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RECOGNITION OF SURGICALLY ALTERED FACE IMAGES

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Abstract - *Plastic surgery procedures provide a procuring way to enhance the facial appearance by correcting efficient and feature anomalies and treating facial skin to get a younger look. The effects of change in illumination direction, plastic surgery procedures induce intra face (face image versions of the same person) dissimilarity, which are obstruction to robust face recognition. The most challenging task for face recognition in these application scenarios is the development of robust face recognition systems. In this research, we have designed a multiple granular algorithm to match face images of a person before and after his plastic surgery. A total of 40 face granules are extracted from each of the images and the granules are compared. Based on the comparison of the two images a decision is made.*

Key Words: **Face recognition, Plastic surgery, genetic algorithm, granular computing.**

1.INTRODUCTION

Widespread use of biometrics for person authentication has instigated several techniques for evading identification of a person. One very famous technique is altering facial appearance using surgical procedures that has raised a challenge for the existing face recognition algorithms. The ever increasing popularity of plastic surgery and its effects on automatic face recognition has attracted attention from the research community for security reasons. However, the nonlinear variations derived from plastic surgery remain difficult to be modeled by existing face recognition systems and need to be modified. [1] In this research, we have implemented a multiple level granular algorithm to match the face images of a person before and after plastic surgery. Surgical procedures amend the facial features and skin texture thereby providing a change in the appearance of face. Reduction in time and cost required for these procedures, the popularity of altering the face using plastic surgery is increasing. The widespread acceptability in the society encourages individuals to undergo plastic surgery for cosmetic reasons like nose jobs, skin up lifting, etc.

The multi objective granular algorithm first generates non-disjoint face granules from two levels of granularity. The granular information is processed using a multi objective genetic approach that simultaneously optimizes the selection of feature extractor for each face granule along with Genetic algorithm. [2] On the plastic surgery face database, the proposed algorithm by this approach yields high identification accuracy as compared to existing algorithms and a commercial face recognition system. Face recognition algorithms either use facial information in a holistic way or extract features and process the min parts. In the presence of variations such as change in expressions, pose made for a photograph, difference in illumination, and disguise, it is observed that local facial regions are more resilient and can therefore be used for efficient face recognition.

Face granules are extracted using two different levels of granularity. The first level provides global information at multiple resolutions, i.e. the granules are extracted to account for wrinkles, lines , edges, etc. [3] This is analogous to a human mind processing holistic information for face recognition at varying resolutions. From the discoveries of Campbell, the inner and outer facial information are extracted at these levels. Features local to the face play an important role in face recognition by human mind. Therefore, at the second level, features are extracted from the local facial regions. We have proposed a multi objective evolutionary genetic algorithm is proposed for feature selection and weight optimization for each face granule. [4] The selection of feature extractors allows switching between two feature extractors (SIFT and EUCLBP) and helps in encoding discriminatory information for each face granule. Detailed analysis of the contribution of two granular levels and individual face granules combines the hypothesis that the proposed algorithm combines diverse information from all granules and addresses the nonlinear variations in pre and post surgery images.

2.LITERATURE SURVEY

Himanshu S. Bhatt et.al.,[1] in his research presents a multi objective evolutionary granular computing based algorithm for recognizing faces altered due to plastic surgery procedure, the proposed algorithm starts with generating non-disjoint face granules where each granule represents information at different resolution and sizes. Two feature extractors, namely Extended Uniform Circular Local Binary Pattern (EUCLBP) and Scale Invariant Feature Transform (SIFT) are used for extracting discriminating features from face granules. Later, different responses are unified in an evolutionary manner using a multi objective genetic approach for improved performance

Richa Singh, Mayank Vatsa et.al.,[2] proposed Facial plastic surgery can be reconstructive to correct facial feature anomalies or cosmetic to improve the appearance. The contribution of this research are 1) preparing a face database of many individuals for plastic surgery, and 2) providing an analytical and experimental underpinning of the effect of plastic surgery on algorithm for face recognition. The results on the plastic surgery database suggest that it is an arduous research challenge and the current state-of-art face recognition algorithms cannot provide acceptable level of identification performance. Therefore, it is imperative to initiate a research effort so that future face recognition systems will be able to address this important problem.

Yuri Ostrovsky et.al., [3]A key goal of computer vision researchers is to create automated face recognition systems that can equal, and eventually surpass, human performance. Thus, it is essential that computational researchers extract features from experimental studies of face recognition by humans. These features provide clues that the human visual system depends upon for achieving its essential performance and serve as the building blocks for efforts to artificially imitate these abilities. In this proposed paper, we present what we believe are 40 basic features which are essential for the design of computational systems.

Jianchang Mao et.al.,[4]The primary goal of pattern recognition is supervised or unsupervised classification. Among the various identification process in which pattern recognition has been traditionally formulated, the most commonly studies approach is statistical approach and also used in practice. The design of a recognition system requires careful attention to different issues like definition of pattern classes, sensing environment, pattern representation, feature extraction and selection, cluster analysis, design of classifier and learning, training selection and test samples, and performance evaluation. New and emerging applications of these algorithm are data mining, web searching, accessing of multimedia data, face recognition, and recognition of cursive handwriting. These all application fields require robust and efficient pattern recognition techniques to give accurate and correct results.

M. De Marisco, M. Nappi et.al.,[8]Proposed the use of region-based strategies for addressing the problem of face recognition after plastic surgery. FARO(Face Recognition against Occlusions and Expression Variations) divides the face into relevant regions and code them independently since different region gives different information. FACE(Face Analysis for Commercial Entities) applies a localized version of image correlation index.

F. Li. and H. Wechsler et.al.,[9]This paper advocates robust part-based face recognition using boosting and transduction. The face representation used spans a multi-resolution (golden resolution) grid that captures partial information at different scales in order to accommodate different surveillance scenarios including human identification from distance.

3.METHODOLOGY

This method operates on several granules, where each granule represent different information extracted from a face image. The first level of granularity processes the image with Gaussian and Laplacian operators to assimilate information from multi resolution image pyramids and generate 6 granules. The second level of granularity divides the image into horizontal and vertical face granules of varying size and information content and generate 18 different granules. The third level of granularity extracts discriminating information from local facial regions using golden ratio concept and generate 16 granules. Further, a multi objective evolutionary genetic algorithm is proposed for feature selection and weight optimization for each face granule generated at different level. The evolutionary selection of feature extractor allows option for two feature extractors i.e. SIFT and EUCLBP and helps in encoding discriminatory information for each non-disjoint face granule of the face. The proposed algorithm is based on the observation that human mind recognizes faces by analyzing the relation among different non-disjoint spatial features of face which are extracted at three different granularity levels. Experiments under different observation, including large scale matching, show that the proposed algorithm performs better than existing algorithms including a commercial system while matching surgically altered face images. Also, experiments on different local and global plastic surgery procedures also show that the proposed algorithm consistently performs better than existing algorithms since it does part wise analysis of given image. Detailed analysis of the contribution of three granular levels and individual face granules confirm the assumption

that the proposed algorithm unites different information from all granules to address the nonlinear variations in pre-surgery and post-surgery images.

4.SYSTEM BLOCK DIAGRAM

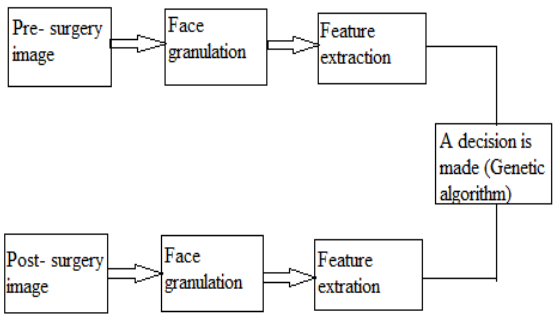

Fig -1 : Block diagram

5.SYSTEM WORKFLOW

1. Take image of face.
2. Pre-processing the image i.e. resize, reshape.
3. Enhancing the image.
4. From the image generate face granules, each granule represents different information.
5. We then use feature extractors i.e. LBP(local binary pattern) & SIFT(scale invariant feature transform)
6. Features of the real image and plastic surgery image are compared.
7. Weight optimization is done.
8. Decision is made.

6.FACE IMAGE GRANULATION

F is the detected frontal face image of size n × m. Face granules are produced pertaining to two levels of granularity. The first level provides global information at multiple resolutions. This is equivalent to a human mind processing holistic information for face recognition at different resolutions. Inner and outer facial information are extracted at the second level. Local facial features play an very important role in face recognition by human mind.

6.1.FIRST LEVEL OF GRANULARITY

In the first level, face granules are generated by applying the Laplacian and Gaussian operators. The Gaussian operator generates a sequence of low pass filtered images by iteratively convolving each of the constituent images with a 2D Gaussian kernel. Granules generated by Gaussian and Laplacian operators are represented by Fig 3 ad Fig 2 respectively.

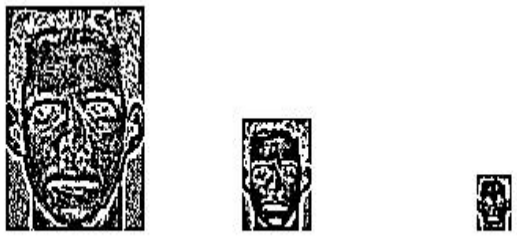

Fig -2 : Output of laplacian operator

Fig - 3 : Output of Gaussian operator

6.2.SECOND LEVEL OF GRANULARITY

To fit in with the observations of Campbell horizontal and vertical granules are generated by dividing the face image F into different regions. The second level of granularity provides toughness to variations in inner and outer facial regions. It utilizes the relation between horizontal and vertical granules to address the variations in chin, forehead, ears, and cheeks caused due to plastic surgery procedures. The granules generated by this level is shown in Fig 4 & 5.

Fig - 4 : Horizontal face granules

Fig -5 : Vertical face granules

7.FEATURE EXTRACTION

(EUCLBP/LBP) or Extended Uniform Circular Local Binary Pattern is a texture based descriptor that encodes exact gray-level differences along with difference of sign between neighboring pixels. The LBP descriptor is computed based on the 8 neighboring pixels for each local patch and is uniformly sampled on a circle (radius=2) centered at the current pixel. The image signature is constituted in a series of interconnected descriptors from each local patch. Two LBP descriptors are matched using the weighted $\chi 2$ distance.

(SIFT) or Scale Invariant Feature Transform : SIFT is a rotation invariant and a scale descriptor that generates a compact representation of an image based on the magnitude, orientation, and spatial vicinity of image gradients. SIFT, is a scanty descriptor that is computed around the detected interest points. However, SIFT can also be used in a dense manner where the descriptor is calculated around pre-defined interest points. SIFT descriptors computed at the sampled regions are then concatenated to form the image signature. Similar to EUCLBP, weighted $\chi 2$ distance is used to compare two SIFT descriptors.

PSO i.e. Particle Swarm Optimization is another method that can be applied in multi objective problems. The efficiency of this method is greater than that of SIFT and LBP when used individually. But when SIFT and LBP methods are combined together in computing a problem it gives more accuracy as compared PSO.

8.GENETIC ALGORITHM

A genetic algorithm (GA) is a method for solving both constrained and unconstrained optimization problems based on a natural selection process that mimics biological evolution. The algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm randomly selects individuals from the current population and uses them as parents to produce the children for the next generation. Over successive generations, the population "evolves" toward an optimal solution.

A chromosome is a string, the length of which is equal to the number of tessellated facial regions. Each unit in the chromosome is a real valued number associated with the corresponding weight of the facial region. Genetic algorithm assigns weights for each facial region and also removes redundant regions that do not contribute towards recognition. The descriptors extracted from the post-surgery image with stored features of pre-surgery images are compared by measuring Euclidean distance.

9.RESULT

This algorithm is a multi objective evolutionary granular computing based algorithm for recognizing faces altered due to plastic surgery procedures. It recognizes surgically altered face images which helps to study the face transformation of a person and to match original image with surgically altered images. Based on the results produced by genetic algorithm the result is displayed in the command window of Matlab in a text format as “MATCHED” if maximum number of features are matched and the result is displayed as “UNMATCHED” if very few features are matched.

10.APPLICATION

- Recognizing high profile criminals.
- Safety systems in banks.
- Military purposes.
- Face recognition systems in security vaults.

11.CONCLUSION

Detailed analysis of the contribution of two granular levels and individual face granules corroborates the hypothesis that the proposed algorithm unites the diverse information from all granules to address the nonlinear variations in pre- and post-surgery images. Other

algorithms has many disadvantages which can be overcome using proposed algorithm. Feature extraction using Gabor wavelet technique has problem issues of high dimension and high redundancy while it has maximum variance if features. Features extracted using only LBP produces long histograms, which slows down the recognition speed especially on large-scale face database. Using the proposed algorithm i.e. EUCLBP & SIFT features extracted are fast, discriminating, rotation invariant and robust to changes in gray level intensity due to illumination. The accuracy of this multi objective algorithm is 70%. The proposed algorithm thus outperforms the existing algorithm by 6.11%.

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