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Forensic Face Sketch Recognition

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Abstract: *In modern society, the overall crime rate is increasing day by day, and in order to overcome this, law enforcement department must also find ways to speed up the entire process and help bring justice. One such method is to use facial recognition technology to identify the criminal. The traditional approach here is to use a hand-drawn sketch of a face, drawn by forensic artist to identify the criminal. Upgrading it will allow us to identify the criminals using hand-drawn sketches and then matching it with law enforcement databases. This approach is time consuming as there are few forensic artists available compared to the increasing crime ratio which is subject to various limitations with the latest technology and increasing crime rates. Our project provides law enforcement department a standalone platform that allows users to create composite sketches of a suspect's face using the drag-and-drop feature without the aid of forensics, thereby reducing time gaps and speeding up the process. The application automatically matches complex face sketches with police database.*

Keywords: Forensic Face Sketch, Face Sketch Construction, Face Recognition, Criminal Identification, Deep Learning

I. INTRODUCTION

Although face sketches can easily identify and prosecute criminals as described by eyewitnesses, in the modern world, traditional hand sketching methods are not efficient and time-saving when used in a consistent fashion. It identifies from an already available database or real-time database.

Several methods have been proposed in the past to automatically identify and recognize suspects in police databases by converting hand-drawn facial sketches, but they did not yield the exact desired results. Applications for creating synthetic face sketches were also introduced, but various limitations such as a limited set of facial features and the creation of a cartoon-like look of a suspicious face made it much more difficult to use these applications and achieve the desired results and efficiency. This project aims to reduce time gaps and speed up the process by providing law enforcement department with a platform where users can accurately sketch the face of a suspect without the assistance of a forensic artist, without special training or artistic skills.

Several methods have been proposed in the past to automatically identify and recognize suspects in police databases by converting hand-drawn facial sketches, but they did not yield the exact desired results. Applications for creating composite face sketches were also introduced, which had various limitations, such as a limited set of facial features and the creation of a cartoon-like look of a suspicious face, making it much more difficult to use these applications and get best results and efficiency.

The above applications and requirements made us to think about creating an application that not only provides a set of individual features such as eyes, ears, mouth, etc. to choose from to create face sketches, but also allows users to upload individual items, hand drawn features. It is then transformed into a set of application components. This will make the created sketch look much more like a hand-drawn sketch and it will be much easier for law enforcement department to adapt the application.

Our application will allow the law enforcement team to upload previous hand-drawn sketch in order to use the platform to identify and recognize the suspect using the much more efficient deep learning algorithm and cloud infrastructure provided by the application.

The machine learning algorithm would learn from the sketches and the database in order to suggest the user all the relatable facial features that could be used with a single selected feature in order to the decrease the time frame and increase the efficiency of the platform.

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II. LITERATURE REVIEW

There are many studies on the construction and recognition of facial sketches using different approaches. Xiaoou Tang and Xiaogang Wang [1] proposed a method for recognizing synthesized photo sketches using a multiscale Markov random field model. This project could combine a given sketch into a photo or a given photo into a sketch and then search the database for a suitable match. The model divided the sketch of the face into patches. To this end, they improved the overall performance of the recognition model by first synthesizing the available photos into sketches, and then training a model to build the model to reduce the difference between photos and sketches.

Anil K. Jain and Brendan Clare [2] proposed a system using a SIFT descriptor that displays the results based on the measured distance of the SIFT descriptor between the face picture and the sketch in the database. The algorithm first transformed the face picture using a linear transformation based on the model proposed by Tang and Wang, and then used the sketch to measure the distance between the face picture and the SIFT descriptor, and in some cases, for better accuracy, distance between images in databases were also measured.

P.C. Yuen and C.H. Man [3] also proposed a way to find a person's face using sketches. This method converted the sketch to a photo and then matched that photo to a face using some local and global variables declared by the face matching algorithm. However, in some cases, it is difficult for a picture to match a human face in databases such as the FERET database and the Japanese database.

A common problem with all proposed algorithms is that it is easier to match face sketches which are front facing on both drawn sketches and face photograph. If the faces have different orientations, the algorithm is less likely to match faces in the database which are facing forward.

Systems for synthetic facial construction have also been proposed, but most systems have been very complex, using facial features taken from photographs, selecting them by the operator based on eyewitness descriptions, and finally forming a single human face. Let any algorithm match the face of a criminal, let alone a person, each facial feature was taken from a separate photo with a different face and combined together was difficult to recognize.

Akash Sahu, Jyoti Sah, et al. [4] proposed a system which was a standalone application allowing user to construct accurate composite face sketch using the predefined facial feature sets provided as tools that can be resized and repositioned as per requirement/described by the eye-witness. Moreover, the constructed composite face sketch can then be matched with the law enforcement departments database using deep learning and the speed and efficiency of cloud infrastructure to identify and verify the criminal.

Thus, all the previous approaches proved either inefficient or time consuming and complicated. Our application would be able to overcome the limitations and enhance the previous proposed systems.

III. PROPOSED METHOD

3.1 System Flow

The figure shows the overall flow of the system, starting with the login section that provides the two-factor authentication process. You can create face sketches using drag-and-drop functionality. The image is passed to a feature extraction process that helps the application apply image processing. and computer vision algorithms, and finally matching the sketch with the database, and then displaying a similarity ratio between the sketch and photos in the database.

In order to seamlessly transition from current technology tonew platforms, platforms use something called backwards compatibility. The current technique was to form a public consensus by using sketches drawn by forensics experts for many years, and the law enforcement department using them to disclose them on various platforms. To find someone who can identify the suspect. In this way, backward compatibility allows law enforcement agencies to use facial recognition modules and upload these hand-drawn sketches to the platform to match suspicious sketches to larger items, reducing the overall time and effort spent on previous old-age technique.

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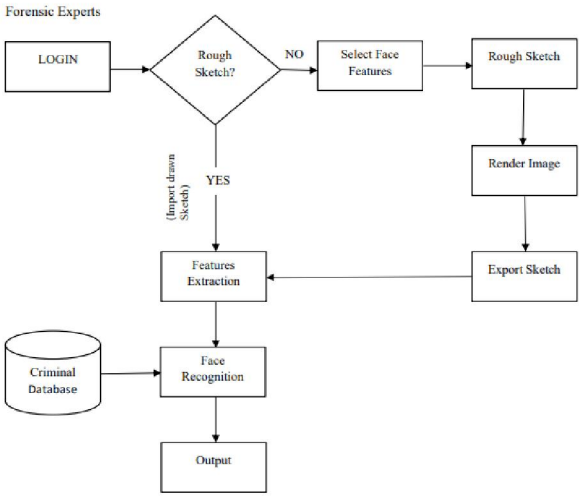

Fig. 1 System flow of Forensic Face Sketch Recognition [4]

3.2 Face Sketch Construction Module

As mentioned earlier, security and accuracy are key features we looked at when developing a law enforcement platform. Therefore, this module of the project mainly aims to create facial sketches based on descriptions provided by eyewitnesses in law enforcement department.

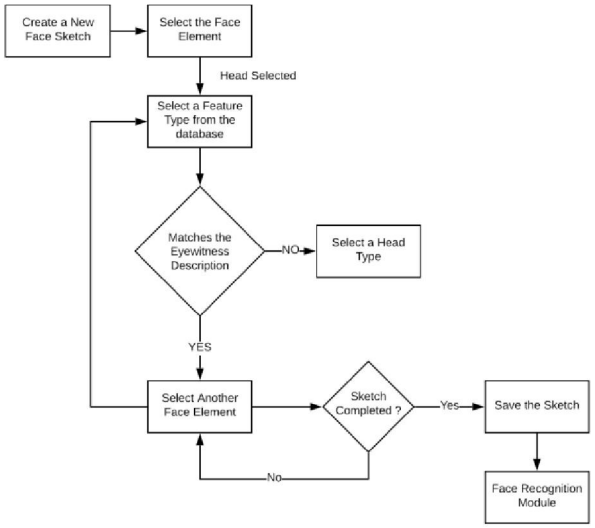

Fig. 2 Flow Chart for Creating a sketch in the application [4]

The flowchart above shows the flow of users followed to ensure that the platform builds accurate facial sketches based on descriptions. The dashboard is designed to save already time-consuming timeframes, designed to make sure no professional learning is required before using this platform and departmental resources.

So, simplicity ensures that users don't have to be professional sketch artists in the forensic department, but they have control over whoever or in some cases anyone in the law enforcement department use the descriptions spoken by the eye witness. However, this is not recommended as it may violate security protocols.

Moving on, the dashboard is organized into five main modules. The first important module is the canvas that appears in the centre of the dashboard, which accommodates face sketch components and face sketch elements to help to draw your face sketch.

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Sketching faces would be a complicated task if all the face elements came together out of order, which would complicate the user's process and make it difficult to build accurate faces, which goes against the agenda of the proposed system. So, to solve this problem, we planned to arrange the face elements based on the face category they belong to, such as head, nose, hair, eyes, etc. This greatly simplifies user interaction with the platform and creation. Drawing a sketch which is available in the left column of the canvas in the dashboard. By clicking on the face category, users can get a variety of different face structures.

To solve this problem, our platform will use machine learning in the future to predict similar facial elements or suggest elements to select, as there can be multiple elements and n elements for one category for different facial elements in a particular face category predict to do. However, this will only work if you have adequate data to work with to train the model on this algorithm and improve the platform.

Now when the user clicks on a specific face category, a new module will open on the right side of the canvas where the user can create a sketch of a face by selecting an item from the Face Items option. This option can be selected based on the explanation provided by the eye witness.

The selected element is displayed on the canvas and can be moved and placed according to the eyewitness description to get more accurate and a better sketch, the element has a fixed position and placement order on the canvas, just like the element of the eye as it appear above the head element, regardless of the order in which they were selected. The same for each element of the face.

The last module is an option to improve the use of the dashboard. Assuming the user is selecting an element that shouldn't be selected, this can be corrected with a feature that clears out certain elements to display when face categories are displayed and selected in the left panel. The main button is on the right panel, there is a button that can completely clear everything on the dashboard canvas, leaving it completely empty.

Then there is a button to save the composed face sketch, which saves the face sketch as a PNG file for easier access later. This can be anywhere on the host computer or server, depending on law enforcement department.

3.3 Face Sketch Recognition Module

As mentioned earlier, security and accuracy are key features we looked at when developing a law enforcement platform. Therefore, this module of the project is mainly aimed at accurate and reliable recognition of facial sketches of law enforcement photos.

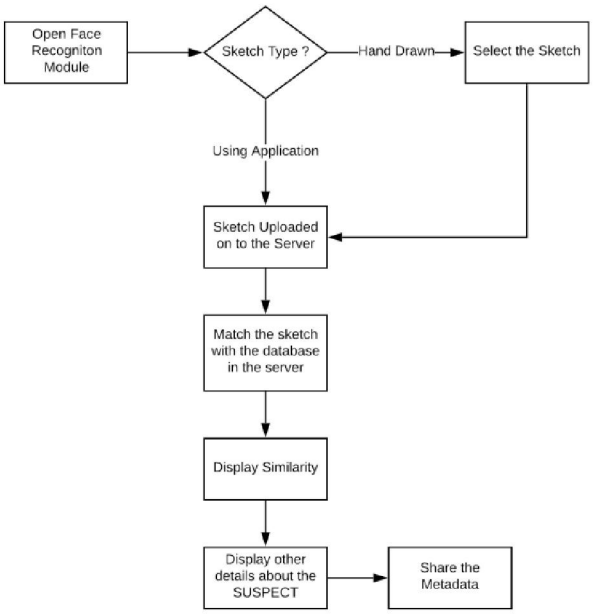

Fig. 3 Flow Chart for Recognizing a sketch in the application [4]

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The flowchart below shows the user's flow through the platform to provide accurate facial sketch recognition as described. The dashboard is designed to be simple to avoid professional training before using this platform, saving time frames and resources that would have already been time consuming for the department.

So, simplicity ensures that users don't have to be professional sketch artists in the forensic department, but they have control over whoever or in some cases anyone in the law enforcement department use the descriptions spoken by the eye witness. However, this is not recommended as it may violate security protocols.

The first part is to train and provide a platform algorithm that recognizes and assigns facial photo IDs from existing records to users prior to using the facial recognition platform to make existing records for law enforcement departments suitable for our platform. To do this, the platform's algorithm connects to the record, divides each face picture into various smaller features, and assigns an ID to the multiple features generated for a single face photo.

Now, a module designed to run on law enforcement servers primarily for security protocols runs the first time a user opens either a hand-drawn face sketch stored on a host computer or a platform-generated face sketch. Face sketch are loaded onto the law enforcement server hosting the recognition module to ensure that the process or recording data is secure and accurate without tampering.

When a sketch is uploaded to the server, the algorithm first learns the features of the sketch by tracking it, then matches the features to match the facial photo features in the record.

If a sketch matches, a face sketch matches an item and a match is found, the platform displays the matching face along with the item's similarity percentage and other details of the person.

IV. CONCLUSION

Our application will allow the law enforcement team to upload previous hand-drawn sketch in order to use the platform to identify and recognize the suspect using the much more efficient deep learning algorithm and cloud infrastructure provided by the application. The machine learning algorithm would learn from the sketches and the database in order to suggest the user all the relatable facial features that could be used with a single selected feature in order to the decrease the time frame and increase the efficiency of the platform. The platform even has features which are different and unique too when compared to related studies on this field, enhancing the overall security and accuracy by standing out among all the related studies and proposed systems in this field.

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REFERENCES

[1]. W. Zhang, X. Wang and X. Tang, "Coupled information-theoretic encoding for face photo-sketch recognition," CVPR 2011, 2011, pp. 513-520, doi: 10.1109/CVPR.2011.5995324. MathWorks “what is deep learning” [2022] (online). Available: https://www.mathworks.com/discovery/deep-learning.html

[2]. Klare, Brendan, and Anil K. Jain. "Sketch-to-photo matching: a feature-based approach." Biometric technology for human identification VII. Vol. 7667. International Society for Optics and Photonics, 2010.

[3]. P. C. Yuen and C. H. Man, "Human Face Image Searching System Using Sketches," in IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans, vol. 37, no. 4, pp. 493-504, July 2007, doi: 10.1109/TSMCA.2007.897588.

[4]. Patil, Abhijit, et al. "Forensic Face Sketch Construction and Recognition." International Journal of Information Technology (IJIT) 6.4 (2020).

[5]. S. Klum, H. Han, A. K. Jain and B. Klare, "Sketch based face recognition: Forensic vs. composite sketches," 2013 International Conference on Biometrics (ICB), 2013, pp. 1-8, doi: 10.1109/ICB.2013.6612993.

[6]. Facial Recognition. Available: https://www.kaspersky.com/resource-center/definitions/what-is-facial-recognition.

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[7]. Applications of Facial Recognition. Available: https://www.facefirst.com/blog/amazing-uses-for-face-recognition-facial-recognition-use-cases/

[8]. Ali, Tauseef, Raymond Veldhuis, and Luuk Spreeuwers. "Forensic face recognition: A survey." Centre for Telematics and Information Technology, University of Twente, Tech. Rep. TR-CTIT-10-40 1 (2010).

[9]. Galea and R. A. Farrugia, "Forensic Face Photo-Sketch Recognition Using a Deep Learning-Based Architecture," in IEEE Signal Processing Letters, vol. 24, no. 11, pp. 1586-1590, Nov. 2017, doi: 10.1109/LSP.2017.2749266.

[10]. Zeinstra, Chris G., Didier Meuwly, A. Cc Ruifrok, R. Nj Veldhuis, and Lieuwe Jan Spreeuwers. "Forensic face recognition as a means to determine strength of evidence." Forensic Sci Rev 30, no. 1 (2018): 21-32.

[11]. Ouyang, Shuxin, et al. "Forgetmenot: Memory-aware forensic facial sketch matching." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2016.

[12]. Aatika Syed, Huda Farhat, Manisha Singh, Tauheed Khan, Vrushali Hadke and Prof. Ritish G. Shrivastav, “Forensic Face Sketch Construction”, in Gis Science Journal, doi:20.18001.GSJ.2022.V9I3.22.3898105.