



Face Sketch Creation and Recognition

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Abstract

Forensic face sketching has long been a cornerstone in criminal investigations, offering a visual representation of suspects based on eyewitness descriptions. This paper provides a comprehensive overview of the historical evolution and intricacies involved in the creation of these sketches, underscoring the challenges posed by time constraints and the necessity for skilled artists proficient in translating verbal descriptions into accurate depictions. In response to these challenges, this research proposes a forward-looking solution that embraces technological advancements. The envisioned solution revolves around the development of a dedicated standalone application tailored for composite sketching. This application will revolutionize the process by introducing intuitive drag-and-drop functionalities, effectively mitigating the reliance on specialized forensic artists. The application autonomously generates composite sketches based on input descriptions, thereby streamlining the investigative process and significantly reducing the time required for suspect identification. Moreover, the application will boast seamless integration with police databases, facilitating automated matching and comparison against a vast repository of existing records. This integration not only enhances efficiency but also opens up avenues for further research, paving the way for continuous improvement and refinement of the sketching and recognition capabilities. In summary, this paper advocates for a paradigm shift in the realm of forensic face sketching through the implementation of an innovative technological solution. By embracing automation and leveraging the capabilities of deep learning, this proposed application aims to revolutionize suspect identification processes, ultimately enhancing the effectiveness of criminal investigations while also serving as a catalyst for ongoing advancements in the field.

Keywords: AWS, Criminal Identification, Cloud Computing, Face Sketch and Construction, Face Recognition

1. Introduction

Forensic face sketching has long been employed by investigatory organizations as a crucial tool in criminal investigations, aiding in suspect identification based on eyewitness or victim descriptions. However, traditional hand-drawn sketches, while effective in capturing facial features, face challenges in terms of accuracy, time consumption, and integration with modern technological advancements. With the advent of digitalization and the need for rapid identification from vast databases, there arises a pressing demand

for innovative approaches to forensic sketching. Historically, forensic sketching traces its origins to the late 19th century when law enforcement agencies began utilizing photographs for suspect identification. Yet, due to the limitations of photograph quality and witness availability, the efficacy of this method was often compromised. Over time, forensic sketching evolved, with skilled artists employing various techniques to translate witness descriptions into visual representations of suspects' facial features and physical characteristics. While



traditional methods of sketching have served as invaluable aids in investigations, the contemporary landscape demands more efficient and technologically-integrated solutions. Recent efforts to automate the identification process through computer generated composite sketches have faced challenges such as limited feature kits and cartoonist outputs, hindering their practical applicability. This research endeavours to address these challenges by proposing a novel application for forensic face sketching. The application aims to bridge the gap between traditional hand-drawn sketches and modern technological advancements by offering a user-friendly platform that allows for the creation of composite sketches with enhanced accuracy and efficiency. By integrating deep learning algorithms and cloud infrastructure, the application streamlines the identification process, enabling law enforcement agencies to match sketches with databases swiftly and effectively. Through this research, we seek to contribute to the advancement of forensic sketching techniques, offering a viable solution that meets the evolving needs of criminal investigations in today's digital age.

2. Literature Review

Forensic face sketch construction and recognition have been subjects of numerous research studies, each exploring various methods and approaches to enhance accuracy and efficiency in criminal investigations. Dr. Charlie Frowd et al. [4]. developed a standalone application for constructing and identifying facial composites, utilizing a novel approach where the victim selects similar faces resembling the suspect. Xiaoou Tang and Xiaogang Wang [1]. proposed a recognition method using a Multiscale Markov Random Field Model to synthesize sketches into photos and vice versa, improving the overall efficiency of the recognition model. Anil K Jain and Brendan Klare [2]. proposed a sketch-to-photo matching method employing SIFT Descriptor, which displayed promising results and accuracy enhancements compared to previous models. P. C. Yuen and C. H. Man [3]. also introduced a method for searching human faces using sketches. This approach involved converting sketches into mug shots and subsequently matching

them with faces using local and global variables specified by face matching algorithms. However, there were instances where matching mug shots with human faces in databases such as FERET Database and Japanese Database posed difficulties. The accuracy of this proposed method in experimental results hovered around 70%, which, while decent, fell short of the required accuracy levels for law enforcement purposes. Common limitations among these approaches include difficulties in matching non-frontal faces and the complexity of combining facial features from separate photographs into a single composite. Our proposed application aims to address these challenges by integrating hand-drawn sketches with modern composite face techniques, bridging the gap between traditional and contemporary methods in forensic face sketching. Through this literature survey, we underscore the importance of ongoing research efforts to refine forensic sketching techniques and highlight the potential of our proposed application to enhance accuracy and efficiency in criminal investigations.

3. Methodology

Our application enables users to generate precise synthetic facial sketches by utilizing a predefined collection of facial features that can be adjusted in size and position according to eyewitness descriptions. It includes various facial components such as the head, eyes, eyebrows, lips, nose, ears, and allows for the incorporation of essential accessories like hats and eyeglasses. Given the paramount importance of security and privacy for investigatory organizations, our application prioritizes these concerns by implementing robust privacy protection and security measures.

3.1. Machine Locking

This technique ensures that once the application is installed on a system, it cannot be tampered with or operated on any other system. It utilizes two locking parameters: one software and one hardware locking parameter. The software parameter includes the HD ID, which is the volume serial of the hard drive with the operating system, while hardware parameter involves the NET ID, which comprises the hardware ID, specifically the MAC address (Figure 1).

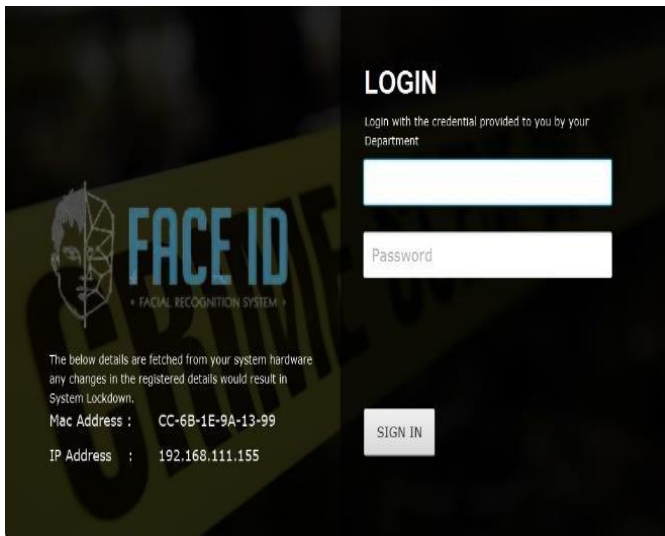


Figure 1 Login Page of the Application

3.2. Two Step Verification

Each authorized law enforcement user will be provided with an official email ID for logging into the application. This login process includes an additional security step where the user must enter a randomly generated code shared with them on their mobile device or desktop to complete the login process. [5]

3.3. Centralized Usage

The application is designed to operate on systems connected to a centralized server located within the law enforcement department's campus. This server houses the database and other essential features of the application. As a result, the application cannot function when disconnected from the server. The system initiates with the login phase, which incorporates a two-step verification process to ensure security. Once authenticated, users can opt to utilize either a hand-drawn sketch or a composite face sketch generated through the drag-and-drop feature. Subsequently, the selected image undergoes a feature extraction procedure, enabling the application to apply advanced image processing and computer vision algorithms. Following feature extraction, the system proceeds to match the sketch against the database of stored photographs. Utilizing sophisticated matching algorithms, it identifies similarities between the sketch and database images. Finally, the system presents users with a comprehensive analysis, displaying the ratio of similarities between the sketch and the corresponding database photograph, as shown in the Figure 2. [6]

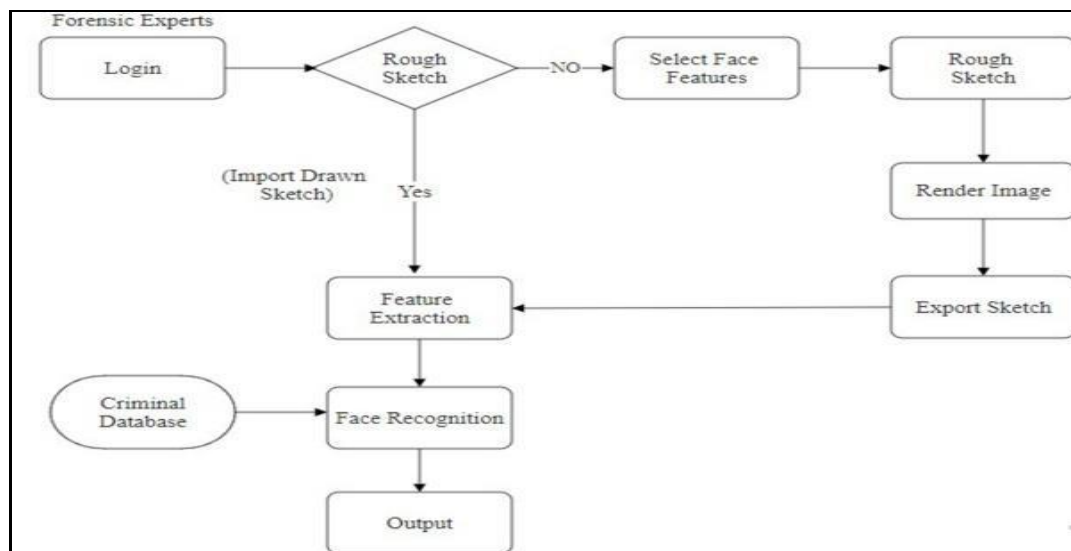


Figure 2 System Flow Chart of the Application

3.4. Face Sketch Construction

Our application facilitates the creation of precise composite face sketches by utilizing predefined sets of facial features, which can be adjusted in size and

position to match eyewitness descriptions. It categorizes facial features such as the head, eyes, eyebrows, lips, nose, ears, along with optional

accessories like hats and glasses, providing users with comprehensive tools for sketch construction. The user flow depicted in the flowchart outlines the sequence of steps undertaken by the platform to generate an accurate facial sketch based on user descriptions. The dashboard interface is intentionally designed with simplicity in mind, ensuring that users, even those without professional training, can navigate the platform effortlessly.

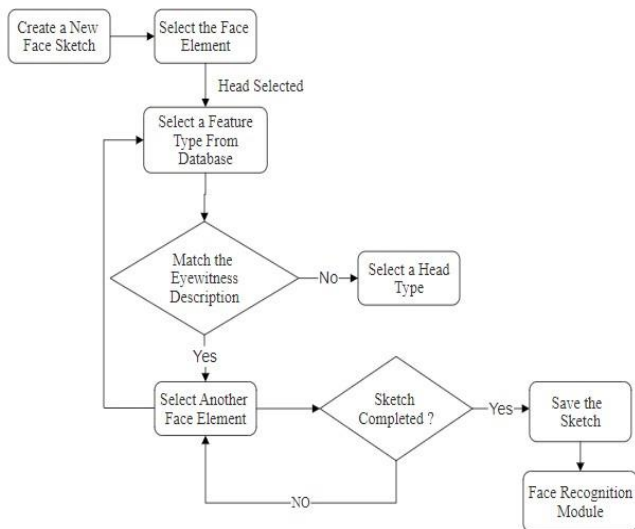


Figure 3 Flow Chart for Creating a Sketch in The Application

This user-friendly design significantly reduces the time and resources required by the department, streamlining the sketch creation process and enhancing overall efficiency (Figure 3 & Figure 4).

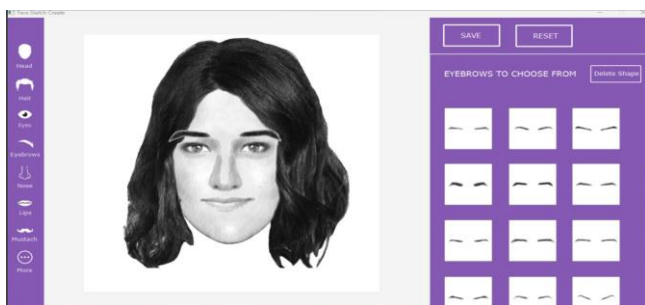


Figure 4 User Interface of Sketch Creation

3.5. Face Sketch Recognition

The following flowchart illustrates the user's journey through the platform to achieve precise facial sketch recognition. The dashboard is intentionally designed

to be user-friendly, eliminating the need for extensive professional training before utilizing the platform. This approach saves valuable time and resources for the department, which would otherwise be consumed in training sessions. Simplicity ensures that users, including those without professional sketching expertise, can effectively utilize the platform to interpret eyewitness descriptions. However, it's essential to note that granting access to untrained individuals within the law enforcement department based solely on eyewitness descriptions may pose security risks and is not recommended (Figure 5).

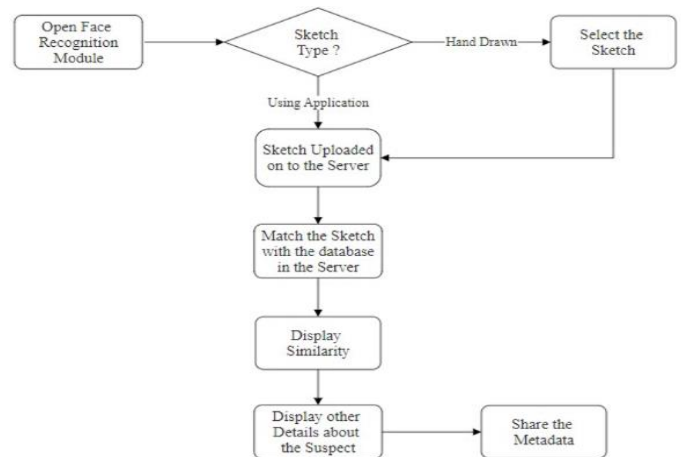


Figure 5 Flow Chart for Recognizing a Sketch in The Application

Conclusion

The project "Forensic Face Sketch Construction and Recognition" has been meticulously designed, developed, and rigorously tested to cater to real-world scenarios, prioritizing security, privacy, and accuracy at every stage. From the initial splash screen to the final data retrieval phase, the platform has been engineered with these key factors in mind. Significantly, the platform has demonstrated exceptional security measures by implementing strict protocols. For instance, it verifies the user's credentials by matching the MAC Address and IP Address during the loading process, effectively blocking unauthorized access. Additionally, the OTP system adds an extra layer of security by preventing the reuse of previously generated OTPs and generating new ones with each page reload or login attempt. 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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