

A SURVEY ON FORENSIC SKETCH MATCHING

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ABSTRACT

Biometrics is one of the unique ways of identifying a person by the physiological features in the human body. Various biometric techniques includes features in the human body like the facial, iris, gestures, fingerprint, gene, key stroke biometrics, etc. In the facial recognition many algorithms are explored highly with various different orientations. The facial matching framework accepts the input as faces and the outputs the recognized faces from the image database. The objective of forensic sketch matching is the mapping between the image databases with the sketches. Since the information obtained from the victims is almost inadequate the mapping is very complicated. The selection of the features and modeling them for matching without any human intervention is still a challenging task. This paper gives a survey on the various sketch matching techniques that are used in the face matching and recognition. The complexity in forensic sketch matching is analyzed and a new model based on the neural network is proposed to automate the forensic sketch matching system.

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KEY WORDS

Biometrics; Forensic sketch;
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INTRODUCTION

Biometrics is a technique for identifying a person based on the physiological features of the human body. Some of the biometric techniques include fingerprint recognition, facial recognition, iris recognition, key stroke biometrics, signature, voice recognition, hand geometry, DNA. Numerous algorithms are available for face recognition and matching the faces. Various faces are identified automatically by the algorithms. The finger print is also an important feature to uniquely identify the persons. The advantage of finger print biometrics is in the case of twins the face resembles but the finger print of the twins cannot be same. In the forensics finger print plays a major role to identify the suspect easily. But in the forensic images it is impossible to depict the finger print by the artist from a victim. This also applies to the iris recognition where the iris pattern of the human is identified and recognized. In the case of the forensic matching the mapping is to be performed with the facial image and a sketch. So it leads to the development of various face matching algorithms with the forensic sketch and original image. Even the suspect can be identified by the voices, but sometimes it can be duplicated by the hackers. In the DNA a gene matching is done for identifying the suspect. In the key stroke biometrics the key press events of the users are identified and matched. It is useful in detecting uneven access by the fraudulent in the login pages. In forensics the Key stroke and gene plays a lesser role. But the finger print and facial features plays a vital role in identifying the suspect in a crime scene. The major motivation behind this paper is in all the existing models a manual inspection is needed to confirm the criminals. So it is very much necessary for an automated system without human intervention to identify and arrest the criminals before they commit the next assassination.

OUTLINE OF FACE MATCHING AND SKETCH MATCHING

Categories of face matching

Many face matching algorithms are proposed to uniquely identify and recognize the faces. The facial point's distances are collected from the face image and they are mapped with the input image for identifying the faces. Also researchers have explored various face detection algorithms with different categories. **Figure- 1** shows the various categories given below. It includes face recognition with multiple orientations like straight pose, side pose, with and without spectacles, under various face expressions (mouth open, mouth closed, mouth opened with teeth) and photos

under various illuminations. Also varieties of researches are going with the images under age variations which become a massive challenge.



Fig: 1. Various ways for face detection

Overview of forensics and sketches

Face matching is a difficult process as it is taken from various sources under various conditions. The sources of image are from surveillance cameras, social networks, and mobile cameras etc which are captured under different conditions. There must be a source to capture the images for the further process. But difficulties arise if there are no image capture sources. It becomes a big challenge for the police to find out the suspect without an image. So to identify the suspect the police identify the people in the crime environment and ask for the information about the person for the further investigation.

Forensic is a logical technique for collecting and analyzing the information about the crime in the earlier period. The aim is to detect the crime and identify the suspect based in the information collected. After collecting the information a sketch is drawn named forensic sketches. Sketches can be categorized into two types one is viewed sketches and another is forensic sketches. As for as viewed sketches in considered the sketch is drawn by viewing the photos of the particular person. So a qualified artist is needed to draw the face of the person. Also the task is not much complex as the photo of the person is available [13].

In the next case of the forensic sketches the information about the person is not available with the artist. All the information are to be collected by the people in the surrounding area where the incident has turn out. So the artist sits along with the people who were on the spot and analyses about the various facial features and draw the sketches. This seems to be complex problems where the image of suspect drawn will not be exactly matching. Many forensic artists are specialized in drawing the forensic sketches [3].

In the case of the forensic sketches certain methodology are to be followed strictly like more preprocessing techniques cannot be applied. The reason behind this is the people in the spot can remember more of the external features of the face than the internal features. External features include hair style, race, color, age factor, gender etc. Internal features are rarely identified. A high preprocessing may leave most of the external features. So a novel preprocessing method is always necessary during the process of forensic sketches. **Figure– 2** shows the steps in the forensic sketch matching for face matching [13].

OVERVIEW OF SKETCH MATCHING TECHNIQUES

There are various techniques available with face sketch recognition. The various images of a single person are combined into a single image and a model is created based on the combination to enhance the matching of the forensic sketches. Even though this method provides an acceptable result a human analysis is needed to pin point the final suspect [1]. The meaningful information from the facial attributes are obtained and cross modeled architecture was created, it works with caricature sketches but still it out performs with forensic sketches [2]. Availability of image data base to for the matching is very less so researchers started to create test set databases with sketches for the matching [4]. The face is converted into a sketch and the matching is performed over the image with the sketches. The comparison with the geometry and the Eigen face methods shows a better performance [5].

Also face photo match retrieval through the sketches are performed by an invariant descriptor called Gabor shape [6]. The features extracted from the viewed face sketches must be spotted in varying illumination, noise and scaling. So researchers has even developed detection using SIFT (Scale Invariant Feature Transform). As for the above said methods the complexity of the problem was not further explored with large set of images [7]. The methodology of converting image into a sketch and vice versa is also performed for the matching of the image. Multi scale markov random fields are used in synthesis and recognition. So a new combined sketch photo model is learned in this method [8].

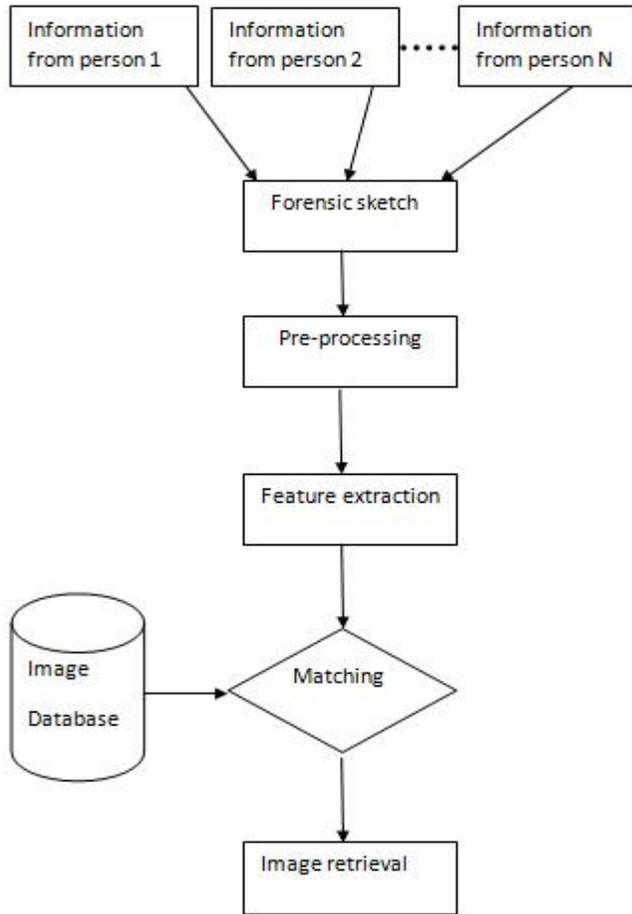


Fig: 2. Steps in forensic sketch matching

The external features of the suspect can easily identify and explained by the people in the spot. Researchers have developed methods to retrieve images using the tattoo. To eliminate the duplicates various metadata were used by the researchers. The system developed is based on unsupervised method. So further extensions can be done in the semi supervised methods and unsupervised methods [9].

In some methodologies a pseudo sketch based on the local linear safeguard of geometry between the photo and sketch images are generated and non discriminate analysis were used in the recognition of the probe sketch. The external feature hair is omitted in this methodology. Also the above said method will not work with different pose, illumination and photos with different conditions [10]. Certain features in the face can be remembered by the humans easily which includes marks in the faces. In order to identify the facial marks researchers have developed various methods using morphological operators. But still the accuracy can be improved with an automatic mark deduction system [11].

The above said methods were performed only for the viewed sketches. Only two large scale experiments were performed till date with the forensic sketches. The first large scale was done by Brendon klare et al for the

forensic sketches. The sketches and photos are distinguished by SIFT and Multi scale local binary patterns image descriptors. Filtering was done by race and gender also the results were compared which shows improvement in the accuracy [13]. The second large scale was performed by Kotha *et al* where the methodology based on Speeded Up Robust Features (SURF). Also an improved preprocessing method was proposed in order to preserve the external features. But the filters were not used for the improvement of the results [14]. At one point of time a human suggestion is needed to identify the images based on the comparison of top N rankings of the images. A fully automated forensic sketch matching is yet to be developed.

PROPOSED ARCHITECTURE

A proposed architecture that using fuzzy and neural network to reduce manual intervention is given in **Figure-3**

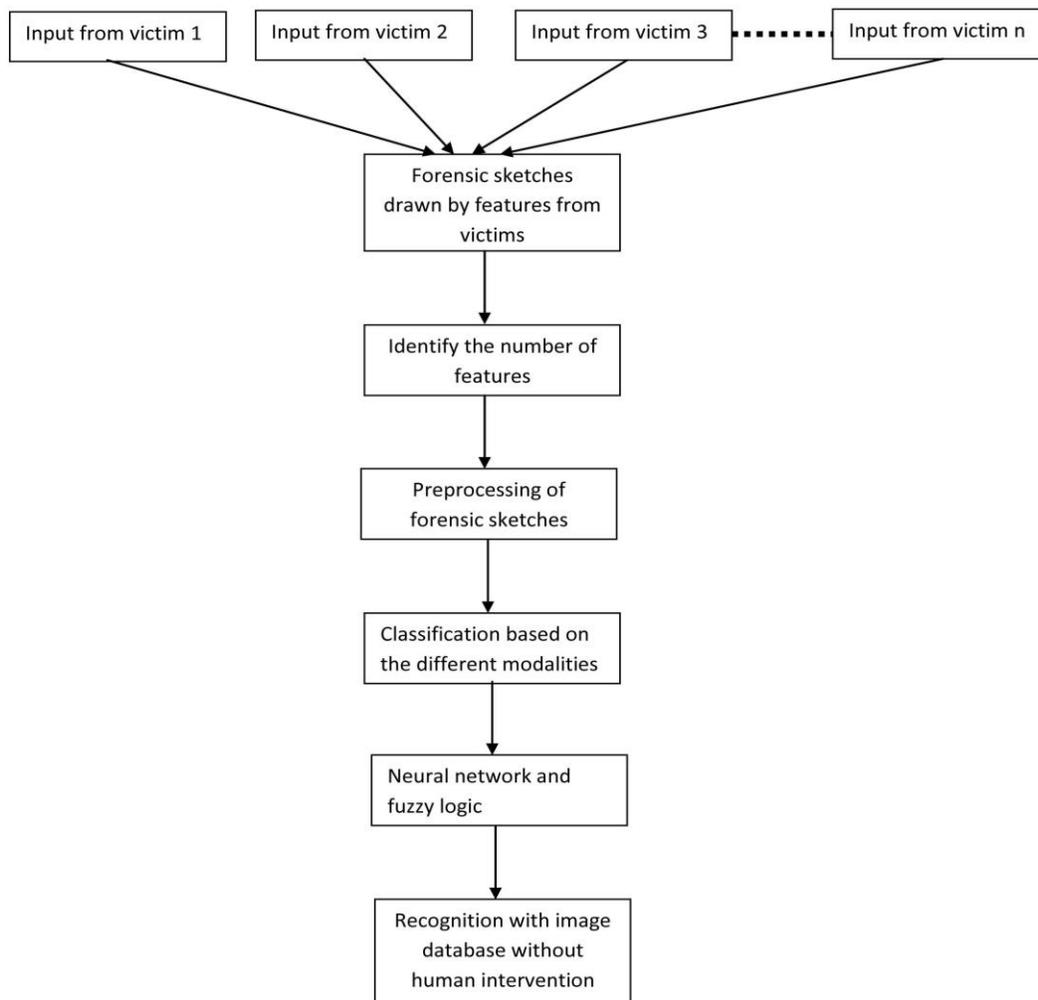


Fig: 3. Using fuzzy and neural network to reduce manual intervention

CONCLUSION

This paper gives a clear picture of all the existing methods and the research gaps in the existing methods. So the new framework will take in account of all the facial attributes with the balance of the neural network an automated forensic sketch facial recognition will give an accurate output. The systems complexities are to be analyzed. But due to the insufficient availability of the database the complexity analysis were not performed at all the cases. The

forensic sketches were not performed over various poses with a higher efficiency. So in future an efficient multi pose forensic sketch recognition must be performed without any human intervention.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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