models to reduce the system's space and time complexities.

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