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SKETCHING OF FACES USING ML TECHNIQUES

An Analytical Survey

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Abstract —*In this paper, the study of the face composite system is represented. The face composite system is the system of making a sketch from the description of witness in a face frame by combining various facial parts. For years, sketching of faces was done manually. After the evolution of technology some computer generated sketching systems were developed. In this paper, the review of the different techniques used to generate sketches is presented. The review suggests that computer generated face composite systems can be very efficient and can potentially replace manual systems. Also, matching these generated sketches with digital images is a very important law enforcement application. The paper contains techniques to match generated sketches to digital images.*

Keywords*-Facial Composite System, Mugshot Matching, Genetic Algorithm, Eigen Faces*

I. INTRODUCTION

A police investigation of the place in which a crime has occurred or the perpetrators of crime, may lead to many different evidences related to crime. The person specific evidence left unintentionally at a crime scene such as fingerprint, DNA, etc can be sometimes invaluable for identification. In majority of the crime scene no information regarding the suspect is available as such. In such cases the police department often considers the statements of witness and victims for construction of facial composite of people they have seen committing a crime in case any.

In such situation, specially trained forensic sketch artist based on verbal description given by the eyewitness of the crime or victim helps to draw sketches that are also known as forensic sketches which might resemble the criminals. But due to lack of memory the sketches that are constructed by forensic artist based on statements of eyewitness or victims hardly convey the original face. This slow and tedious hand drawn method of drawing sketches is useful and might help in catching criminals but it is not that effective.

Based on the review the manual system should be replaced by, face composite systems based on the software to make it more effective. This Facial composite tool can be easily used in criminal investigation to identify the suspect of a crime. Software generated composites are created using menu driven software kits based on description provided by witness. In most composite software, operator selects from a set of facial components to create a face[6]. Henceforth the sketches drawn are made public with the help of media hoping that someone will recognize the suspect and provide information's leading to arrest.

II. RELATED WORK

In Soňa Duchovičová, Barbora Zahradníková, Peter Schreiber[3] author described the early stages of the research in the field of evolving a facial composite, primarily face detection and facial features extraction. Author discussed about face feature extraction performed on the normalized face to extract the salient information. To simplify the process and to shorten the processing time author presented automated face detection (Key feature points landmarking). They also suggested that the key point features provide a more accurate and consistent representation with lower complexity for facial feature extraction.

Barbora Zahradnikova, Zuzana Sutova and Peter Schreiber[4] presented comparison of three holistic different methods of making facial composites by conducting an experiment with the help of 22 participants. First method was interactive genetic algorithm automatically counting fitness function values (IGAFF) in which the user was supposed to choose one individual most resembling the searched face, the other faces are assigned fitness function based on the RMSE(Root Mean Square Error) and Roulette wheel was used as a selection mechanism for parents to be bred. Second method was Interactive genetic algorithm manually evaluated by user(IGA) in which the individual faces were evaluated as "best", "good", "not selected". Except best , other faces were muted and then copied to the new generation set of faces while best was directly considered into the set. The third method was interactive differential evolution in which the user is supposed to select one individual most resembling the target. This individual is directly copied to the next generation, the other faces are its muted copies. Here only one individual per generation becomes a parent for the offspring. Result discussed was based on the factors like construction time, usability and generation.

N K Bansode and P K Sinha[7] has presented the experiment for face sketch generation based on evolutionary genetic algorithm. The genetic algorithm is a search and optimization technique based on Darwin's principal of the "survival of the fittest". The face is described using facial feature description such as gender, age and shape. The facial features are captured through the graphical user interface. Genetic algorithm works on the population of face and evolves through several generations. In each generation, the faces with higher fitness value retained and the faces with the lower fitness value are removed. Thus, genetic algorithm iterates through the several generation until the desired face is generated.
Christopher J. Solomon, Stuart J. Gibson, Joseph J. Mist[10] presented the elements of the EFIT-V system. They constructed a statistical appearance model of human facial appearance and employed an interactive evolutionary algorithm to enable witnesses to crimes to create the facial appearance of a suspect. In this system, the witness is only required to make simple decisions in response to the facial stimuli. They also suggested that there appears to be scope for continued research into more effective and efficient search methods. In particular, preliminary work suggests that there may be considerable potential for faster attainment of the target identity by using explicitly rejected faces to weight the search space. Their generated composites using the system exhibited near photo-realistic quality.
The basic face recognition systems typically use image-based queries to solve identification problems. The input to the system is a digital image of a face to be identified, which the system then attempts to match to images of known individuals in the database. A new recognition-based facial composite system composed by Hussein Hamdi AL-Fiadh[12] using genetic algorithm coined as Genetic-based Facial Composite System (GFCS) is formed. This system consists of two main activities, i.e. preparing database and reconstructing facial composite image. The first activity involves extraction of face parts from the face images in the database whereas second activity involves reconstruction of facial-composite image. To partition the face image into its parts, two methods are used. The first method use feature annotations for extracting the face parts while the second method extracts the face parts directly by enclosing each face part with rectangle. Unlike previous works on facial composite systems, in GFCS the user has to rate each facial part instead of the whole image. In addition to the crossover adaptation, GFCS also incorporate self-adaptive mechanisms for selecting rates of mutation.

III. METHODS

3.1. Genetic algorithm

The genetic algorithm gives a software solution providing witness with a series of images depicting a whole face instead of individual features. Evolutionary algorithms are used in the programs to generate such images. Based on the population replacement strategy, there are two kinds of GAs : The generational GA (GGA) and the steady state GA (SSGA). In the GGA, the whole population is replaced at each generation. In the SSGA, only a few individuals (or none) are replaced at a time.
A population simply means a set of chromosomes . Here, each chromosome represents a possible solution of the algorithm. Chromosomes consist of numeric values called "genes". After the generation of the initial population randomly, the chromosomes in the population undergo an iterative evolutionary process. After each iteration, the initial population is replaced by the final mating pool. If the population is of size N and chromosome of length n:

3.1.1. Selection. In the GGA, the tournament selection method is applied. N chromosome pairs are selected randomly from the parent population. The chromosome with the highest fitness value enters the mating pool. The ith and (i+1)th chromosomes in the mating pool become pairs, which will proceed to the cross-over operation. In the SSGA only one random pair is selected for the cross-over operation.

3.1.2. Crossover. The crossover is almost identical in both GAs. For each pair, two points are selected randomly in the range [0, n]. Every gene between these points is exchanged between the parent chromosomes with probability PC. In the GGA, N offspring are formed after the crossover operation. In the SSGA only one offspring is generated.

3.1.3. Mutation. The gene values of each offspring chromosome are changed with the probability PM. In both algorithms the Gaussian mutation technique is used : A random variable drawn from a normal distribution with mean 0 and standard deviation (step size) σ is added to each gene value: $x'i = xi + Ni(0, 0.1)$, $i \in \{1,...,n\}$. If the new gene value exceeds the boundary values, the mirroring method is applied.

3.1.4. Replacement
The previous population is replaced by the offspring. In the GGA the offspring replace the parents. In the SSGA, if the offspring's fitness value is greater than one of its parents, that parent is replaced by the offspring. In the case of replacement with elitism, the most fit chromosome of the parent population replaces the least fit chromosome of the offspring.
Third-order headings, as in this paragraph, are discouraged. However, if you must use them, use 10-point Times, boldface, initially capitalized, flush left, preceded by one blank line, followed by a period and your text on the same line.

3.2. Eigenfaces method

Eigenfaces method is used for face recognition. The basis of the eigenfaces method is the Principal Component Analysis (PCA). The Principal Component Analysis is a method of projection to a subspace and is widely used in pattern recognition. An objective of PCA is the replacement of correlated vectors of large dimensions with the uncorrelated

vectors of smaller dimensions. Another objective is to calculate a basis for the data set. Main advantages of the PCA are its low sensitivity to noise, the reduction of the requirements of the memory and the capacity, and the increase in the efficiency due to the operation in a space of smaller dimensions. The strategy of the Eigenfaces method consists of extracting the characteristic features on the face and representing the face in question as a linear combination of the so called 'eigenfaces' obtained from the feature extraction process. The principal components of the faces in the training set are calculated. Recognition is achieved using the projection of the face into the space formed by the eigenfaces. A comparison on the basis of the Euclidian distance of the eigenvectors of the eigenfaces and the eigenface of the image under question is made. If this distance is small enough, the person is identified. On the other hand, if the distance is too large, the image is regarded as one that belongs to an individual for which the system has to be trained.

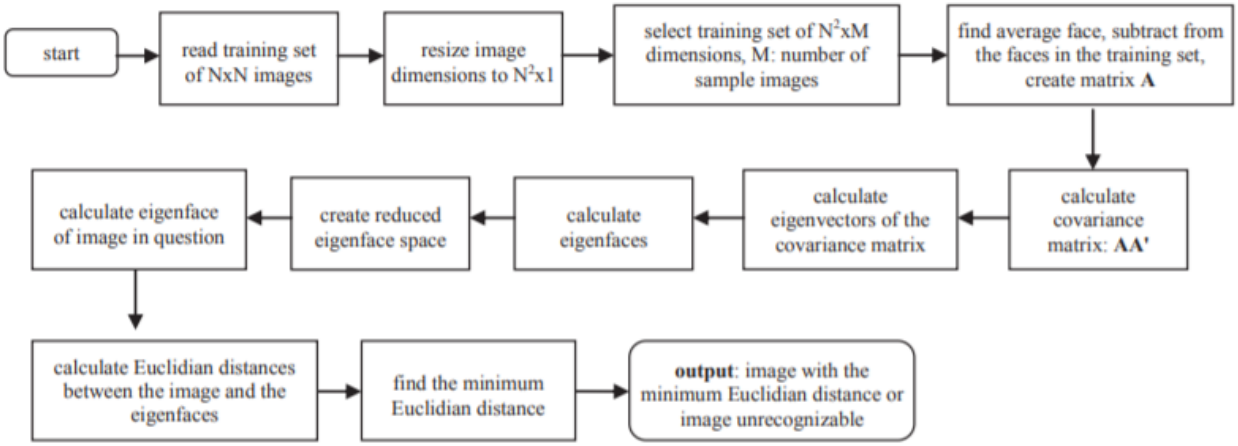

Figure 1. Eigenfaces method algorithm

3.3. Holistic approach

The Holistic approach is used to identify faces at different perspective variations. First of all this algorithm is detect location of eyes which is given as input. After detecting eye locations, the facial composite is normalized to a fixed height and width and transformed such that right and left eyes are at the same position for every composite. The center-surround divisive normalization filter is then applied to the composite to compensate for the differences related to the change in modality between composite and mug shot. CSDN filter results in the best matching performance for composites. The resulting reduction in complexity is increases the speed of an algorithm. A diagram of the holistic algorithm is given below.

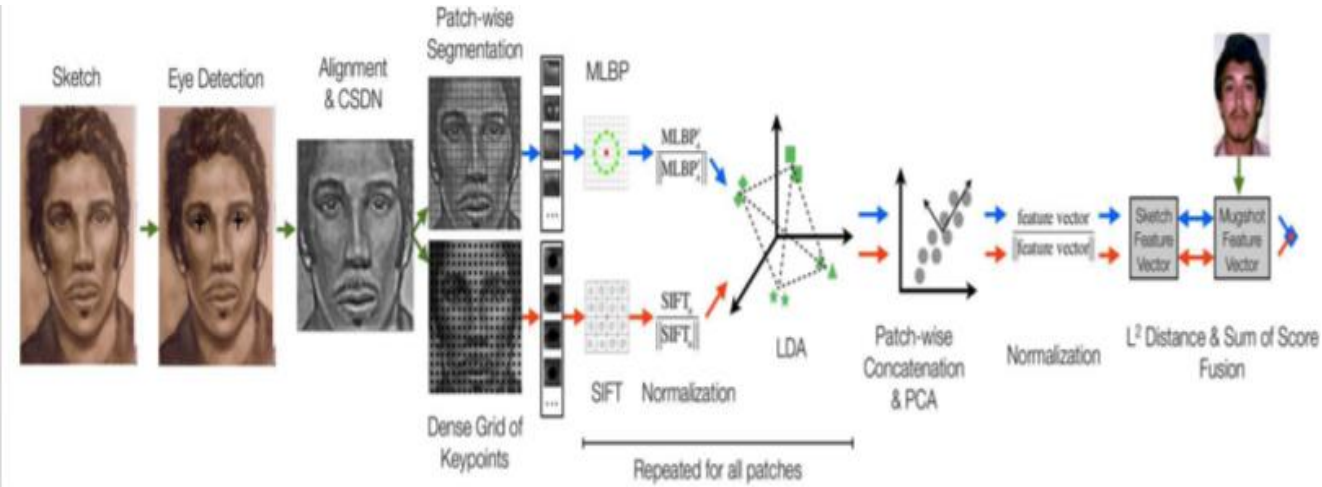

Figure 2. Holistic approach algorithm[6]

IV. CONCLUSION

Identification of criminals using Forensic sketches drawn manually is the current method that is been into practice. The ongoing research on Facial Composite sketch tools will definitely to take its place in future. This survey paper throws light on the methods like Genetic Algorithm, Eigen Faces and Holistic Approach, that can be used to create facial composite tools. Instead of forcing witnesses to construct likenesses from individual features we can use Holistic Approach for constructing faces. Also, the genetic algorithm provides witness with a series of images depicting a whole face instead of individual features. While Eigenfaces method based on the Principal Component Analysis is used for face

recognition. From the above survey we conclude that Genetic Algorithm is more appropriate than other methods but further research is required to generate the highest quality and accurate sketch of the target face.

V. REFERENCES

[1] N K Bansode and P K Sinha, "Face Sketch Generation: A Survey", International Journal of Computer Trends and Technology (IJCTT) – volume 30 Number 1 – December 2015.
[2] Reshma C Mohan1, M. Jayamohan2 and Arya Raj S3, "A Survey on Face-Sketch Matching Techniques", International Journal of Modern Trends in Engineering and Research. ISSN NO: 2393-8161.
[3] Ing. Soňa Duchovičová, Ing. Barbora Zahradníková, doc. Ing. Peter Schreiber CSc., "Facial Composite System Using Real Facial Features", The Journal of Slovak University of Technology, Volume 22, Issue 35, 2014.
[4] Barbora Zahradnikova, Zuzana Sutova, Peter Schreiber, "Interactive Evolution of Facial Composites", 20th IFAC World Congress, Volume 50, Issue 1, July 2017, Pages 11776-11781. Slovakia.
[5] Deborah Davis and Elizabeth F. Loftus, "Eyewitness Science in the 21st Century What Do We Know and Where Do We Go from Here?" Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience, Fourth Edition, edited by John T. Wixted. DOI: 10.1002/9781119170174.epcn116
[6] Chippy Thomas and Dr. D. Loganathan, "Enhanced Holistic and Component Based Algorithm for Sketch to Photo Matching in Criminal Investigations", International Journal of Computer Science and Information Technologies, Vol. 7 (3), 2016, 1267-1272. ISSN NO: 0975-9646.
[7] N K Bansode and P K Sinha , "Face sketch generation using evolutionary computing", International Journal on Soft Computing (IJSC) Vol.7, No. 4, November 2016. Pune.
[8] Stuart Gibson, Alvaro Pallares Bejarano, and Christopher Solomon, "Synthesis of Photographic Quality Facial Composites using Evolutionary Algorithms", School of Physical Sciences University of Kent, UK, 2003 DOI:10.5244/C.17.23.
[9] Kokila R, Sannidhan M S and Abhir Bhandary, "A Study and Analysis of Various Techniques to Match Sketches to Mugshot Photos", International Conference on Inventive Communication and Computational Technologies (ICICCT 2017). pp. 1458-1464.
[10] Christopher J. Solomon, Stuart J. Gibson, and Joseph J. Mist, "Interactive evolutionary generation of facial composites for locating suspects in criminal investigations", School of Physical Sciences, Ingram Building, University of Kent, Canterbury, United Kingdom 3298-3306.
[11] Charlie Frowd and Gemma Hepton , (2009), "The benefit of hair for the construction of facial composite images", The British Journal of Forensic Practice, Vol. 11 Iss 4 pp. 15 – 26.
[12] Hussein Hamdi AL-Fiadh , "Facial Composite System Using Genetic Algorithm" , Department of Computers, Sciences College University of Baghdad.

