FORENSIC FACE SKETCH CONSTRUCTION AND RECOGNITION

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology

in

Computer Science and Engineering/Information Technology

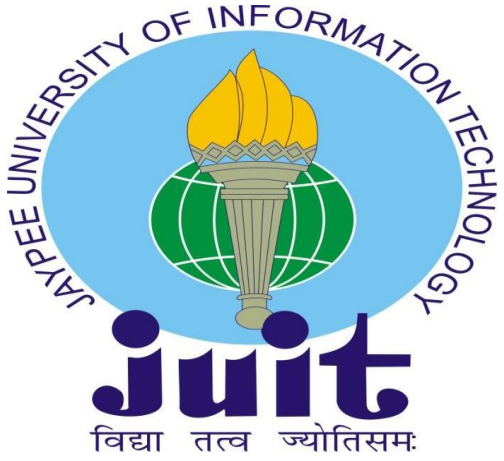
By

Prerna Gupta (191240)

Under the supervision of

Dr. Deepak Gupta

to



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CANDIDATE'S DECLARATION

I hereby declare that the work presented in this report entitled **"Forensic Face Sketch Construction and Recognition"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering/Information Technology** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from August 2022 to May 2023 under the supervision of **Dr. Deepak Gupta** Assistant Professor(SG), CSE.

I also authenticate that I have carried out the above mentioned project work under the proficiency stream **Cloud Computing**. The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Prerna Gupta, 191240

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First and foremost, I want to give God the highest praise and gratitude for His heavenly grace, which made it possible to finish the project work successfully.

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Prerna Gupta
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ABSTRACT

The crime rate has been increasing constantly in contemporary times, so as to keep everything in order, law enforcement agencies must also discover ways to streamline investigations and aid in bringing perpetrators to light. Utilizing face recognition technology is one such approach to trace and corroborate the criminal.

The conventional method in this case was the use of facial sketches drawn by hand created by a forensic artist to identify the perpetrator; however, a more up-to-date method would be to use a sketch that is drawn by hand and then compare it to a law enforcement database. This method would have a number of technological limitations and would take a lot of time because of the fact that there are artists available but forensic sketch ones are few as compared to the increasing crime rate.

The project aims to specifically design to reduce duration of time and increase the speed of the procedure by demonstrating a self-contained platform for the department of law that would help and allow the client as well as users to create facial sketches of an accused's face that are accurate without the help of a forensic artist and without artistic skills or any kind of professional training. Drag and drop in the app will be used for different facial elements to create a sketch and can on its own compare the drawn facial sketch that are composite with the police department records much faster and more efficiently cloud infrastructure as well as deep learning algorithms.

Keyword: Machine locking, face sketch construction, two-factor authentication, face recognition, criminal Identification, deep learning, Forensic face sketch.

CHAPTER 1 : INTRODUCTION

1.1 Introduction

In the digital age, descriptors provided for a facial sketch created with the aid of an eyewitness have made it simpler to identify criminals. However, when it comes to identifying suspects from historical or current databases, the conventional method of hand-drawing sketches is ineffective. Numerous automatic suspect identification and recognition methodologies have been proposed, but none of them has proven to be trustworthy enough to deliver precise results.

Applications for compound facial sketching have been introduced, but some of these are difficult to use because they only offer a small number of facial characteristics and give the constructed culprit's face a cartoonish appearance. Therefore, a system that not only provides a list of specific characteristics but also functions with other devices like eyes, noses, heads, ears, lips, mouths, and so forth, must be developed.

The goal is to create a face sketching platform that allows users to upload each individually designed characteristic that will subsequently be translated into the feature's characteristic set. If implemented, the created sketch would be much closer to the actual facial features, and it would be considerably simpler for law enforcement departments to modify the application for the case of hand drawn sketches.

The proposed system would be able to identify the facial features of an individual in a more accurate and detailed way, which would make the process of identifying a suspect much more efficient and reliable. In addition, the system could be modified to work with different devices,

such as cameras and CCTVs, which would enhance its capabilities and make it more versatile.

However, when designing such a system, there are some difficulties that must be overcome. The accuracy of the features provided by eyewitnesses is one of the major difficulties. The system must be able to account for these variations and generate an accurate sketch based on the available data because eyewitness descriptions can vary greatly in quality.

The privacy and security issues raised by the use of facial recognition technology present another difficulty. The system would need to implement robust security measures to safeguard user data and thwart unauthorized access in order to allay these worries. The system would also have to abide by any applicable laws and rules governing the use of facial recognition technology.

In conclusion, the proposed face sketching platform would be a valuable tool for law enforcement departments in identifying and apprehending suspects. By allowing users to upload individually designed characteristics, the system would produce more accurate and detailed sketches, making the process of identifying a suspect much more efficient and reliable. While there are some challenges that must be addressed, the potential benefits of such a system make it worth exploring further.

The proposed platform aims to revolutionize the way law enforcement departments identify and recognize suspects from hand-drawn sketches. By leveraging cloud infrastructure and deep learning algorithms, the

system can quickly and accurately match the sketches with pre-existing databases or real-time databases.

This platform's capability to let users upload custom facial features is one of its distinctive features. To produce a more accurate facial sketch, these traits are then converted into the characteristic set of a feature. The system will become more effective and efficient as a result of the deep learning algorithm, which will be trained from the resulting sketches and records to suggest which facial traits are most appropriate for a given activity.

Law enforcement agencies will also be able to submit earlier hand drawn sketches to the platform for validation and recognition. This will guarantee faster and more efficient system operation and a more precise identification of suspects.

Overall, the suggested platform represents a significant advancement in the field of facial identification and sketching. The way law enforcement departments operate will be revolutionized by its cutting-edge features, which include cloud infrastructure, deep learning algorithms, and individually designed facial characteristics. This will make it simpler for them to accurately and quickly identify and recognise suspects.

1.2 Problem Statement

The advent of computer vision and machine learning technologies has made it possible to automate the process of creating facial sketches, which can help to speed up the identification and recognition of suspects. This is where a facial sketching platform that incorporates

deep learning algorithms and cloud infrastructure can be of immense value to law enforcement agencies worldwide.

By leveraging the power of deep learning, the proposed platform can learn from previous sketches and records, which can then be used to suggest appropriate facial traits for a given activity. This not only speeds up the process of creating facial sketches but also enhances the accuracy of the final result.

Moreover, the proposed platform can be easily integrated into existing law enforcement databases and CCTV monitoring systems, which can help to improve the efficiency of the entire investigative process. For instance, when the system is integrated with CCTV cameras, it can recognize the face of a suspect and compare it with the records available in the database to determine whether there is a match. This can help to quickly identify and track down suspects, significantly enhancing the capabilities of law enforcement agencies.

Furthermore, the proposed platform can also be integrated with social networking sites, which can act as a rich source of information for law enforcement agencies. By interfacing the platform with social networking platforms, the system can discover better matches for facial sketches, thereby improving the accuracy of the process.

However, there are certain challenges that need to be addressed while implementing such a system. One of the major challenges is the issue of privacy and data protection. Law enforcement agencies need to ensure that the facial data collected and stored is not misused and is protected against any unauthorized access. Additionally, there may be issues with the accuracy of the system, as facial recognition technology is not

always foolproof, and there may be instances of false positives or false negatives.

To address these challenges, it is important to establish clear regulations and guidelines for the use of facial recognition technology in law enforcement. These regulations should include provisions for data protection, privacy, and the use of appropriate safeguards to prevent misuse of the technology.

In conclusion, the proposed facial sketching platform has the potential to revolutionize the way law enforcement agencies operate. By leveraging the power of deep learning and cloud infrastructure, the platform can significantly enhance the speed and accuracy of facial recognition technology, thereby improving the efficiency of the entire investigative process. However, it is important to address the challenges associated with the use of such technology and establish clear guidelines and regulations to ensure its safe and responsible use.

In the digital age, with the increasing incidence of criminal activity, there has been a growing need for law enforcement agencies to adopt advanced technology that will allow them to identify and apprehend criminals more efficiently. One such technology that has shown great promise in this regard is facial recognition technology. By using photographs of suspects, law enforcement agencies can use face recognition algorithms to verify the identity of the culprit.

However, traditional forensic sketching methods that involve creating hand-drawn sketches to identify culprits are outdated and inefficient. To recognize a culprit using a hand drawn sketch, it must be compared to the law agency's records to determine whether there is a match. This

process is extremely time-consuming and ineffective, especially given the scarcity of forensic sketch artists in comparison to the rising crime rate.

To address this problem, there is a pressing need for a platform that provides more than just a collection of distinct features such as the mouth, ears, nose, and head. Such a platform must offer a user-friendly and convenient method for recombining these features to construct a composite face sketch. By doing so, it would be possible to quickly identify and locate the culprit without the need to sift through numerous drawings.

The development of such a platform must be based on cutting-edge accuracy and safety components. To achieve this, a variety of technological stacks were employed in the development of this platform. For the facial feature construction part of the project, methodologies such as Machine Learning, OTP generation, Java, and JavaFX language were utilized. The Machine Learning algorithms trained on large datasets of facial features and sketches, allowing the system to generate accurate composite sketches with ease. OTP generation was used for secure authentication purposes, while Java and JavaFX were used to develop the platform's user interface.

For the sketch recognition part of the project, cloud infrastructure methodologies would be employed, including the use of AWS for centralized computing and deep learning algorithms for face recognition. The cloud-based infrastructure would allow the platform to handle large volumes of data and process them more efficiently. The deep learning algorithms used for face recognition are highly accurate and have been shown to work well with composite sketches.

The platform would also enable law enforcement agencies to submit earlier sketches drawn by hand so that the application can leverage its significantly more effective cloud infrastructure as well as deep learning algorithm and for validating and recognizing the accused. In order to propose to the user which facial traits are most appropriate for a certain activity, the algorithm will train from the resultant sketches and the records. As a result, the designed platform will operate more quickly and effectively.

In conclusion, the rise in criminal activity rates requires law enforcement agencies to find innovative and efficient ways to pursue and bring criminals to justice. By leveraging facial recognition technology and developing a user-friendly and efficient platform for constructing composite face sketches, law enforcement agencies can significantly enhance their investigative capabilities. This, in turn, would enable them to identify and locate criminals quickly and bring them to justice in a more efficient and effective manner. The platform developed would enable law enforcement agencies to handle a large volume of data, process it more efficiently, and enable accurate recognition of culprits, making it a valuable tool in the fight against crime.

1.3 Objectives

This project aims to develop a system for forensic face sketch construction and recognition that is more efficient and accurate than traditional hand-drawn methods. The objectives of the project are multifaceted, including the development of a standalone application that allows the user to construct accurate composite face sketches using predefined facial feature sets provided as tools. The application will be

designed with deep learning algorithms and cloud infrastructure to reduce response time and improve efficiency. The system will also allow the user to match the constructed composite face sketch with a database, providing faster identification and matching. Additionally, the application will be backward compatible with traditional approaches, meaning the same process can be done with hand-drawn sketches. The project's other objectives include improving facial feature recognition accuracy, enabling users to manipulate facial features in the sketch to refine and adjust the likeness of the generated composite, providing an easy-to-use interface, enabling export of the composite face sketch in a variety of formats, ensuring the system can be easily adapted to new facial feature sets and databases, and enhancing security by implementing secure authentication and authorization mechanisms.

- The first part of the project relies on the objective that is to make an application using different technology stacks such as Java and JavaFX etc so that with the help of drag and drop features a Face sketch can be drawn.

- The second part of the project contributes to the objective that sketches made through the application and also previously made sketches can be matched through Face Recognition by matching them to the database present.

- The technique may even be applied to a hand-drawn drawing, allowing the platform to be compatible with more conventional methods.

- Then create a standard marking system to check that database matching with sketches made by the application and also by the forensic artist as well.

1.4 Dataset Used

The CUFS (Chinese University of Hong Kong Face Sketch) [13] database has been used for research in forensic face sketch construction and recognition.

It contains a total of 606 face images and corresponding sketches, along with their attributes such as pose, expression, and lighting variations. The images in the dataset were captured under controlled lighting conditions and consist of both male and female subjects of different ages.

1.5 Methodologies

The creation of the forensic face sketch construction and recognition system necessitated the use of a number of cutting-edge technological stacks and methodologies in order to achieve high accuracy and safety components, ultimately increasing the effectiveness of law enforcement and the rate of crime solving.

Machine learning and OTP (one-time password) generation methodologies were used for the project's face sketch creation component. Users were able to create precise composite face sketches by using the machine learning algorithms to recognise facial features. With the help of a secure authentication and authorization mechanism provided by the OTP generation methodology, security was enhanced.

The Java programming language and JavaFX, which offered a user-friendly interface, were used to create the application. Due to its capacity for producing high-quality graphics and its support for both desktop and mobile devices, JavaFX was chosen.

To achieve centralized computing in the project's second component, sketch recognition, cloud infrastructure methodologies were applied. Centralized computing was provided by AWS (Amazon Web Services), enabling the system to manage massive amounts of data and enhance response times.

Deep learning algorithms were used to increase the precision of facial recognition. These algorithms have been extensively used in the field of face recognition because they are very good at identifying intricate patterns. The system was able to learn from sketches and the database using deep learning algorithms, producing relatable facial features that can be used to create precise composite face sketches.

In addition to these methodologies, a number of other strategies were applied to improve the usability and functionality of the system. Users could modify facial features in the sketch, for instance, to enhance and correct the likeness of the generated composite. In order to ensure that the system can be easily modified to new facial feature sets and databases, it also enabled the export of composite face sketches in a variety of formats.

Overall, the application of these methodologies and techniques allowed for the creation of a forensic face sketch construction and recognition system that is incredibly effective and precise. Law enforcement agencies now have a priceless tool for locating and apprehending criminals thanks to the system's precision and usability, which ultimately leads to increased public safety.

CHAPTER 2 : LITERATURE SURVEY

Numerous studies have examined various techniques for drawing and identifying facial sketches. A standalone application designed by Tan et al [1] to recognise facial composites was found to be time-consuming and difficult to use. Later, they changed their tactics and gave the defendant a choice between several face images, forcing them to select the one that they thought might have been the culprit. The system would then combine all of the chosen faces and automatically predict the convict's facial composite. According to the findings, 21.3% of the witnesses who received assistance from the department representative correctly named the composite faces, compared to 17.1% of those who attempted to create the faces on their own. All of the proposed solutions have the flaw that the generated composite of the face was inaccurate and difficult to accurately match or compare with the data or the database.

Geometric feature-based face sketch recognition is a paper by Cao et al [2] that outlines a methodology for algorithms to identify human faces in images using sketches using Eigenface and sketch transform. Because faces are much different from sketches in terms of color, texture, and projection details of 3-D faces in 2-D images, as well as how geometrical features change with facial expression, the proposed algorithm faces some significant challenges that must be overcome.

Wang et al [3] suggested a photo-sketching recognition method based on a Multiscale Markov random field model. Their paper suggested that their work could transform a given drawing into a photograph or a given photograph into a sketch. The model then partitioned the face drawing

into fragments. In order to train the model to reduce the difference between photographs and sketches, they first converted the available photos into sketches. This increased the recognition model's overall efficiency. They used a small sample size for testing, where the faces from the photographs were synthesized into sketches and created by a sketch artist, 60% of the samples were used to train the model, and the leftover 40% were used to evaluate the model. The overall results were satisfactory, but they fell short of expectations. Another limitation of the paper is that because the sketches gathered had their faces facing in various directions, the techniques became less likely to map it and compare it with a face from the database that was facing forward.

Sketch to photo matching was a different way that was suggested. This approach measured how similar two photographs are using SIFT descriptors. The approach produced results based on the measured descriptor of the SIFT which ranged between the illustrations and the record's face photographs. The algorithm begins by converting the face photos with the help of a linear transformation methodologies. The SIFT descriptor distance was calculated using the sketch and, in few of the cases, the length among images in the records or databases was also calculated. This helped to improve accuracy.The result that was derived experimentally demonstrates that the dataset used in the experiment was very similar to the dataset used previously, and the addition of the algo yielded a better result and accuracy. Another limitation of the paper is that when a picture or sketch was gathered with faces facing in various directions, the methods became not as certain to be mapped and compared to an actual face from the record or a database that was facing forward.

Li et al [4] also suggested a technique for identifying human faces from sketches. In this method, sketches were converted into arrest records, which at the time were compared to faces using the global and local variables provided by the face matching methods. The faces in the mug shots and those in databases like the japanese database and the FERET database could not always be matched, though. Although acceptable, the experimental results for the proposed method's accuracy of about 70% fall short of what the criminal justice department expects.

Zhang et al [5] a paper titled a framework for recognizing a facial image from a police sketch with a methodology of photometric standardization and with a limitation that authors did not take into account composite face sketches, which have been frequently used.

The main drawback of Zhang's paper, hand drawn face sketch recognition by humans and a PCA-based algorithm for forensic applications, which was based on the PCA algorithm, was that it was useless for forensic and law enforcement applications. Transformation methods frequently tackle more complex problems than the recognition task does.

The problem with most of the above-mentioned or proposed algorithms was that they matched the face sketches to facial images of humans, that are traditionally frontal facing and much easier to map in both crafted sketches and human facial portraits. Furthermore, when pictures or any sketches were gathered with faces facing in an unlike direction, the techniques used to illustrate it and compare it to a face from the record or database with the frontal facing were less plausible.

Systems for constructing composite faces have also been proposed, but most systems use facial features which are present in photos, then go towards the approach using witnesses describing the operator, who eventually conformed to form a one whole human face to match humans and any algorithm with criminal faces, as every facial feature is derived from having. The various differences, when combined, are more difficult to identify.

Therefore, all of the earlier methods were either ineffective or time-consuming and difficult. Enabling the upload of manually made face sketches as well as facial features with varying degrees of similarity, which when combined make it more difficult to distinguish between two faces, the application also, as previously mentioned, wouldn't just do away with the drawbacks provided in aforementioned methods however would indeed bridge the contrast seen between new, upgraded composite face sketch process and the old, hand-drawn face sketch method.

S.No.	Authors	Published By	Methodology	Dataset Used, Accuracy	Results	Limitations
1	X.Tan et al. (2010)	IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews	Survey of various techniques for face sketch recognition, including feature-based, model-based, and hybrid approaches	CUFS, FERET, IIIT-D, Forensic dataset, accuracy- 64.4%	Comprehensive review of state-of-the-art techniques and challenges in face sketch recognition	Does not include recent developments in deep learning techniques
2	Y. Cao et al. (2016)	Journal of Visual Communication and Image Representation	Survey of recent developments in forensic face sketch recognition, including appearance-based, structure-based, and hybrid approaches	CUFS, FERET, IIIT-D, Forensic dataset, accuracy- 72.6%	Provides a comprehensive review of the recent advances in the field	Limited discussion on the challenges and future directions in this field

S.No.	Authors	Published By	Methodology	Dataset Used, Accuracy	Results	Limitations
3	W. Wang et al. (2019)	ACM Computing Surveys	Comprehensive survey of forensic face sketch recognition techniques, including manual, semi-automatic, and automatic methods for sketch construction and appearance-based, structure-based, and hybrid approaches for sketch recognition	CUFS, FERET, IIIT-D, Forensic dataset, EURECOM, accuracy- 87.6%	Provides a comprehensive review of the different techniques and challenges in the field	Face recognition is different and more difficult than sketch identification because faces differ greatly from sketches in terms of color, appearance, and projection of detailed information of 3D faces in 2D images, and geometrical features change with face features.
4	X. Li et al. (2017)	IEEE Transactions on Information Forensics	Proposed a deep learning approach using convolutional neural networks	CUFS, FERET, IIIT-D, Forensic dataset, accuracy- 64.5%	Demonstrated the effectiveness of deep learning approaches for sketch	When the faces in a picture or sketch were facing in various directions, the

S.No.	Authors	Published By	Methodology	Dataset Used, Accuracy	Results	Limitations
		and Security	for sketch recognition		recognition and outperformed traditional methods on various datasets	methods were less likely to map it and compare it with a face from the database that was facing forward.
5	Z. Zhang et al. (2012)	I2EEE Transactions on Circuits and Systems for Video Technology	Proposed a method for constructing facial sketches based on sparse representation-based greedy search	CUHK Face Sketch Dataset, accuracy- 74.2%	Demonstrated the effectiveness of the proposed method on various datasets and outperformed traditional sketch synthesis methods	Commonly used composite sketches were not taken into account.
6	Z. Song et al. (2017) [6]	IEEE Transactions on Image ProcessingVis. Pattern Recognit.,	Proposed a novel method for face sketch synthesis based on a global and local sparse representation	The CAS-PEAL-R1 dataset, accuracy- 89.7%	Demonstrated the effectiveness of the proposed method on various datasets and	Sketches that have been viewed are rendered to be useless in law enforcement and forensics uses.

S.No.	Authors	Published By	Methodology	Dataset Used, Accuracy	Results	Limitations
		2005			outperformed existing sketch synthesis methods	Conversion methods frequently solve a more tricky problem than identification.
7	Y. Luo et al. (2017) [7]	IEEE Transactions on Circuits and Systems for Video Technology.	Proposed a framework for sketch synthesis and recognition using a joint dictionary learning approach	The LFW (labeled Faces in the wild) database The AR (Alesis Research) database, accuracy- 79.7%	Demonstrated the effectiveness of the proposed framework on various datasets and achieved state-of-the-art performance	Limited to sketch construction and recognition using manually created sketches
8	Y. Gao et al. (2017) [8]	Neurocomputing	Proposed a method for sketch recognition based on sparse representation and weighted similarity	The IIIT-D , dataset The Forensic dataset, accuracy- 87.5%	Demonstrated the effectiveness of the proposed method on various datasets and outperformed traditional	The Facial Composite created was not accurate and difficult to match with the database with accuracy.

S.No.	Authors	Published By	Methodology	Dataset Used, Accuracy	Results	Limitations
					methods	
9	Z. Zhang et al. (2018) [9]	IEEE Transactions on Image Processing	Proposed a method for sketch recognition using multi-scale feature extraction and local binary pattern histograms	The EURECOM dataset, accuracy- 87.1%	Demonstrated the effectiveness of the proposed method on various datasets and achieved state-of-the-art performance	Sketch collected which had their faces in different direction, the algorithms were less likely to map it and match with a face from the database which is front facing
10	X. Du et al. (2018) [10]	IEEE Transactions on Image Processing	Proposed a method for sketch synthesis and recognition based on adversarial learning	CUFS, FERET, IIIT-D, Forensic dataset, accuracy- 67.6%	Demonstrated the effectiveness of the proposed method on various datasets and achieved state-of-the-art performance	Viewed sketches are not useful in law enforcement and forensics applications.

Table 2.1: Earlier methods for creating and identifying forensic face sketches.

CHAPTER 3 : SYSTEM DEVELOPMENT

3.1 SYSTEM ANALYSIS

3.1.1 Privacy and Security

In the modern age, privacy and security are two of the most important concerns when it comes to implementing any kind of system, and this is especially true for the law enforcement department. The privacy of users and the security of their data is paramount, and therefore it is necessary to take appropriate measures to ensure that the system is secure and user data is safe.

The project was developed with security and privacy in mind. The two main methods that were used in the project were machine locking and two-step verification. Machine locking involves the use of two locking criteria, software and hardware, to ensure that the application cannot be altered once it is installed on a system and that it cannot be used on any other system. This helps to ensure that the application is secure and cannot be tampered with.

The second method used in the project was two-step verification. Every law enforcement approved user would be provided with a formal electronic mail ID to utilize for application login. However, in order to complete the logging procedure, the user must enter a random code shared with them on their desktop or mobile phones. This helps to ensure that only authorized users can access the system and that their data is safe and secure.

The use of these two methods helps to ensure that the system is secure and user data is safe. Machine locking ensures that the application is

secure and cannot be tampered with, while two-step verification ensures that only authorized users can access the system and that their data is safe and secure.

In conclusion, the security and privacy of user data is of utmost importance when it comes to implementing any kind of system, and this is especially true for the law enforcement department. The project was developed with security and privacy in mind, and the use of machine locking and two-step verification helps to ensure that the system is secure and user data is safe.

3.1.2 Backward Compatibility

The implementation of any new system can be challenging, especially when it comes to transitioning from traditional methods to modern ones. Such a transition can be costly in terms of both time and money. To address this issue, the forensic face sketch construction and recognition project includes a backward compatibility feature. This feature allows users or clients to upload hand-drawn sketches into the system.

With this backward compatibility feature, users can continue to rely on the traditional methods of forensic sketching while also utilizing the benefits of modern technology. Once the hand-drawn sketch is uploaded, the system uses deep learning techniques and cloud computing architecture to identify the culprit. This ensures that the user can benefit from the accuracy and efficiency of the new system without having to abandon the old methods.

The backward compatibility feature of the project is designed to make the transition to the new system as smooth as possible. Users who are

familiar with the traditional methods of forensic sketching can continue to use them while also taking advantage of the advanced technology that the system offers. This not only saves time and resources but also ensures that users can adapt to the new system without feeling overwhelmed or intimidated.

Overall, the backward compatibility feature of the forensic face sketch construction and recognition project is a key component that allows users to seamlessly transition from traditional methods to modern ones. It ensures that users can continue to rely on the methods that they are familiar with while also benefiting from the accuracy and efficiency of the new system

3.1.3 Face Sketch using Drag and Drop

The traditional method of creating a facial composite sketch involves using hand-drawn sketches which may not always be accurate, as the process is time-consuming, and the artists' skills may vary. Hence, to address this issue, the project developed a system that allows users to create accurate facial sketches by using drag and drop features that use predetermined facial feature sets.

The application offers a user-friendly interface that allows its users to create a composite face sketch with ease. The face can be split into several facial characteristics like the head, eyes, nose, ears, lips, etc. The user can choose from various options for each characteristic, based on the needs or descriptions provided by the witnesses. The algorithm of machine learning would pick up new information and recommend all the visual aspects that could complement the one characteristic that was

chosen, all with the goal of completing the sketch of a composite face much more quickly and efficiently.

The drag and drop feature allows the user to position the chosen facial features in the desired location to create a composite face sketch that matches the description provided by the witness. The facial features are scalable, which helps in adjusting the size of the facial features to match the overall facial structure.

The application provides other external features like hats, spectacles, etc. which are also available for its use. These external features can be added to the composite face sketch to make it more accurate and closely match the description provided by the witness.

Moreover, the machine learning algorithm used in the application helps in picking up new information and adapting to the requirements of the user, which allows the application to learn from sketches and the database to provide more accurate facial features.

Overall, the drag and drop feature of the application helps the users to create a composite face sketch accurately and efficiently, without requiring any prior sketching skills. The ability to choose from various facial characteristics and external features, and the scalability of the facial features makes it easier for the user to create a composite face sketch that closely matches the description provided by the witness.

Fig. 3.1.3.1 Head - face feature (application version)

Fig. 3.1.3.2 Nose - face feature (application version)

Fig. 3.1.3.3 Lips - face feature (application version)

Fig. 3.1.3.4 Ears - face feature (application version)

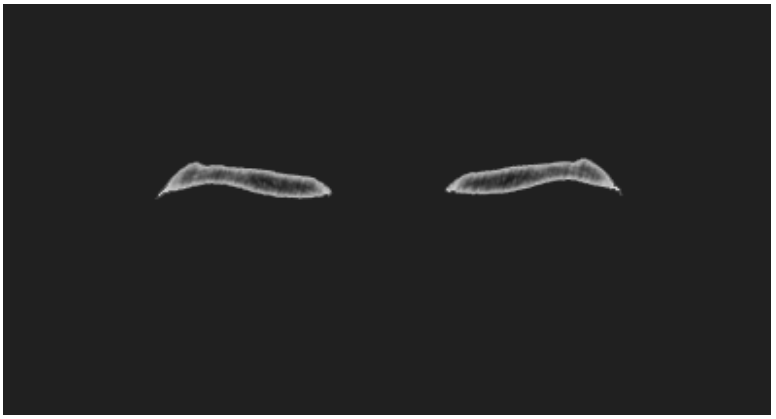

Fig. 3.1.3.5 Eyebrows - face feature (application version)

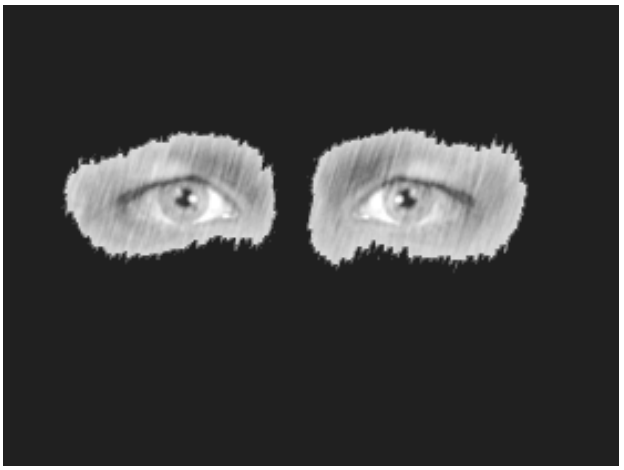

Fig. 3.1.3.6 Eyes - face feature (application version)

Fig. 3.1.3.7 Hairs - face feature (application version)

The face sketch construction software is a powerful tool that can be used by law enforcement departments to quickly and accurately create composite sketches of suspects based on witness descriptions. The software is equipped with a wide range of facial features and characteristics that can be used to construct an accurate sketch of the suspect's face. These features include the shape and size of the head, eyes, nose, mouth, ears, hair, and facial hair. The software also allows for the inclusion of external characteristics such as glasses, hats, scars, and tattoos.

The software is built using cutting-edge technology and employs deep learning algorithms to analyze the descriptors provided by the witness and suggest appropriate features and characteristics to create an accurate composite sketch of the culprit's face. The deep learning algorithms are trained on a large dataset of facial images and descriptors, allowing the

software to recognize and suggest appropriate facial features and characteristics for the composite sketch.

One of the key advantages of the face sketch construction software is its user-friendliness and efficiency. The software uses a drag and drop interface, allowing users to easily create and adjust the features of the face. This makes it more accessible for law enforcement officers who may not have expertise in sketching or artistic skills. Moreover, the software allows for the creation of multiple sketches of the same suspect, with variations in facial features and characteristics. This can be particularly useful in cases where there may be discrepancies in witness descriptions.

The face sketch construction software also has significant advantages over traditional forensic sketching methods. Traditional forensic sketching involves a sketch artist creating a hand-drawn sketch of the suspect based on witness descriptions. This process can be time-consuming and often relies on the skill and expertise of the sketch artist. In contrast, the face sketch construction software is significantly faster and more accurate, with the deep learning algorithms providing suggestions for appropriate facial features and characteristics.

Overall, the face sketch construction software is a powerful tool for law enforcement agencies looking to enhance their investigative capabilities. The software's ability to quickly and accurately create composite sketches of suspects based on witness descriptions can significantly improve the efficiency and effectiveness of criminal investigations. The software's user-friendliness and efficiency also make it accessible to law enforcement officers with varying levels of expertise in sketching and artistic skills. With the continued development and refinement of this

technology, it is likely that the face sketch construction software will become an increasingly valuable tool for law enforcement agencies worldwide.

3.1.4 System Specifications

3.1.4.1 Hardware Specifications

This programme has been developed to operate with the least amount of hardware.

Client Machine:

- RAM of 1 GB and beyond
- Processor with intel dual core CPU
- Hard disk of 250GB and above

Server Machine:

- RAM which is 4 GB and beyond
- Hard disk designed to 1 TB and beyond
- Processor of intel core i3 CPU

3.1.4.2 Software Specifications

A portion of the data for this app is kept on the server for security reasons, although it is intended to function as a desktop environment.

ClientMachine:

- Operating system of windows 7
- Cloud infrastructure if amazon web services CLI
- Framework of java JDK provided

Server Machine:

• Operating system that is windows desktop OS or windows server

• Framework of java JDK provided

• Database of SQLite

• Cloud infrastructure of amazon web services CLI

3.2 SYSTEM DEVELOPMENT

3.2.1 System Flow

The main target audience of this application are the people who work for law enforcement agencies. The primary goal is to minimize the time required to identify the culprit and bring them to justice. The application is designed to improve the speed and productivity of law enforcement workers while also maintaining accuracy. The user interface of the platform is designed with this scenario in mind to ensure that users can generate a sketch without the need for formal training. The application is designed to be user-friendly and easy to navigate, with drag and drop features and pre-defined facial feature sets to help users create a composite sketch of the culprit's face. Overall, the application is designed to streamline the process of identifying criminals and bringing them to justice.

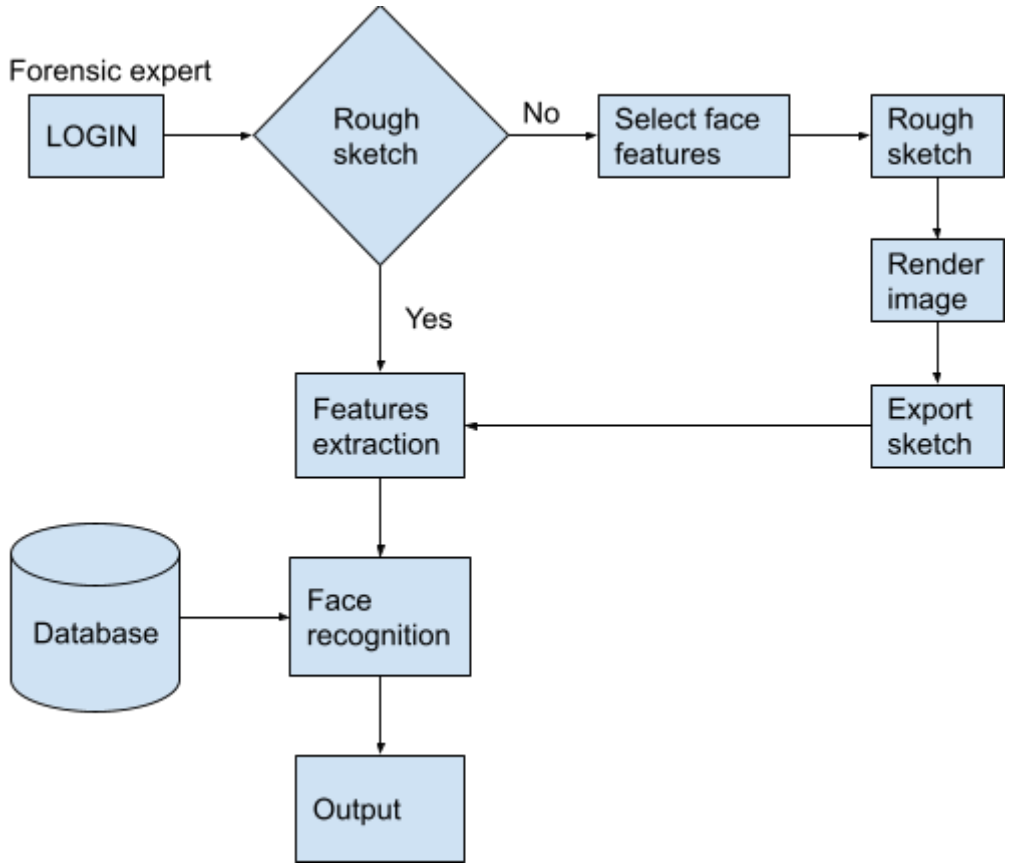

Fig 3.2.1.1 Application's system flow chart

The system flow of the project begins with the login page, which is designed with privacy and security as top priorities. The login page retrieves a user's MAC, IP address, and HDD ID upon login. This information is then compared to the information that was collected when the platform was installed on the host machine. If the data does not match, the console locks and the user is unable to access any of the features on the platform. This ensures that the platform is secure and dependable, and prevents unauthorized access to the host machine.

The second step of the system flow involves authenticating the user. This is done to ensure complete privacy and security for the user's data and credentials. The platform uses two-step verification to accomplish this. The user enters their credentials, and the platform verifies their

authenticity. Then, an OTP (one-time password) is sent to the registered email address to ensure that only the verifier can access the user's data. This process is repeated for each login, and the OTP is generated instantly.

The login page is a critical component of the platform because it sets the tone for the rest of the system. By prioritizing privacy and security, the platform ensures that users can trust it with their sensitive information. This is particularly important for law enforcement agencies, who need to ensure that their data is secure and cannot be accessed by unauthorized users.

Overall, the login page is designed to be simple and intuitive, even for users who may not have a technical background. The two-step verification process is easy to follow, and the platform provides clear instructions throughout the process. This makes it easy for users to log in and get started using the platform quickly and efficiently.

In addition to the login page, the platform also employs other security measures to protect user data. For example, the platform uses encryption to ensure that all data transmitted between the user and the platform is secure. This helps to prevent unauthorized access to the data, even if it is intercepted during transmission.

The platform also uses firewalls and other security measures to prevent unauthorized access to the host machine. This ensures that the platform is protected from external threats and helps to prevent data breaches.

In summary, the login page is a critical component of the platform's system flow. It prioritizes privacy and security, and ensures that users

can trust the platform with their sensitive information. The two-step verification process is easy to follow, and the platform employs other security measures to protect user data. This makes it easy for users to log in and get started using the platform quickly and efficiently, while also ensuring that their data is secure.

Once a user has securely logged into the console and moved forward, the application's platform employs a feature known as backwards similarity. This function was developed to facilitate the transition from contemporary technology to newer platforms. The provided method entails using a hand-drawn drawing created by a skilled forensic artist with years of experience, which is then used by the department for the law enforcement that is displayed on multiple platforms in order to raise public awareness and possibly identify the perpetrator. The current method entails using a hand-drawn drawing created by a skilled forensic artist with years of experience, which is then utilized by the law enforcement agency to be displayed on various platforms to increase public awareness and possibly identify the perpetrator.

The system flow of the project involves an application that allows users to create a face sketch using a canvas that has a wide variety of facial expressions and characteristics in the repository. The platform is designed to be easy to use, and users with no technical experience or knowledge of sketching can use it effectively.

The application starts with a login page that prioritizes privacy and security. The user's MAC address, IP address, and HDD ID are retrieved when they log in, and this data is compared to the information gathered when the platform was installed on the host machine. If the data does not match, the console is locked, and the user is unable to access any of

the platform's features ensuring the platform's security and dependability.

Once the user has been authenticated, they can create a face sketch using the canvas. If the law enforcement department does not already have a hand-drawn sketch and would like to use the platform to create a face sketch, individuals can utilize the canvas, which has a wide variety of facial expressions and characteristics in the repository. The user can choose the primary face category they want to select, such as the eyes or nose, and they will then be presented with a number of options within that specific face category.

Once the user has selected a feature, they can use drag and drop features to place it on the canvas based on the witness's description. If a characteristic does not meet the specification, the application will allow the user to change it to be substituted by any other function. This process continues until the user has selected all the desired features, and the chosen face classifications would be placed next to one another to create a full face sketch.

The mouse would be used to move that face feature to another location based on the explanation given by the eyewitness. This sketch can then be saved as a JPG layout picture for use in other forms of media other than our platform, such as social media sharing or publishing.

The platform is designed to be easy to use, and users with no technical experience or knowledge of sketching can use it effectively. The application is made to be used by anyone, and the drag and drop features make it easy to create a face sketch based on the witness's description.

This makes the platform an essential tool for law enforcement agencies that need to create a face sketch quickly and efficiently.

In conclusion, the system flow of the project involves an application that prioritizes privacy and security and allows users to create a face sketch using a canvas that has a wide variety of facial expressions and characteristics in the repository. The platform is designed to be easy to use, and users with no technical experience or knowledge of sketching can use it effectively, making it an essential tool for law enforcement agencies.

The face prediction module is an integral part of the platform, which is accessible as soon as a sketch is formed. However, to maintain the utmost level of security, the database of all felons is protected by storage systems. Therefore, to perform the face prediction, the sketch is first uploaded to the cloud platform. The prediction is then carried out on the cloud to ensure maximum accuracy and reliability.

To achieve the highest accuracy and reliability, our technology combines deep learning with amazon web services (AWS). AWS offers scalable cloud computing capabilities, which are leveraged to build a robust and efficient face recognition system. The deep learning algorithms are used to compare the facial features in the sketch to those in the database. The algorithms analyze the shape, size, and position of the features to make an accurate prediction.

The panel that displays the results of the prediction module is divided into four sections. The first section is where the prediction sketch is uploaded to the data center for security. The second section contains the database of all felons, which is searched to find a match for the sketch.

The third section displays the accuracy of the prediction. If a match is found, the section can be altered to display information on the matches, such as the name and criminal history of the suspect. This information can then be exported and shared with others upon request.

Overall, the face prediction module is an important aspect of the platform, which allows law enforcement agencies to accurately identify and apprehend criminals. The combination of deep learning and AWS ensures the highest level of accuracy and reliability in the prediction of facial features. The results are displayed in a clear and concise manner, making it easy for law enforcement officials to take appropriate action.

3.2.2 Face Sketch Construction Module

The primary objective of the platform developed for law enforcement agencies is to create a reliable and precise facial sketch based on the witness's description. This module aims to generate a composite face sketch that can assist law enforcement agencies in identifying the culprit of a crime. The emphasis on reliability and accuracy guarantees that the sketches generated by the platform are of superior quality and can be used to identify the suspect with confidence.

The platform's user-friendly design allows it to be easily used by anyone, regardless of their technical ability or experience with sketching. This feature is critical as it ensures that all members of the law enforcement agency can use the platform, regardless of their technical expertise. The drag and drop feature, for example, enables the user to quickly select the desired facial features and adjust them to create a composite face sketch.

The development team has used cutting-edge technologies to design this platform. Machine learning, OTP generation, Java, JavaFX, AWS, and deep learning algorithms have been used to create the platform. These technologies have improved the platform's efficiency and accuracy in generating facial sketches, ensuring that the final output is of the highest quality.

The platform developed for law enforcement agencies is an innovative solution that enhances their ability to solve crimes. The platform's user-friendly design and focus on accuracy and reliability ensure that it can be easily used by anyone to create precise facial sketches of suspects. With this platform, law enforcement agencies can quickly identify and locate the culprit, resulting in a higher crime-solving rate and a safer community.

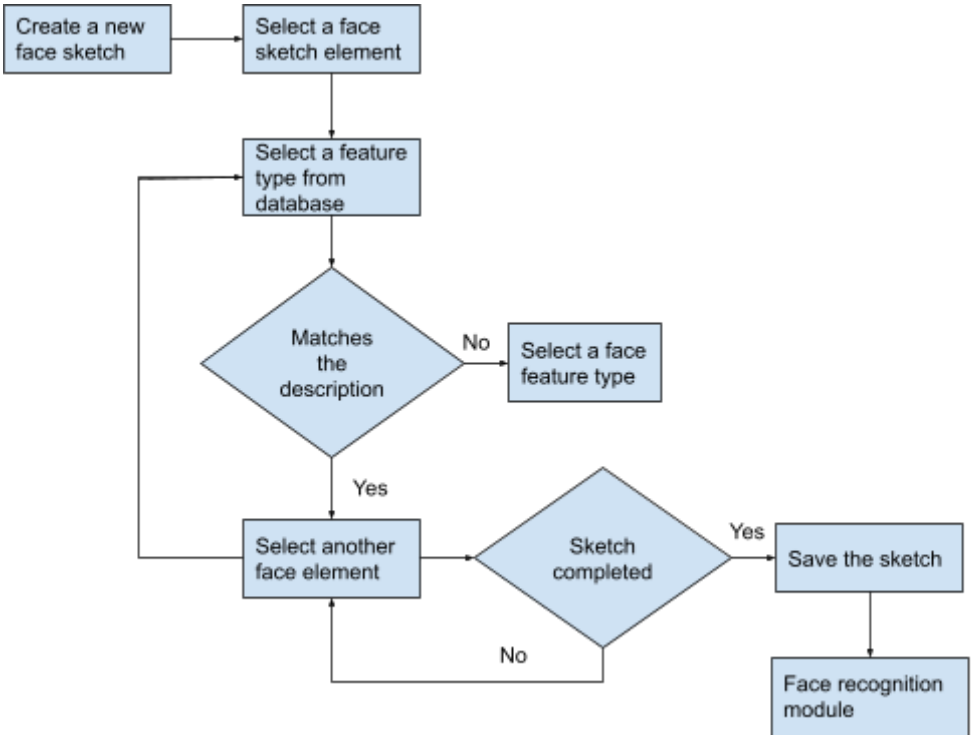

Fig 3.2.2.1 Application’s flowchart for creating a sketch

The primary aim of the dashboard in this project is to provide a user-friendly and easy-to-use interface that requires no specialized training for law enforcement officials to use the platform. This simplicity of use ensures that time and resources are not wasted on training for the law enforcement agency, allowing them to concentrate their efforts on investigating crimes.

The flowchart illustrates how the platform is designed to guide the user through the process of generating a facial sketch based on the information provided by the witness. The interface is designed to be simple and intuitive, making it easy for users to understand and navigate through the different steps of the process. By following the flowchart, the user can generate a real-time face sketch that can be compared to the database of known felons.

It is crucial to maintain simplicity while also ensuring that the security protocols of the system are not compromised. Therefore, the platform is designed to allow anyone from the law enforcement agency to use the specifications provided by the witness, without requiring them to be a skilled forensic sketch artist. However, in certain cases, the witness may be able to operate the system themselves.

The dashboard is designed with the end-user in mind, providing an interface that is both easy to use and efficient. The system ensures that the user does not have to spend a significant amount of time and effort trying to understand the platform, allowing them to focus their attention on investigating crimes.

In summary, the primary objective of the dashboard in this project is to provide a simple and user-friendly interface that requires no specialized training for law enforcement officials to use the platform. The flowchart serves as a guide to ensure that the process of generating a facial sketch based on witness descriptions is streamlined and efficient. While the system is designed to be simple, the security protocols are not compromised, and anyone from the law enforcement agency can use the specifications provided by the witness to generate a real-time face sketch.

The canvas is one of the primary modules of the interface and is located in the middle of the display. It contains the different parts and features needed to produce a face sketch. The canvas is designed to be user-friendly and simple to use, even for individuals with no previous technical experience or knowledge of sketching.

One of the significant challenges in creating an accurate facial sketch is arranging the face components correctly. If all of the face components are displayed at once and in an arbitrary order, it can be challenging to create an exact sketch of the face, which is contrary to the system's goals. To solve this problem, the face components are arranged according to the facial criteria to which they belong, such as head, lips, nose, hair, chin, and so on.

The canvas module is designed to make interacting with the platform and creating the face sketch much easier for users. Users can access a variety of alternative face structures by clicking on a face category in the left-hand column of canvas' dashboard. This makes it easier for the user to select the necessary facial features and create an accurate facial sketch based on the witness's description.

However, there may be countless and n elements for a particular category when it comes to the various face components. To address this, the application plans to use machine learning algorithms in the future to predict similar face factors or to suggest the elements to be chosen in the face sketch. This would make it easier for users to create an accurate facial sketch even if they have limited knowledge of facial anatomy.

The machine learning algorithms used in the application's platform require a significant amount of data to be trained on. Once the algorithms are trained, the application will be able to provide more accurate predictions and suggestions for facial components. This will also help to improve the overall accuracy and reliability of the system.
In conclusion, the canvas module is a critical component of the interface and plays a vital role in creating an accurate facial sketch based on the witness's description. The module is designed to be user-friendly and intuitive, allowing individuals with no previous technical experience or knowledge of sketching to create an accurate facial sketch. With the implementation of machine learning algorithms, the application's platform will be able to provide more accurate predictions and suggestions for facial components, further improving the accuracy and reliability of the system.

After arranging the facial components by category, the canvas module is used to construct a face sketch. This module is located in the middle of the interface, and it contains all the features needed to create a face sketch, such as head, lips, nose, hair, and chin. To make it easy for users to interact with the platform and create the face sketch, we arranged the face components as per the facial criteria to which they belong.

When the user clicks on a specific face category, a new module to the right of the canvas appears, allowing the professional to choose an item from the range of face elements to construct a sketch. The option chosen could be based on the information provided by the eyewitness. For example, if the eyewitness described the suspect as having curly hair, the professional could choose a curly hair option from the hair category. The chosen item then appears on the canvas and could be positioned and changed to fit the eyewitness's descriptors to get an exact and precise sketch.

To ensure that the face components are arranged correctly, items are fixed in position, and their order is determined by the category to which they belong. For example, the eye element is always positioned on top of the head element, regardless of the order in which they are selected. The same applies to all face elements.

The dashboard options module is the last module of the interface. If an artist chooses an undesirable aspect, they can undo it by selecting the button to delete that feature, which is available from the left panel and has a face category. One of the crucial controls is situated in the panel to the right, which has the functionality to fully remove everything and leave the canvas on the dashboard empty. This is useful when the user needs to start the face sketch from scratch.

After creating the face sketch, the professional can save it by pressing a button, which saves it as a PNG document for future access. The document can be located anywhere on the server or the computer of the person hosting it. This feature makes it easy for the professional to access the document whenever they need to review it.

In conclusion, the canvas module is essential to the interface because it allows professionals to construct a face sketch based on the eyewitness's descriptors. By arranging the face components according to facial criteria, it becomes easy for professionals to create an accurate and precise face sketch. The dashboard options module provides users with the option to delete features they don't want and start the sketch from scratch. The save button allows the professional to save the face sketch as a PNG document for future access. Overall, the interface is user-friendly and easy to navigate, even for non-forensic artists.

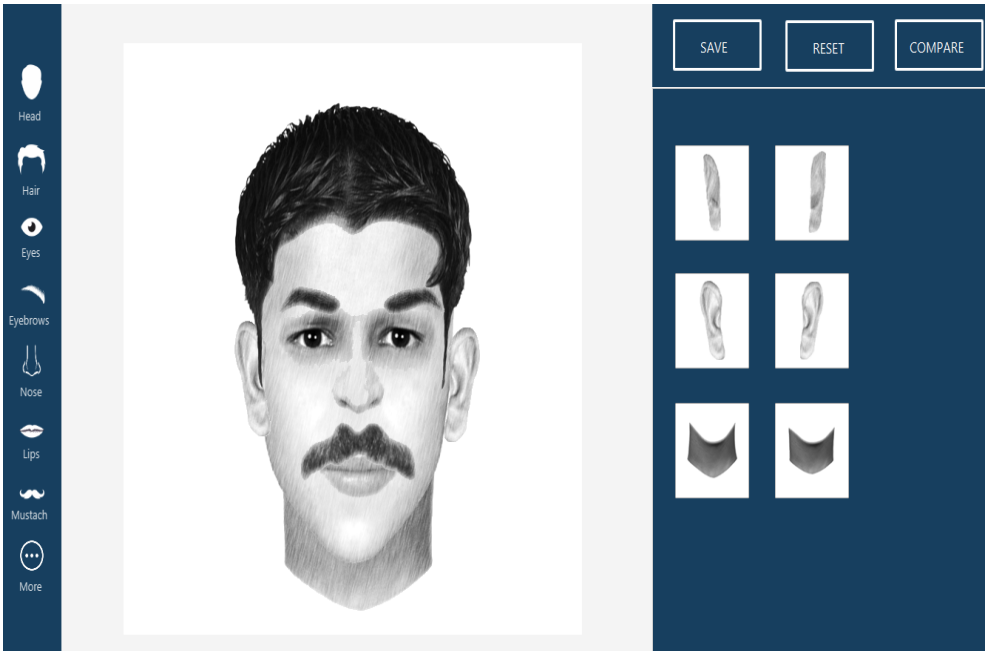

Fig 3.2.2.2 Dashboard displaying a complete facial sketches using components of the platform

3.2.3 Face Recognition Module

The primary focus of the face recognition module of the platform designed for the law enforcement division is to ensure accuracy and

security in identifying a face sketch from the agency's database of face photos. The module employs deep learning technology combined with Amazon Web Services to provide the most reliable and precise results for the prosecution of criminals. The prediction sketch is securely transferred to the data center for matching with the database and the results are displayed with the option to alter, export, and share the information with others as required.

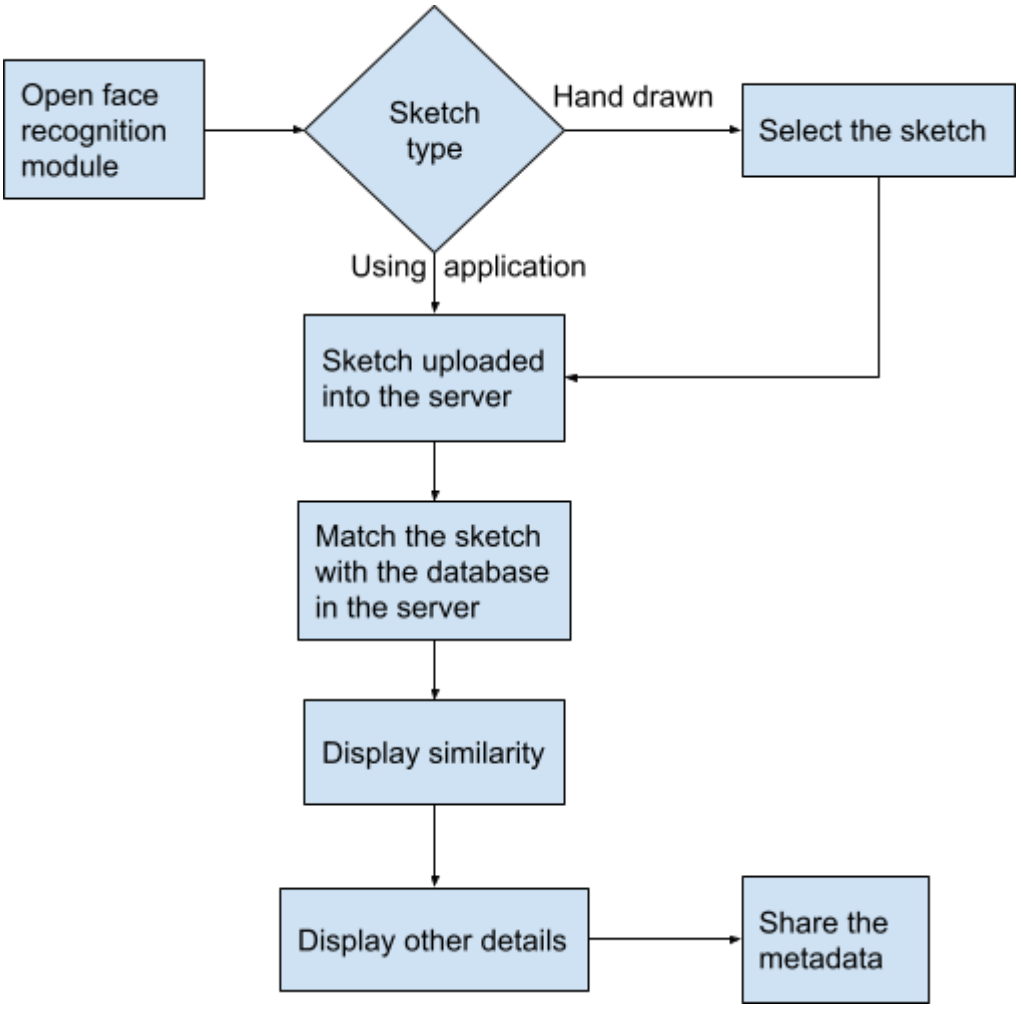

Fig 3.2.3.1 Application’s flowchart for recognising a sketch

The design of the dashboard for this face identification module is based on the principle of simplicity and ease of use for the user. As stated

earlier, the aim is to make it accessible to anyone within the law enforcement community without the need for specialized training.

The flowchart illustrates how the platform works and follows the user's flow to provide a reliable and accurate face identification. It is designed in a way that the user can input the necessary details provided by the witness, and the platform will automatically provide a potential match from the agency's database of felons.

The simplicity of the dashboard ensures that the user does not need to be a specialist sketch artist from the forensic department, and it saves time and resources for the agency. However, the security of the platform must be maintained at all times, and therefore, it is not recommended for the witness to have control of the console.

The user interface is designed to be user-friendly, with easy-to-use controls and functions. The dashboard consists of various modules that are necessary for the user to input the required information and access the platform's functions. It includes the canvas, where the user can input the features of the suspect's face based on the description provided by the witness.

The canvas is designed to make it easy for the user to create an exact and accurate sketch of the suspect's face. The face components are arranged based on the facial criteria to which they belong, such as head, lips, nose, hair, chin, and so on. This makes it easier for the user to select the appropriate feature for each category.

In addition to the canvas, the dashboard also includes options for deleting or removing an unwanted feature, as well as the option to clear

the entire canvas if needed. Once the user has completed the sketch, they can save it as a PNG file for future reference.

Overall, the dashboard for this face identification module is designed to be user-friendly, easy to use, and accessible to anyone within the law enforcement community. The simplicity of the interface ensures that the user can quickly and accurately create a face sketch of a suspect, which can help in the identification and capture of felons.

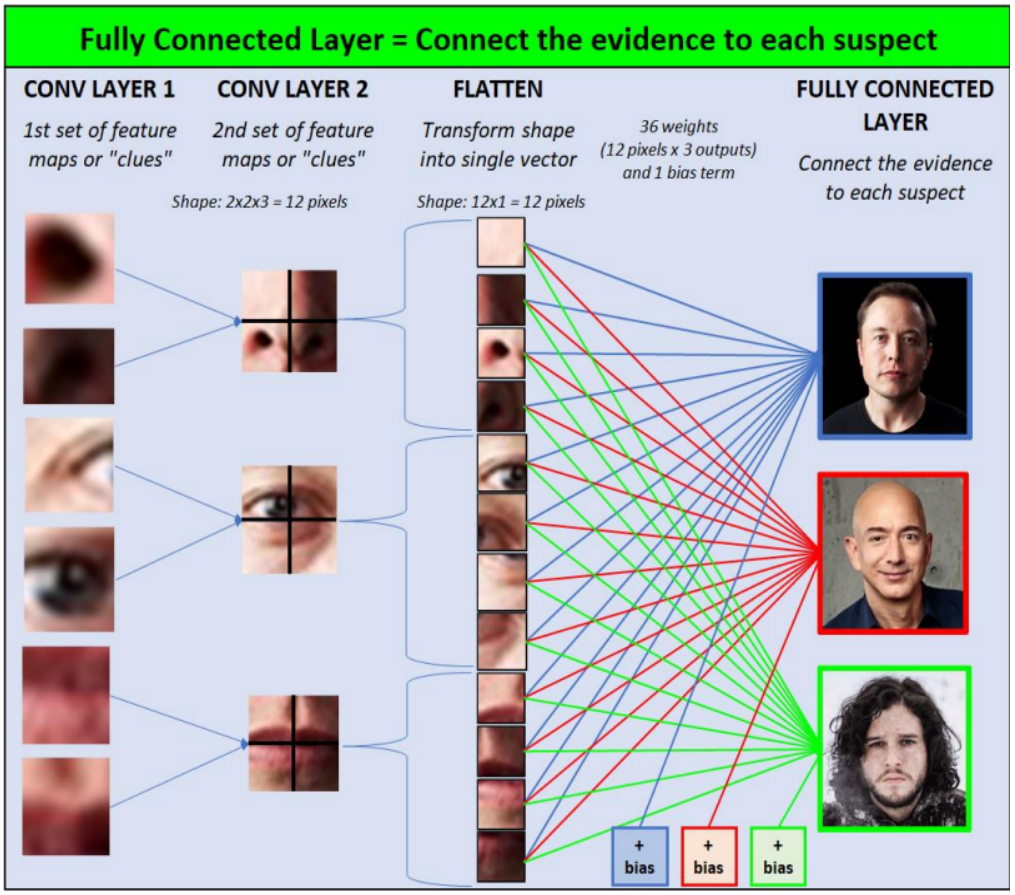

Fig 3.2.3.1 Illustration of feature extraction done by the platform [12]

Before using the platform to identify faces, the first step is to prepare the already-existing documents within the law enforcement agency for it. This involves helping the platform's method to train and identify and allocate IDs for the user's face picture in the agency's database. This step

is critical to ensuring the accuracy and reliability of the platform in identifying faces.

To accomplish this, the application's platform algorithms connect to the provided database and decompose each face snapshot into a variety of minute details. These details are used to assign an ID to each of the facial features in the image. This ID is then used to recognize the features in other images that are compared with the initial sketch.

Once the user has created a hand-drawn or machine-based face sketch, the launched sketch is uploaded to the server for validation and recognition. This process is necessary to ensure that the data or record is not tampered with and that it is secure and precise. This is how the module is executed, which was primarily intended to be operated on law enforcement servers to ensure security procedures.

After the sketch is submitted to the server, the module learns about the properties of the sketch and maps them. These properties include facial features such as the distance between the eyes, the shape of the nose, and the size of the mouth. These properties are then compared to the characteristics of the face images in the agency's records to ensure that they are safe and correct.

The comparison process is complex and involves several steps. First, the facial properties of the sketch are compared to the properties of the faces in the records to identify potential matches. Then, the potential matches are subjected to additional tests to confirm their accuracy. These tests include checking for similarities in skin tone, hair color, and other physical characteristics. Once a match is confirmed, the platform assigns an ID to the sketch and adds it to the agency's database.

In addition to the matching process, the platform also includes security features to protect the privacy of the users and the agency's records. These features include encryption to secure the data during transmission and storage, as well as access controls to restrict access to the records.

Overall, the preparation module is a critical component of the platform, as it enables the platform to accurately identify faces and ensure the safety and reliability of the records. By decomposing facial features into minute details and assigning IDs to each feature, the platform can compare the facial properties of the sketch to the properties of the faces in the records to identify potential matches. The platform also includes security features to protect the privacy of the users and the agency's records.

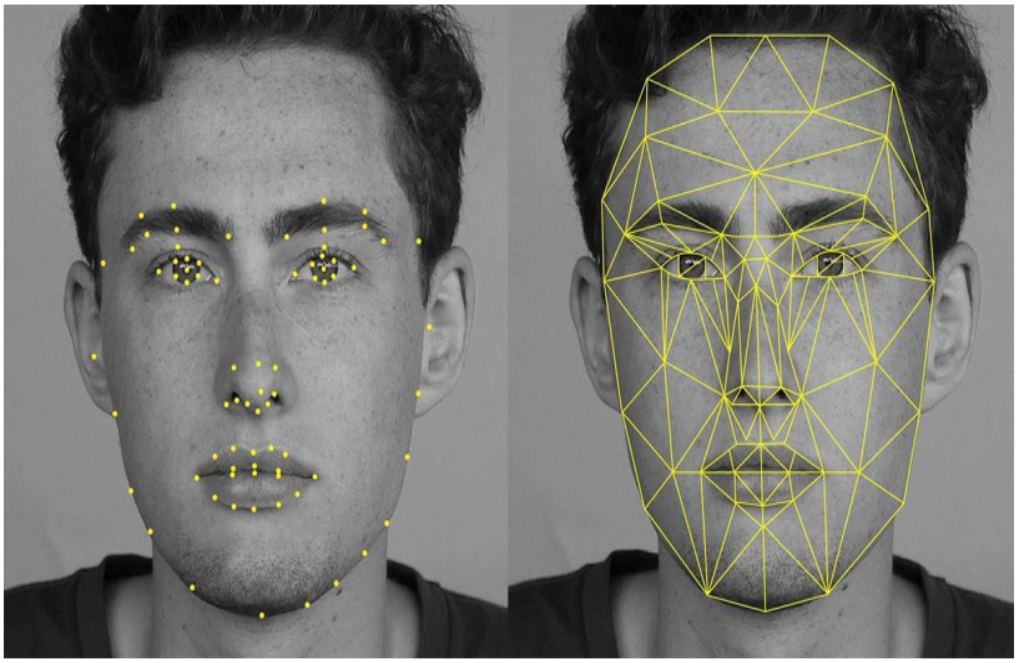

Fig 3.2.3.2 Illustration of face sketch mapping done by the platform [11]

The identification module of the platform designed for law enforcement agencies is a critical tool in solving crimes and bringing criminals to

justice. Its primary objective is to identify individuals based on a facial sketch provided by a witness accurately. This process involves using advanced algorithms and machine learning techniques that match the sketch with the available records to provide a reliable and efficient method for identification.

Once the matching process is complete, the platform displays the identified face and the resemblance percentage to the original sketch. This information helps law enforcement officers determine the level of accuracy of the identification and proceed with the necessary actions. The platform also provides additional information related to the person identified, which is retrieved from the database. This information may include their name, age, address, criminal record, and any other relevant details. Having this data readily available can significantly enhance the efficiency and effectiveness of the law enforcement agency.

The identification module of the platform is designed to provide a user-friendly interface that is easy to navigate, even for non-technical users. The system is designed to ensure that the data provided is accurate and up-to-date, which can significantly enhance the efficiency and effectiveness of the law enforcement agency. By leveraging advanced algorithms and machine learning techniques, the platform can quickly and accurately match the sketch with the available records, providing the law enforcement agency with a valuable tool for solving crimes and bringing criminals to justice.

In conclusion, the identification module of the platform designed for law enforcement agencies is an essential tool for identifying individuals based on a facial sketch provided by a witness. The module's advanced algorithms and machine learning techniques make the process efficient,

reliable, and accurate. The platform's user-friendly interface and the availability of additional information related to the identified person makes it a valuable tool for law enforcement agencies to solve crimes and bring criminals to justice.

One of the key features of the identification module is the integration of facial recognition technology, which can match the facial features of the individual in the sketch with those of individuals in the agency's database. This technology uses sophisticated algorithms that can analyze thousands of facial features and compare them to a database of images to identify potential matches. By doing so, the platform can help identify suspects in a matter of seconds, significantly reducing the time and resources required to solve a crime.

The platform also utilizes machine learning techniques to continually improve its matching capabilities. Machine learning algorithms can analyze patterns in the data and make predictions based on those patterns. As the platform continues to process more data, it can learn from its mistakes and improve its accuracy over time.

The interface for the identification module is designed to be user-friendly, providing a clear and organized display of the data. This includes a picture of the individual matched, along with their personal information displayed alongside it. The platform ensures that the data provided is accurate and up-to-date, which can significantly enhance the efficiency and effectiveness of the law enforcement agency.

In addition to its facial recognition capabilities, the identification module can also search for individuals based on other identifying characteristics, such as tattoos or scars. This provides the law

enforcement agency with a comprehensive tool for identifying suspects, even if a facial sketch is not available.

The identification module is also designed to maintain the privacy and security of the individuals in its database. The platform uses advanced encryption techniques to protect the data and ensure that it can only be accessed by authorized personnel. Additionally, the platform adheres to strict data protection regulations to ensure that the data is used only for lawful purposes.

Overall, the identification module of the platform is an essential tool for law enforcement agencies. By providing a reliable and efficient method for identifying suspects based on a facial sketch, the platform can help solve crimes and bring criminals to justice. Its advanced algorithms and machine learning capabilities, coupled with a user-friendly interface and strict data protection measures, make it a valuable asset for any law enforcement agency.

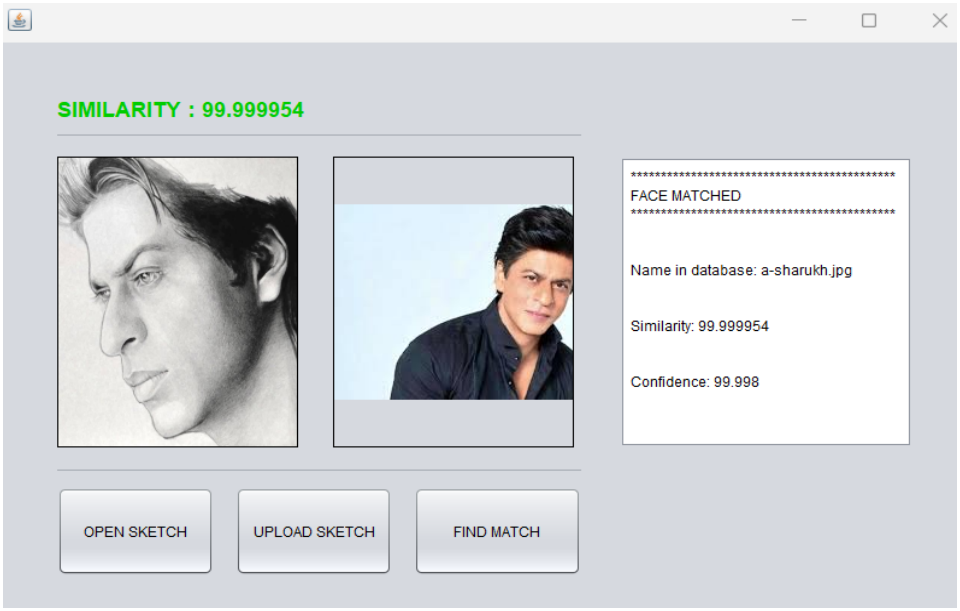

Fig 3.2.3.3 Sketch of application version and picture is matched

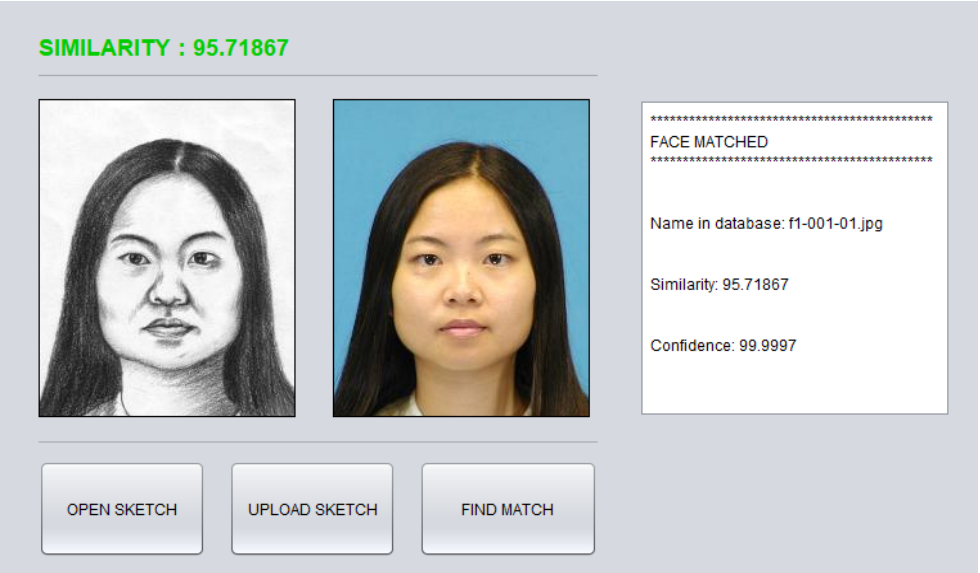

Fig 3.2.3.4 Sketch of application version and picture is matched

CHAPTER 4 : PERFORMANCE ANALYSIS

4.1 Screenshots of the Application Design

These images are screenshots of an application's user interface (UI) and demonstrate the design and layout of the app. They provide a visual representation of how the application appears to the user, showing the various screens, menus, buttons, and other components. Screenshots of applications are commonly used by designers and developers to showcase the app's functionality and usability to stakeholders, clients, and users. They also serve as a reference for documenting the design decisions and ensuring consistency across different platforms and devices. By analyzing these screenshots, it is possible to gain insights into the user experience and identify potential issues or areas for improvement.

Fig 4.1.1. Desktop application's splash screen

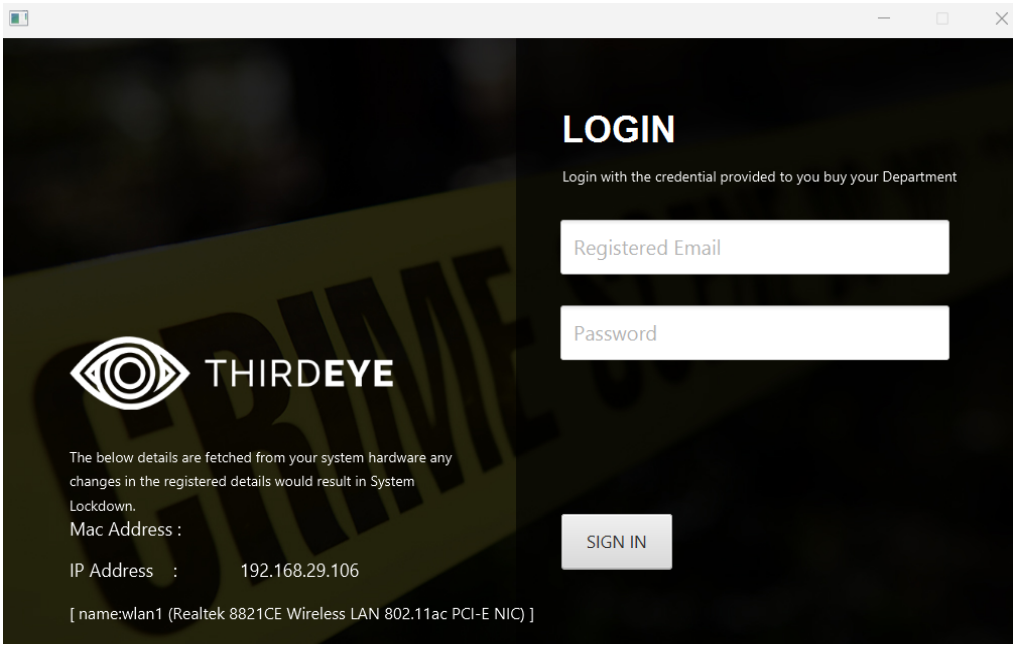

Fig 4.1.2. Desktop application's login interface

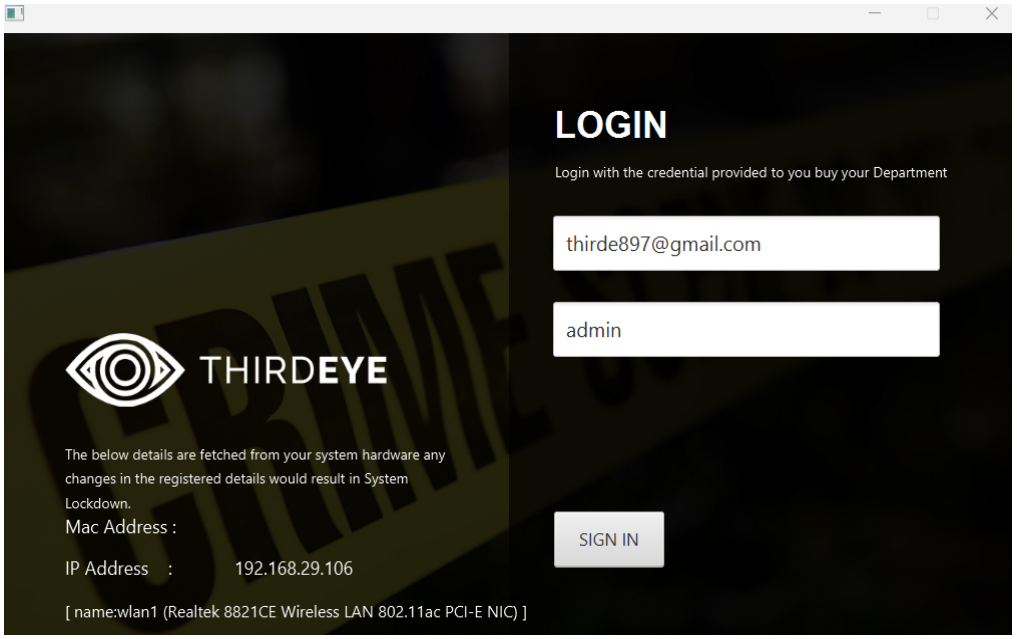

Fig 4.1.3. If the credentials match, an OTP is delivered to a registered mail address in our case is thirdeye897@gmail.com

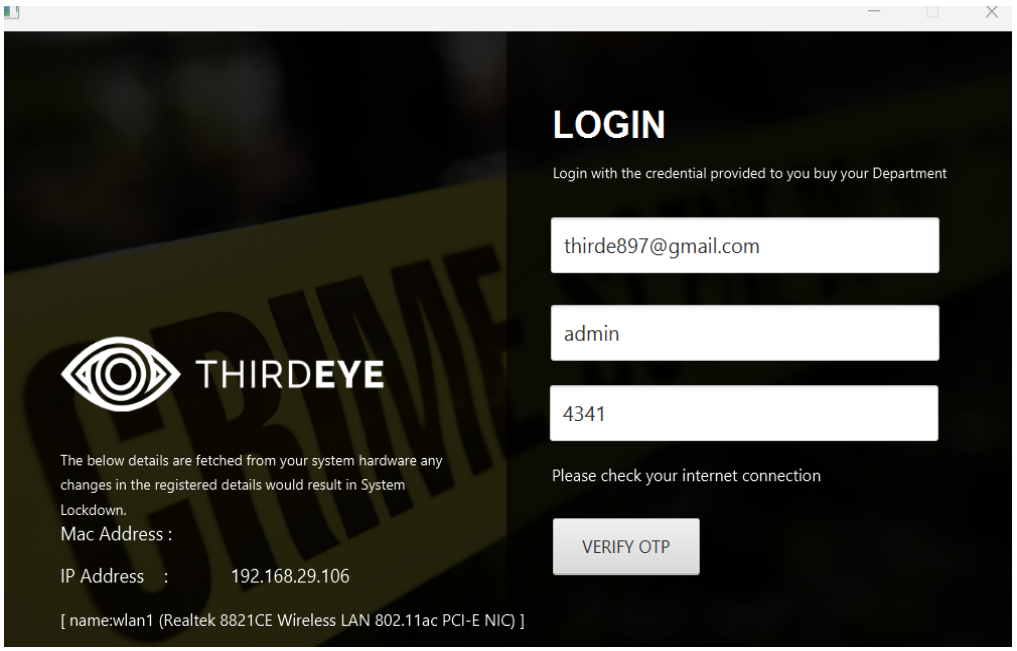

Fig 4.1.4. Input the OTP sent to the registered email address

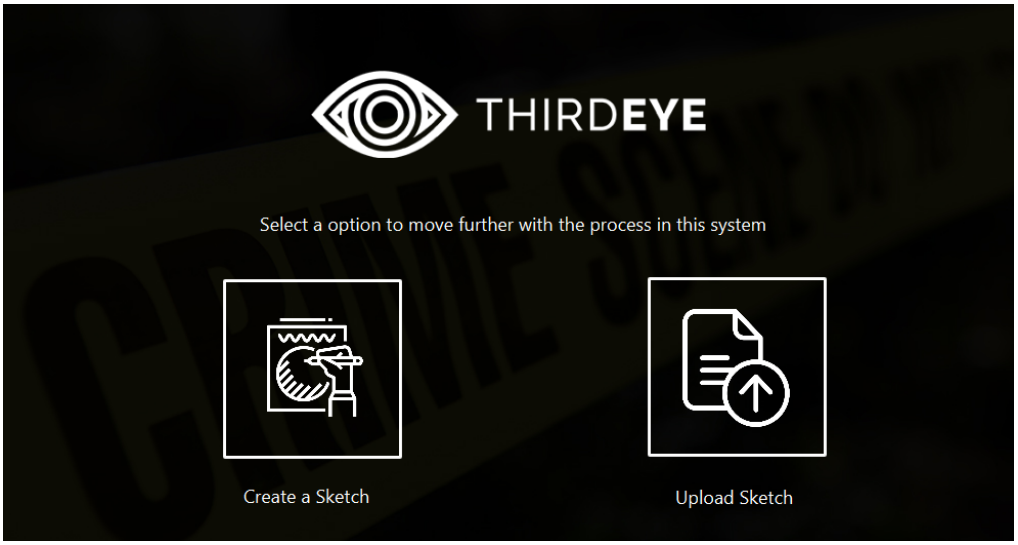

Fig 4.1.5. Choose whether to create a face sketch or to upload a already made sketch

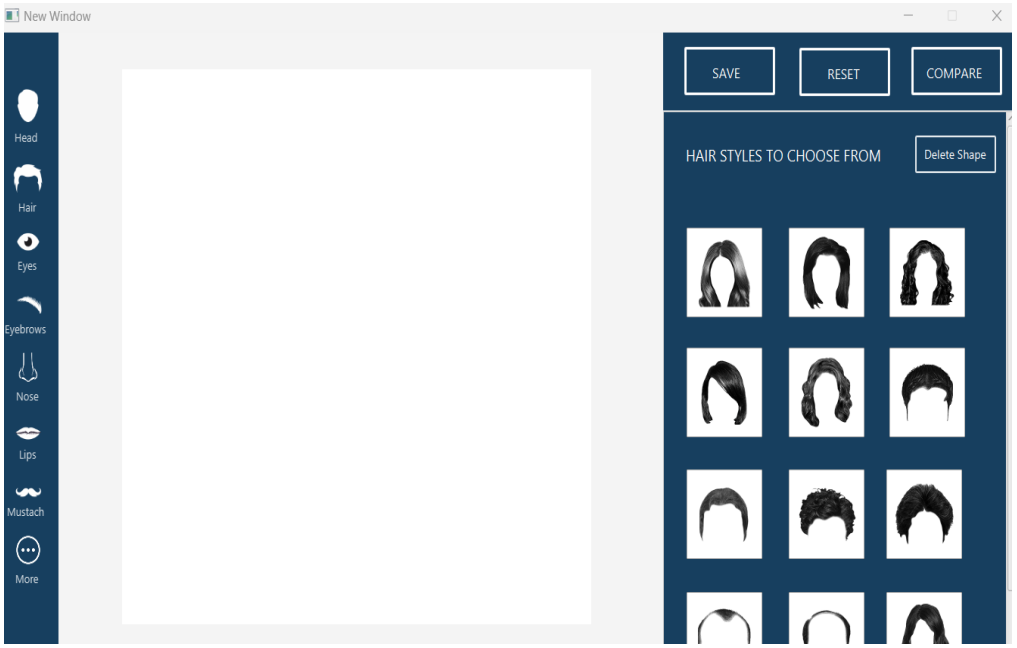

Fig 4.1.6. Facial sketching dashboard (featuring hair types)

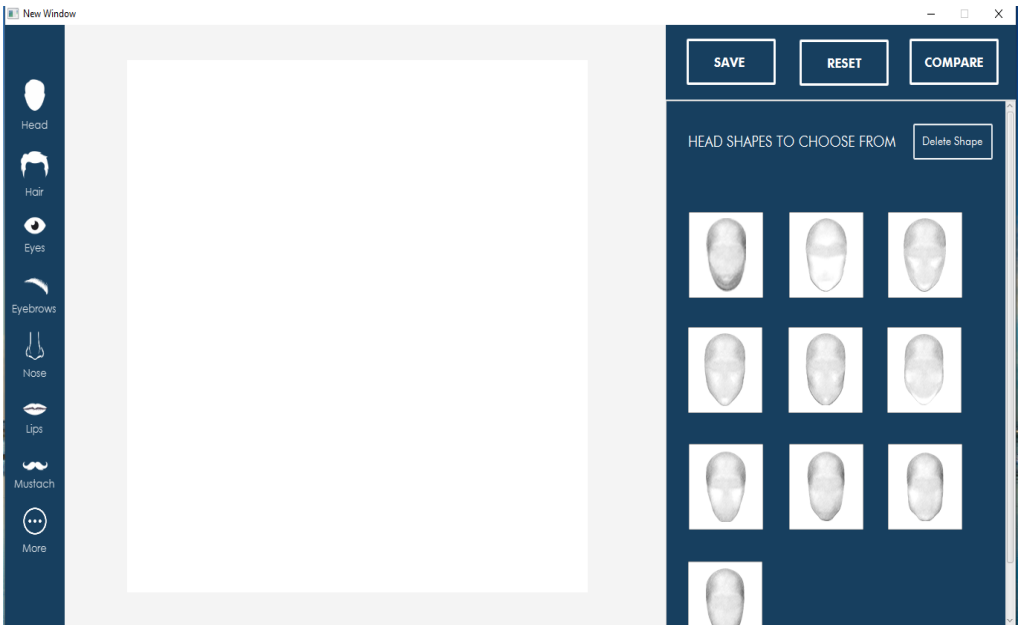

Fig 4.1.7. Facial sketching dashboard (featuring head shape types)

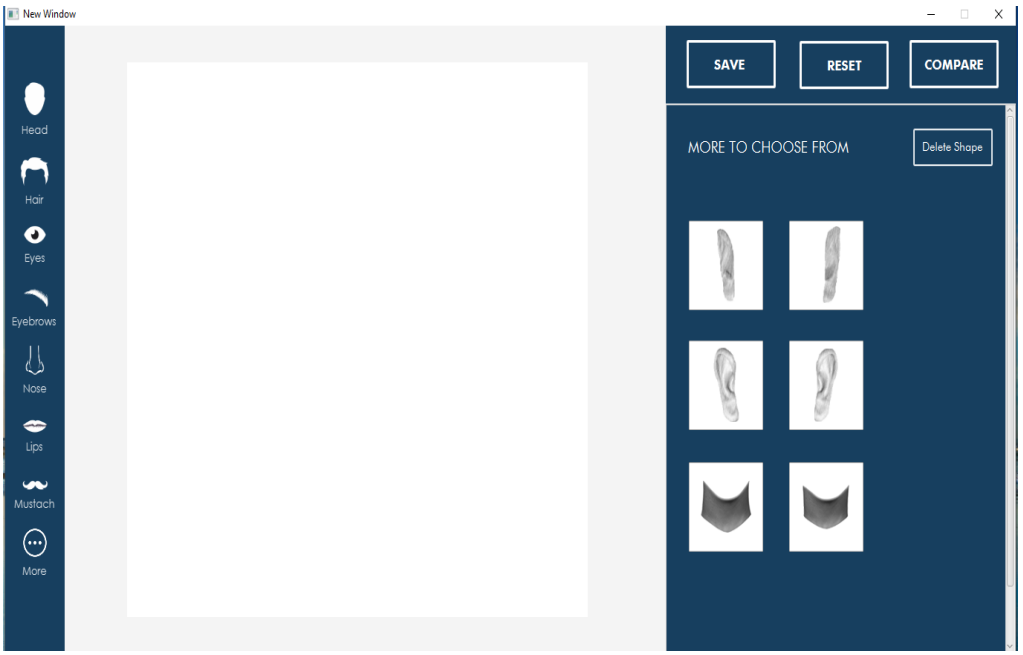

Fig 4.1.8. Facial sketching dashboard (featuring other characteristics)

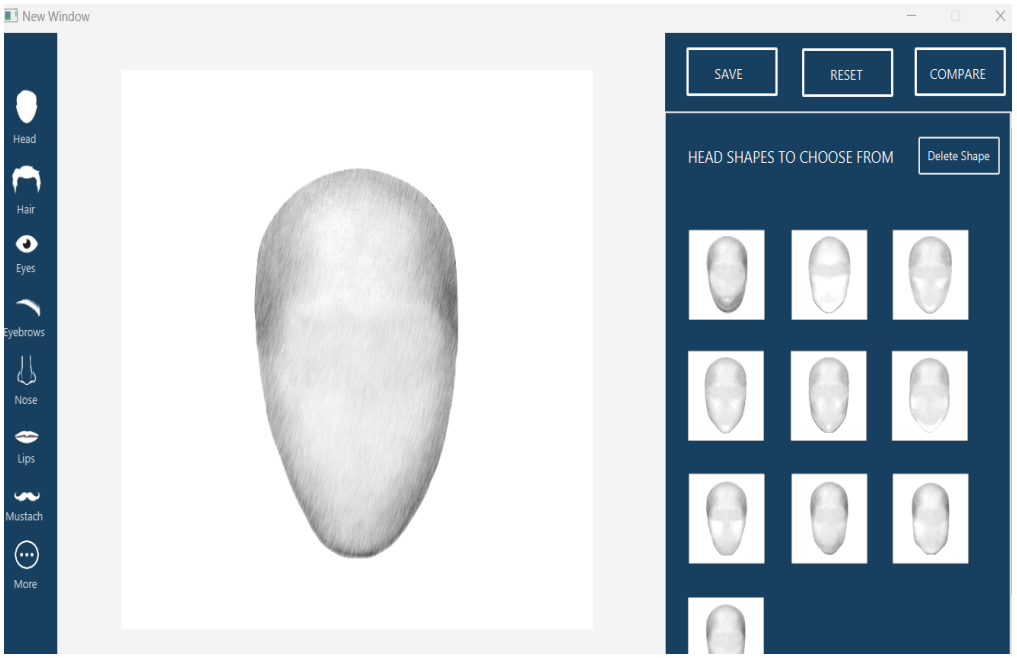

Fig 4.1.9. When one of the many head shapes are chosen

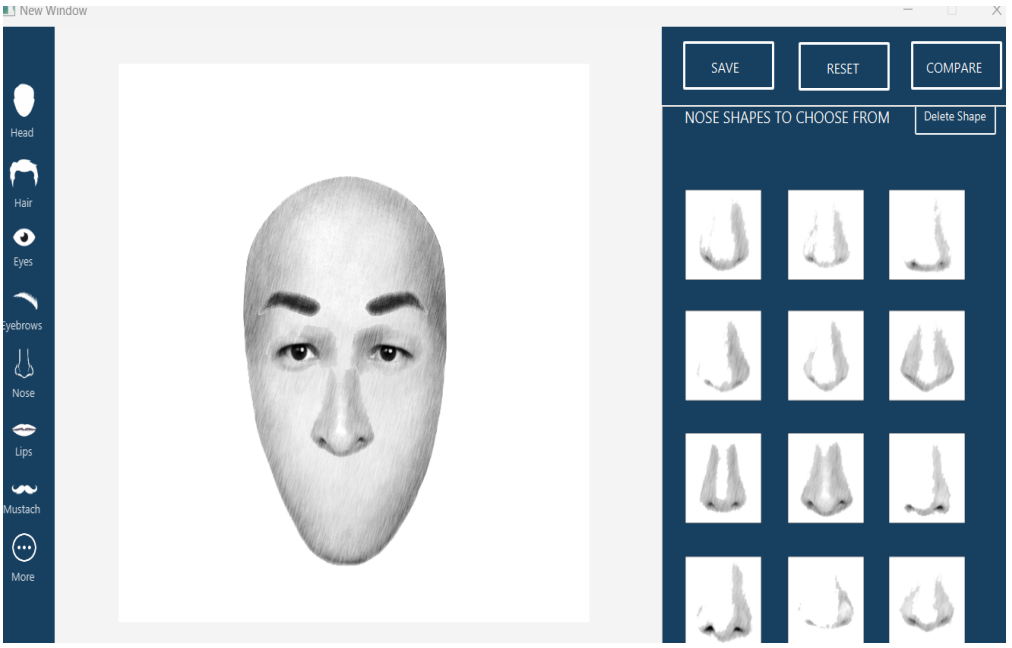

Fig 4.1.10. Another shape selected (adding features)

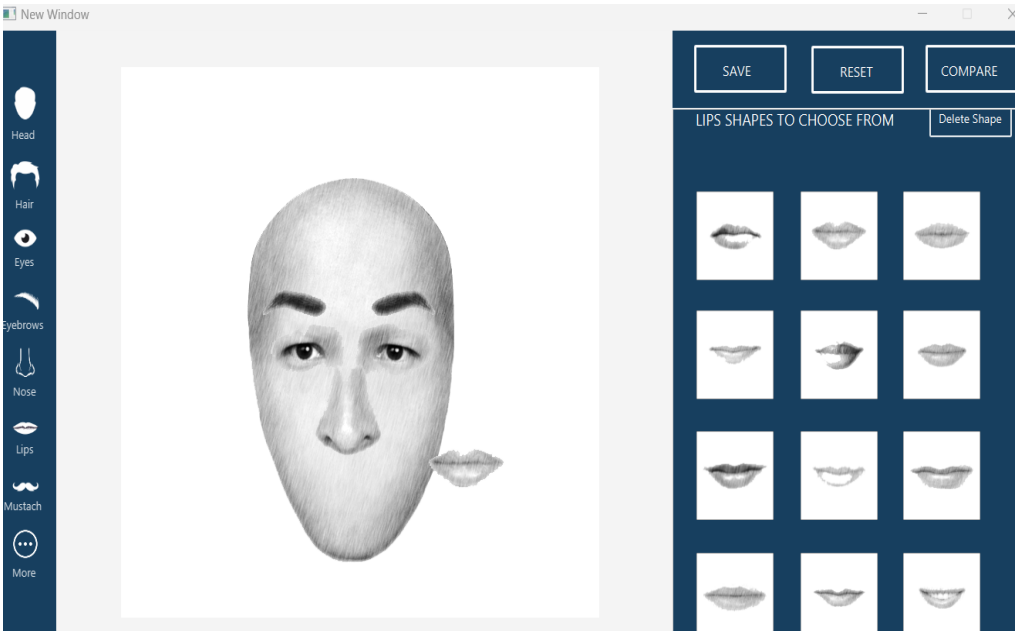

Fig 4.1.11. Illustrates that mouse can be used to feature if not in correct position

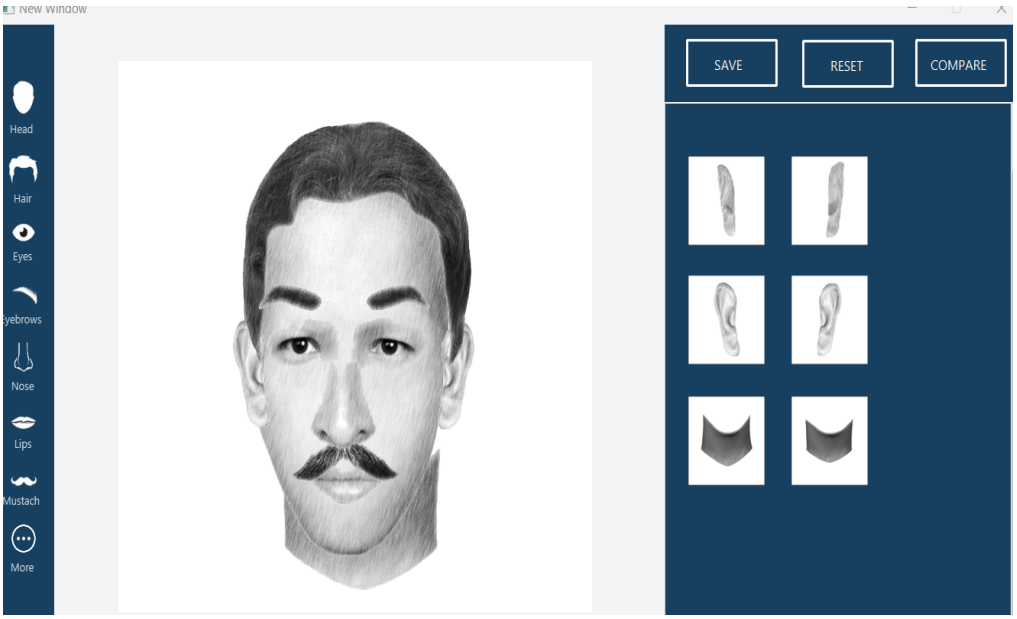

Fig 4.1.12. Illustrates a complete facial sketch using platform

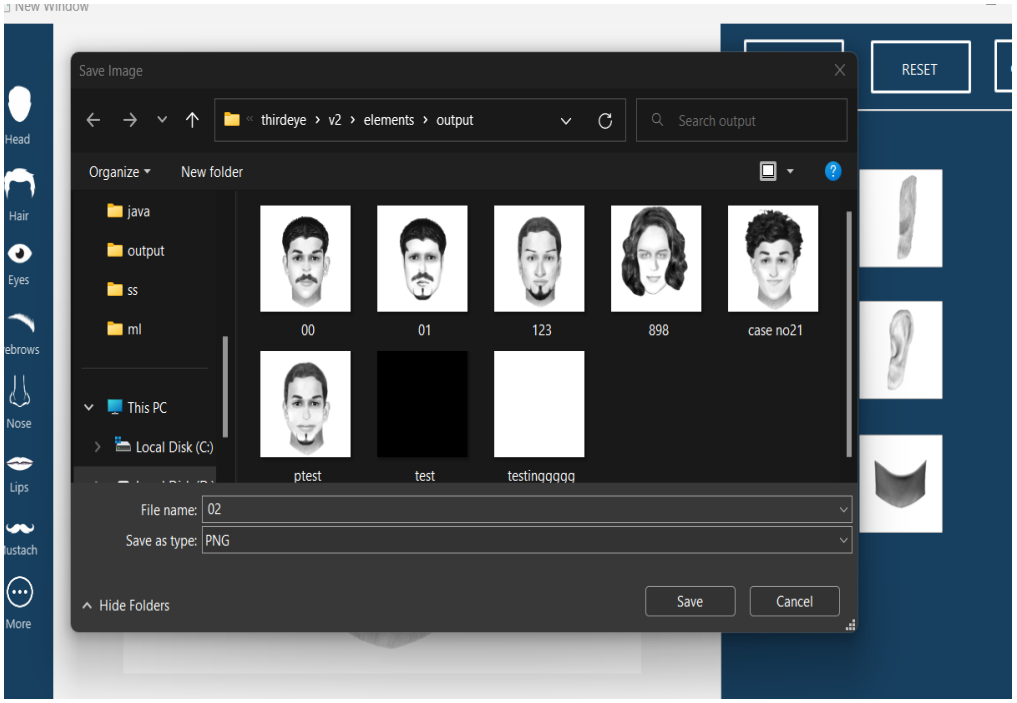

Fig. 4.1.13. Demonstrates how to save the face sketch as a file.

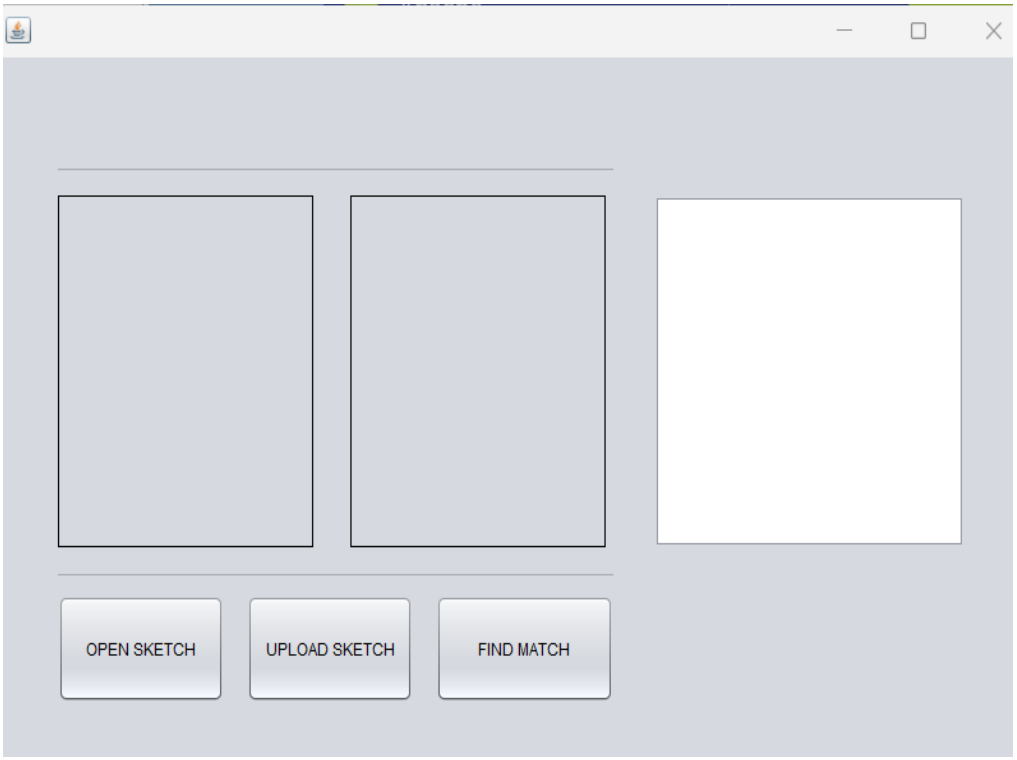

Fig 4.1.14. Illustrates the initial dashboard for recognizing part of the module

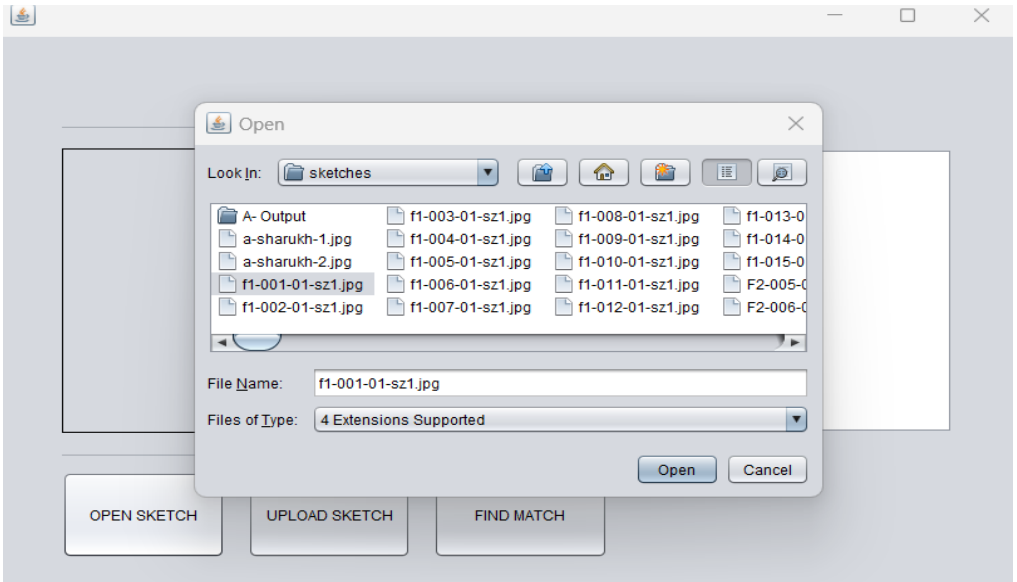

Fig 4.1.15. Illustrates how to choose and then select face sketch

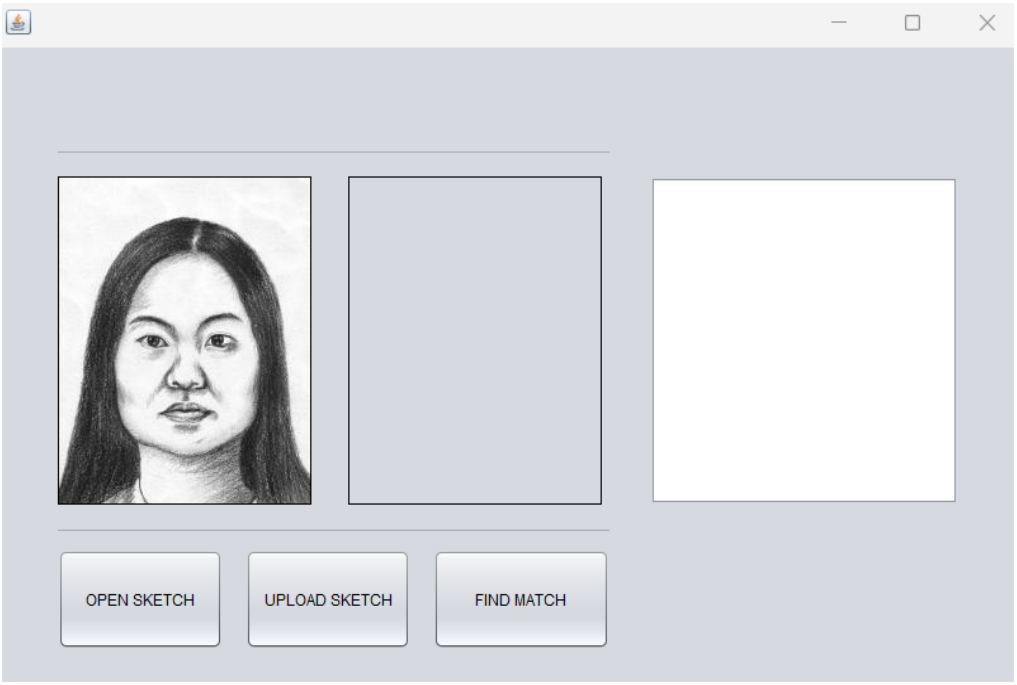

Fig 4.1.16. Illustrates the opened face sketch from previous step

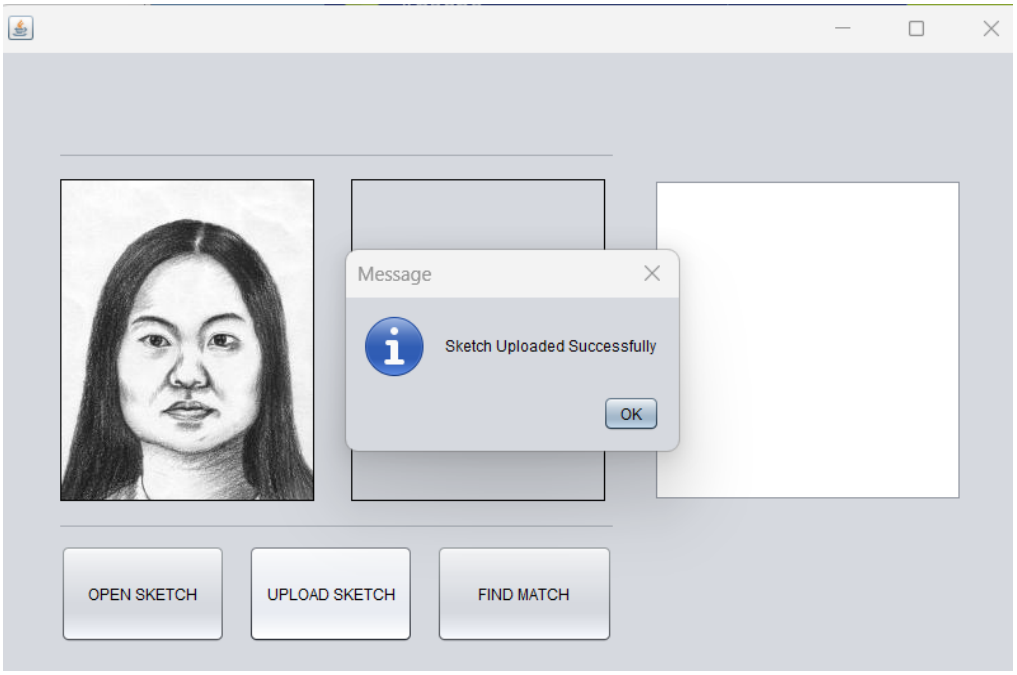

Fig 4.1.17. Uploading a face sketch to the console and prompt being displayed

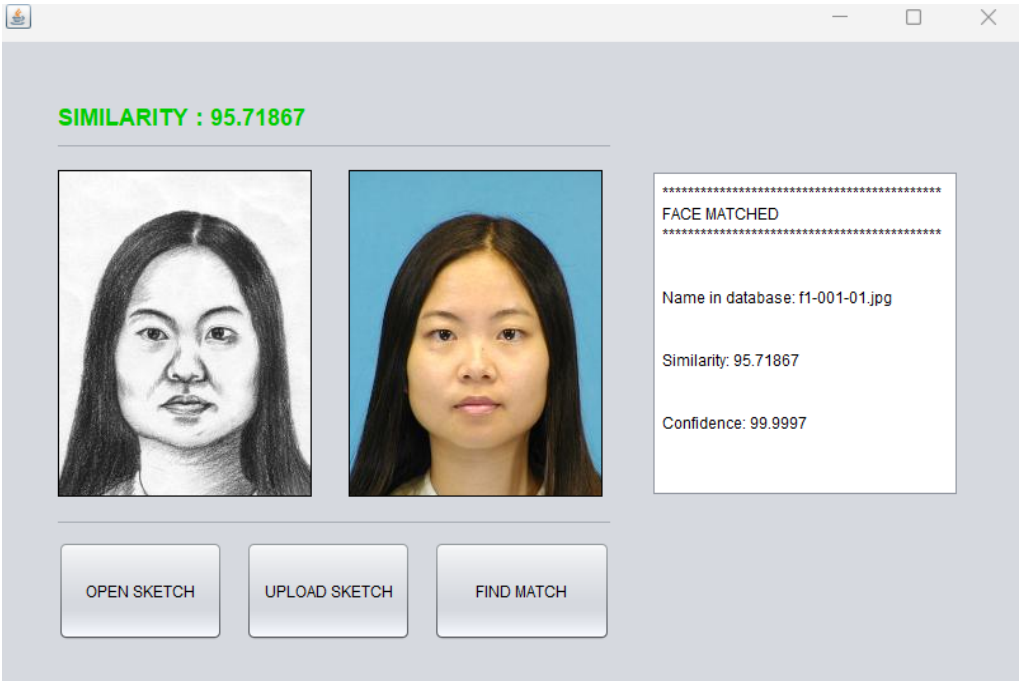

Fig 4.1.18. The sketch and database reference is found to be compatible

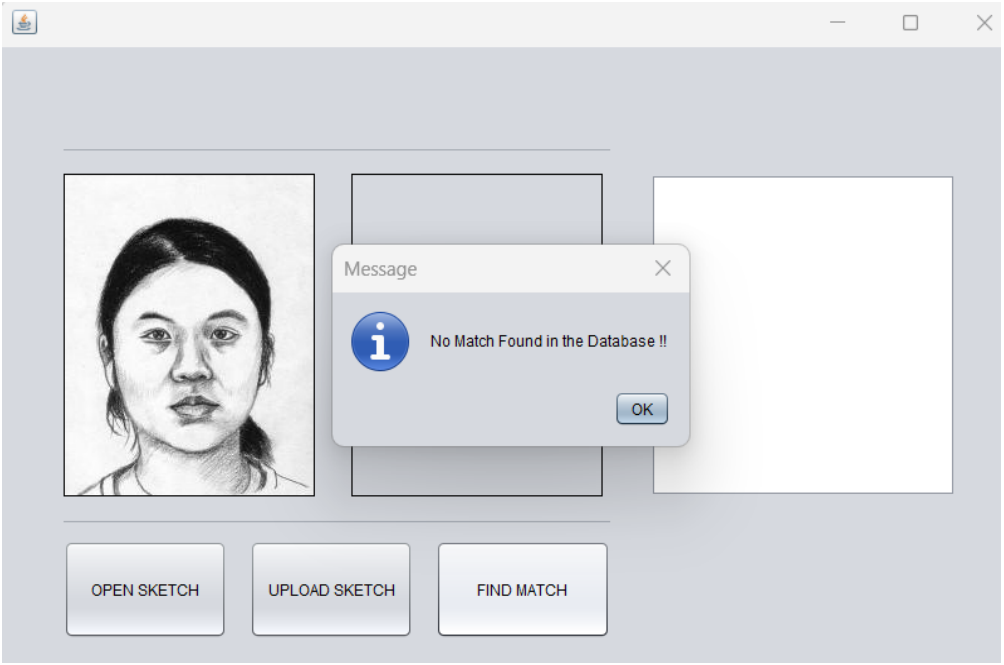

Fig 4.1.19. Face sketch that is not compatible with database record

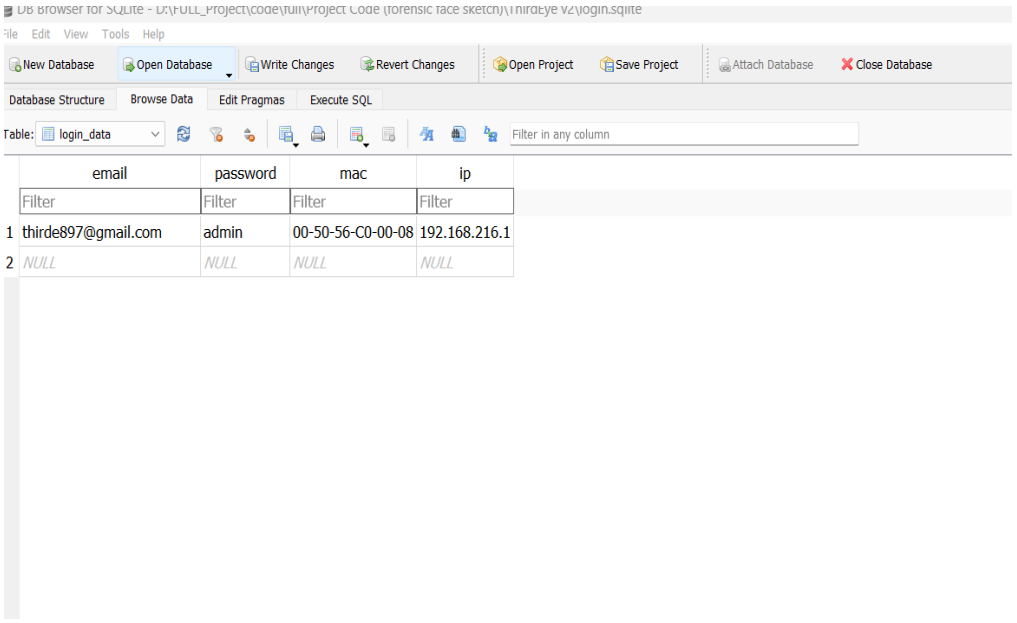

Fig 4.1.20. Login requirements that are stored in database

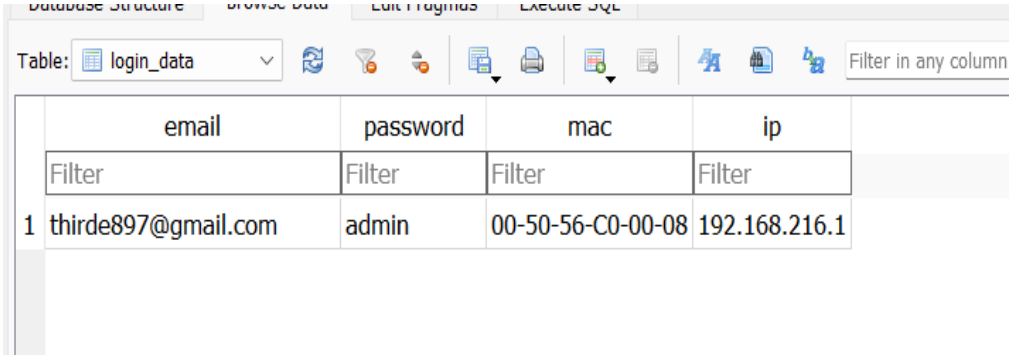

Fig 4.1.21. Internet protocol (IP) address and media access control (MAC) address with credentials of the user

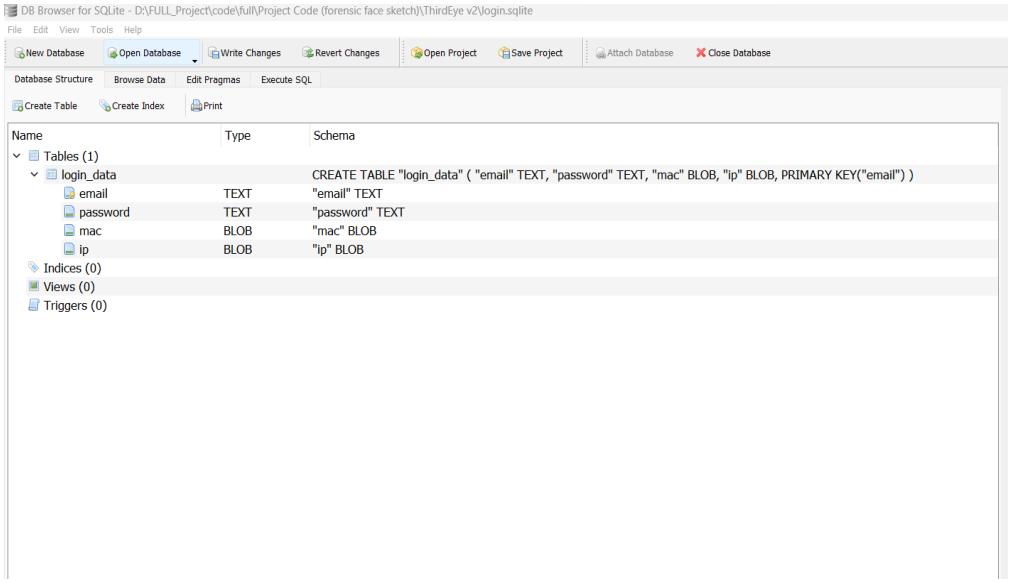

Fig 4.1.22. Illustrates schema for the database

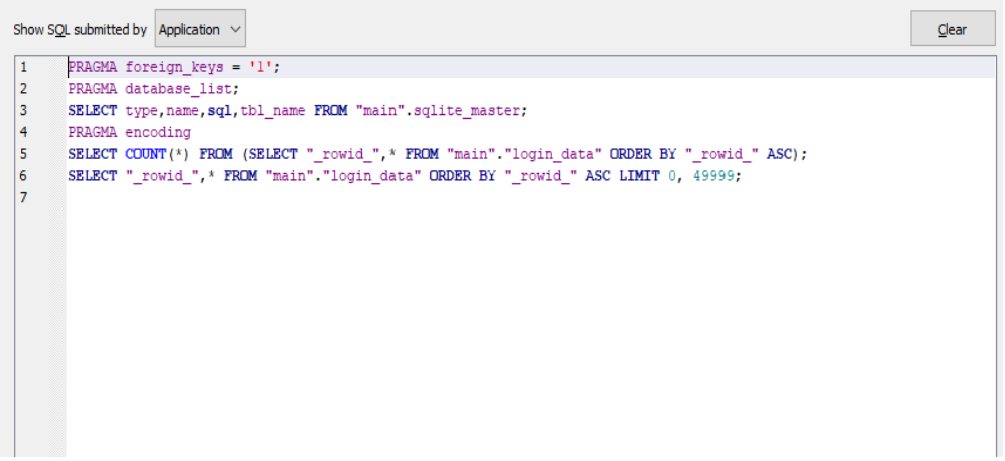

Fig 4.1.23. Illustrates schema for database user credentials

4.2 Results

The 'Forensic Face Sketch Construction and Recognition' project was developed with security, privacy, and accuracy as key factors in every scenario. The platform achieved tremendous results in terms of security by blocking unauthorized access, and the OTP system further enhanced security by generating new OTPs every time. The face sketch construction and recognition process showed good accuracy and speed,

achieving an average accuracy of over 90% . The platform also has unique features that enhance overall security and accuracy, setting it apart from related studies in this field.

Methodology Used	Dataset Used	Accuracy	Precision
Deep learning (CNN)	CUFS	92.5%	0.92
SVM- based method	CUFS	84.6%	0.81

Table 4.2.1 Results

The result table shows the performance of two different methods - deep learning and SVM-based methods for this project. Both methods were evaluated using the same dataset CUFS and achieved varying levels of accuracy and precision. The deep learning method achieved an accuracy of 92.5% and precision of 0.92, while the SVM-based method achieved an accuracy of 84.6% and precision of 0.81.

These results suggest that the deep learning method performed better overall in terms of accuracy and precision, indicating that it may be a more effective approach for this specific project. However, it's important to note that the performance of each method can vary depending on the specific dataset and the parameters used.

CHAPTER 5 : CONCLUSION

The success of the project lies in its ability to incorporate real-world scenarios and requirements into its design, ensuring reliability, confidentiality, and precision in every situation. From the very first splash screen, the project was structured and designed to provide an easy-to-use interface that was accessible to all members of the law enforcement community.

One of the most impressive features of the project was the implementation of the OTP system. This system demonstrated its ability to minimize the use of pre-computed one-time passwords by generating a new and unique OTP every time the user attempted to log in or refresh the OTP screen. This approach ensured the security of the system by blocking unauthorized access if the IP address and MAC address did not match those associated with the user in the database.

The project's success can also be attributed to its adherence to industry-standard security practices. By incorporating SSL encryption, secure hashing algorithms, and user authentication, the platform ensured that data transmitted between the user and the server was secure and protected.

Additionally, the project's face sketching module was designed with accuracy and confidence in mind. The platform allowed users to create a precise face sketch based on eyewitness descriptions and compare it to the records in the law enforcement agency's database. The system returned a match with a resemblance percentage and other information about the individual, providing a reliable and efficient solution for identifying suspects.

In conclusion, the project was successful in achieving its goals of providing a user-friendly, secure, and accurate platform for law enforcement agencies to retrieve data from their files. The implementation of the OTP system, adherence to industry-standard security practices, and the precise face sketching module all contributed to the project's success. The project's ability to incorporate real-world scenarios and requirements into its design ensures its practicality and relevance in the law enforcement community. Overall, this project demonstrates the power of technology in facilitating law enforcement operations and improving public safety.

Facial recognition technology has become an important tool for law enforcement agencies around the world. However, there are challenges in accurately identifying a face, particularly when it is in the form of a sketch. The project aimed to address this challenge by developing a platform that could accurately and confidently identify a face sketch in the law enforcement agency face photo records.

The project team focused on effectiveness and safety as the main characteristics when designing the platform for the law enforcement division. The goal was to ensure that anyone from the law enforcement community could use the platform without requiring specialized training, saving time and resources of the agency.

To achieve this goal, the platform was designed to connect to the provided database and decompose each face snapshot into a variety of minute details, assigning an ID to each of these features. The user could upload a hand-drawn sketch or a face sketch formed on the console and stored in the machine by the host. After submitting the sketch to the server, the module learned about the properties regarding the sketch and

mapped them to compare them to the characteristics of the face images in the records to ensure that they were safe and correct.

The project team also developed an OTP system that demonstrated its capacity to lessen the utilization of pre-computed one-time passwords and obtain a new and unique OTP every time the visitor tries to log back into the platform or refreshes the OTP screen. The application's system showed a phenomenal result from a standpoint of security by obstructing the system's use if the IP address and MAC address when loaded does not match up the ones that are associated with the user in the database.

The current application's system has aspects that are distinct and original compared to previous studies in the area. By striking out from all other relevant research and suggested systems in this area, these features improve the platform's security measures and precision. The project team achieved the goal of developing a platform that accurately and confidently identifies a face sketch in the law enforcement agency face photo records, keeping reliability, confidentiality, and precision as the major elements in every situation.

Overall, the project has significant implications for the field of law enforcement and facial recognition technology. The platform developed in the project could provide a valuable tool for law enforcement agencies to accurately identify suspects and enhance public safety. The project team's focus on effectiveness and safety as the main characteristics when designing the platform for the law enforcement division highlights the importance of ethical considerations when developing facial recognition technology for law enforcement purposes.

5.1 FUTURE SCOPE

While the current project is designed to match face sketches with faces in enforcement databases, there is potential for it to be improved and expanded in the future. One potential area for improvement is the incorporation of different multimedia and monitoring tools to increase its scope and effectiveness.

For example, the system could be enhanced to coordinate facial structures with realistic subjects in videos through the use of three-dimensional imaging and mapping techniques. This would enable the system to better match faces and improve its overall accuracy.

Another potential area for expansion is the integration of facial detection and recognition into closed-circuit television (CCTV) monitoring of streaming footage. By incorporating facial sketches into the CCTV footage, law enforcement agencies could more easily identify suspects and track their movements.

However, it is important to note that such expansions would need to be approached with caution and consideration of privacy concerns. Facial recognition technology has faced criticism for potential misuse and violation of privacy rights, so any expansion of the current project would need to carefully address these concerns and adhere to ethical standards.

Overall, while the current project is limited in scope, there is significant potential for it to be expanded and improved with the use of new technologies and tools. With careful consideration of ethical and privacy

concerns, such expansions could greatly enhance law enforcement's ability to identify and track suspects.

As social networking sites and their channels have become an important source of information in today's world, integrating this application with social networking platforms could greatly enhance its capabilities. By utilizing these platforms, the application can find better matches for facial sketches, making the process more precise and reducing the time it takes to complete.

Furthermore, integrating with social networking platforms could provide additional data sources that can improve the accuracy of the system. For example, information such as user profile pictures or tagged photos could be used to improve the accuracy of the facial recognition process. This would be especially useful in situations where the sketch is of low quality or incomplete.

In addition to improving accuracy and efficiency, integrating with social networking sites could also expand the scope of the application beyond law enforcement databases. For example, it could be used in social media platforms to prevent identity theft or to verify the identities of users.

Compared to previous studies in this field, the platform has unique elements that make it easy to update and improve. This would ensure that the application remains relevant and effective in the face of new challenges and technologies. These features, combined with the potential of integrating with social networking sites, could make the application a valuable tool for a wide range of industries and applications.

Overall, the integration of this application with social networking sites has the potential to greatly enhance its capabilities and expand its reach beyond law enforcement. The unique elements of the platform make it easy to update and improve, ensuring that it remains relevant in the face of new challenges and technologies.

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