FORENSIC FACE CONSTRUCTION AND RECOGNITION

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Abstract:

A modernized application aims to improve the efficiency of identifying criminals using hand-drawn face sketches. The platform allows users to upload hand-drawn features, converting them into a component set. The machine learning algorithm learns from the sketches and database to suggest relatable facial features, reducing time and increasing efficiency. This approach will make it easier for law enforcement to identify suspects. During the past there were several techniques been proposed to convert hand-drawn face sketches and use them to automatically identify and recognize the suspect from the police database, but these techniques could not provide the desired precise results. Application to create a composite face sketches were even introduced which too had various limitations like limited facial features kit, cartoonistic feel to the created suspect face which made it much harder to use these applications and get the desired results and efficiency. The above applications and needs motivated us into thinking of creating an application which would not just provide a set of individual features like eyes, ears, mouth, etc

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Keywords:

JavaFX, Maven, ImageNet, API (Application Programming Interface), Gradle, Windows Implementation Gradle, AWS (Amazon Web Service)

1.   INTRODUCTION

A new application aims to improve the efficiency of identifying criminals using hand-drawn face sketches. The platform allows users to upload hand-drawn features, converting them into a component set. The machine learning algorithm learns from the sketches and database to suggest relatable facial

features, reducing time and increasing efficiency. This innovative approach aims to streamline law enforcement operations.The above applications and needs motivated us into thinking of creating an application which would not just provide a set of individual features like eyes, ears, mouth, etc. to be selected to create a face sketch but also would allow user to upload hand-drawn individual features on the platform which would then be converted in to the applications component set. This in turn would make the created sketch much more similar to the hand-drawn sketch and would be much easier for the law enforcement departments to adapt the application. Our application would even allow the law enforcement team to upload a previous hand- drawn sketch in order to use the platform to identify and recognize the suspect using the much more efficient deep learning algorithm and cloud infrastructure provided by the application.

2. RELATED WORK

Numerous studies have been conducted on face sketch construction and recognition using various approaches. Dr. Charlie Frowd and others developed a standalone application for constructing and identifying facial composites, which was successful. Xiaoou Tang and Xiaogang Wang proposed a recognition method using a Multiscale Markov Random Field Model, which reduced the difference between photos and sketches. Anil K Jain and Brendan Klare proposed a sketch-to-photo matching method using SIFT Descriptor, which showed better results but lacked the accuracy needed by law enforcement departments.

Our application aims to bridge the gap between traditional hand-drawn face sketch techniques and modernized composite face construction, allowing users to upload hand-drawn sketches and facial features, overcoming limitations and time-consuming issues.

Table 2.1 forensic face sketch construction and recognition

AUTHOR	PROPOSEDAPPROACH	LIMITATION
Charlie Frowd eta.l	Automating the Processes Involved in Facial Composite Production and Identification	The Facial Composite created was not accurate and difficult to match with the database with accuracy.
W.Zhang et.al	Coupled information theoretic encoding for face photo-sketch recognition	The common issue with all the proposed algorithm where that they compared the face sketches with human face which were usually front facing making it easier to be mapped both in drawn sketch and human face photograph, but when a photograph or sketch collected
X.Tangand et.al	Face sketch recognition	
B.Klareand and A.Jain	Sketch to photo matching: afeature- based approach	

P.Yuenand eta.al	Human face image search in system using sketches Matching composite sketches to face photos :Acomponent based approach	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.

Table 2.1: Previous proposed approaches in the field of forensic face sketch construction and recognition. The Table consist of the Author name along with the Proposed Approached and their Limitation.

3.   Problem Statement:

The increasing crime rate necessitates faster and more efficient law enforcement methods, such as face recognition technology. Traditional hand-drawn sketches are limited and time-consuming, necessitating the development of an application that includes more features.   The traditional approach here is to use the hand-drawn face sketches drawn by forensic sketch artist to identify the criminal, modernizing this would mean using the hand-drawn sketch and then matching them with the law enforcement departments database to identify the criminal. Using this approach would result in the various limitations with latest technologies and even would be time consuming as there are very few forensic sketch artists available when compared to the increasing crime ratio. Thus, there is a need for creating an application which would not just provide a set of individual features like eyes, ears, mouth, etc. to be selected to create a face sketch that would help in finding the criminal much faster and efficiently.

4.   PROPOSED WORK:

4.1Security and Privacy

  The law enforcement department prioritizes security and privacy when adapting systems, ensuring the application protects privacy through various security measures.

4.2 Machine Locking:

The machine locking technique prevents tampering and system operation of an installed application using one software and one hardware locking parameter.

HDID - Volume serialofhard-drive withOS.

NETI - HardwareID – MAC Address.

4.3 Two Step Verification:

 Law enforcement authorized users will receive an official email ID to login to the application, which requires entering a shared random code on their mobile or desktop.

4.4 Centralized Usage:

The application system is connected to a centralized server in the law enforcement department campus, ensuring its operation cannot be disrupted once disconnected.

4.5 Backward Compatibility

Our application simplifies migration of hand-drawn sketches, utilizing deep learning algorithms and cloud infrastructure to identify criminals, overcoming the challenge of time and resource wastage.

4.6 Face Sketch Construction using Drag and Drop

The application creates an accurate composite face sketch using predefined facial feature sets, allowing eye-witnesses to resize and position features based on their requirements, using machine learning algorithms for efficient completion.

Fig 4.1 .Shows the sketch of the facial feature viz. Head Fig. 4.2 .Shows the sketch of the facial feature viz. Eyes Fig. 4.3 Shows the sketch of the facial feature viz. Ears

Fig 4.1 : sketch of the facial feature viz. Head	Fig. 4.2: sketch of the facial feature viz. Eyes	Fig. 4.3 : sketch of the facial feature viz. Ears
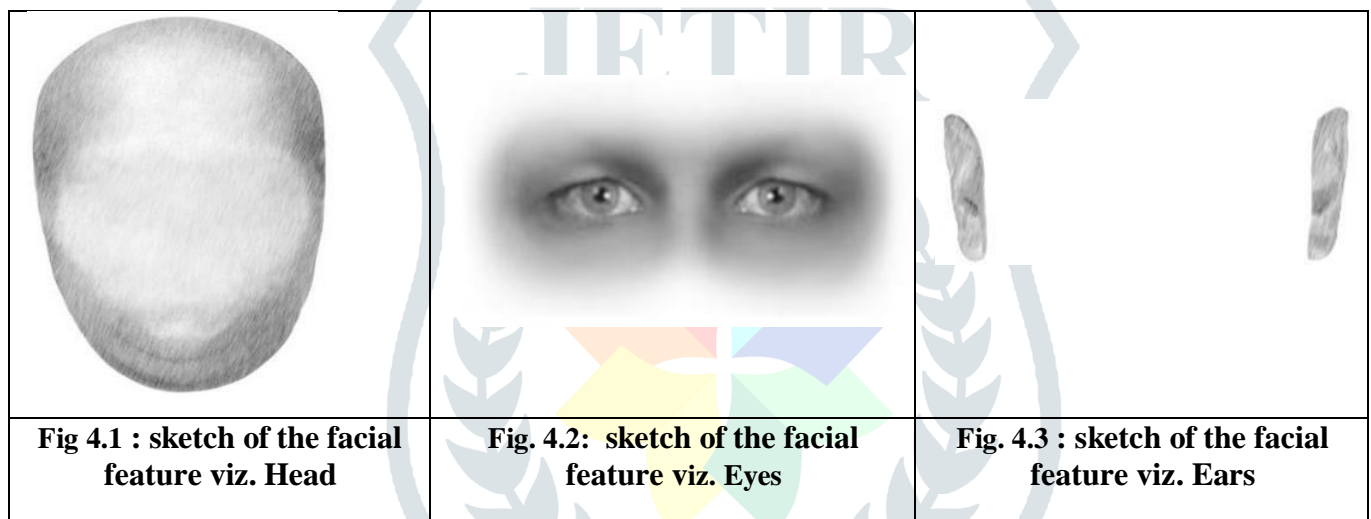
The application uses facial features to create a composite face sketch of a suspect based on eye-witness descriptions provided to law enforcement and forensic departments.

4.7   Face Sketch Construction Module:

The project focuses on developing a security and accurate platform for the law enforcement department by creating a face sketch based on Eye Witness descriptions. The dashboard is designed to provide an accurate face sketch based on eye witness descriptions, allowing users from law enforcement departments to use the platform without professional training. The dashboard consists of five main modules: Canvas, which houses face sketch components, Ordered Face Elements, which can be categorized by head, nose, hair, or eyes, and Machine Learning for predicting similar elements. The
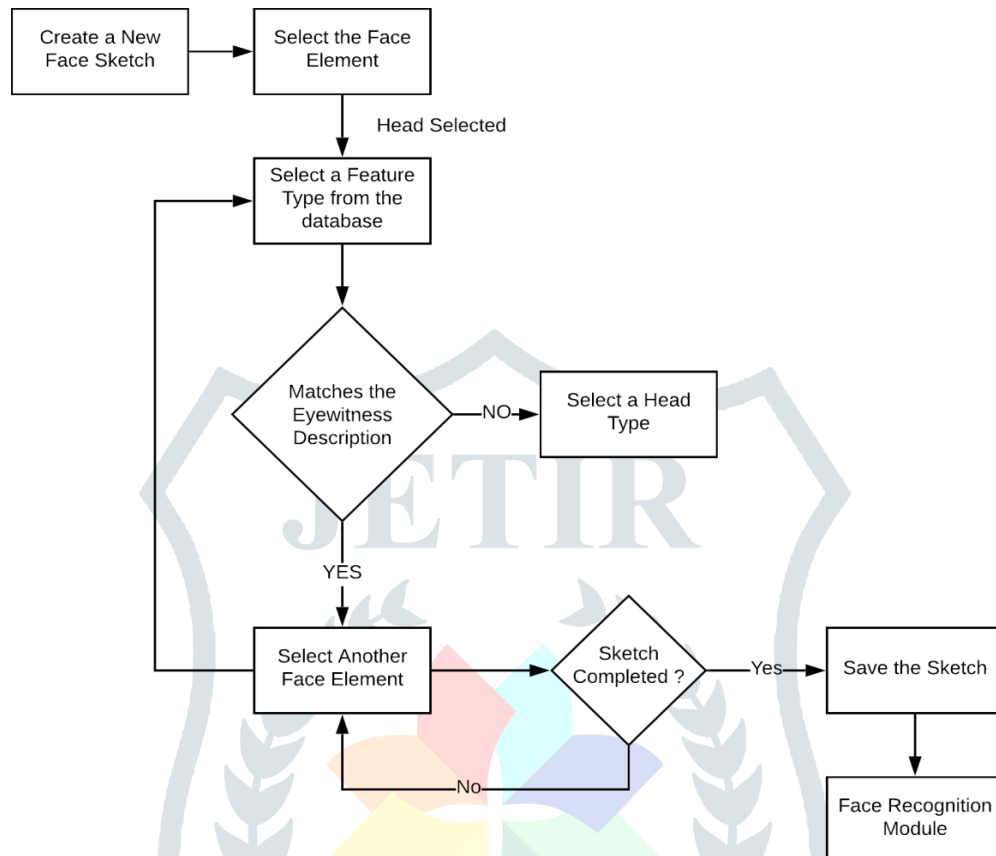
dashboard also features options to erase selected elements, ensuring a more accurate and efficient process.

4.8 Face Sketch Recognition Module:

The project focuses on developing a security and accurate platform for the law enforcement department, specifically recognizing face sketches in face photo records with confidence.
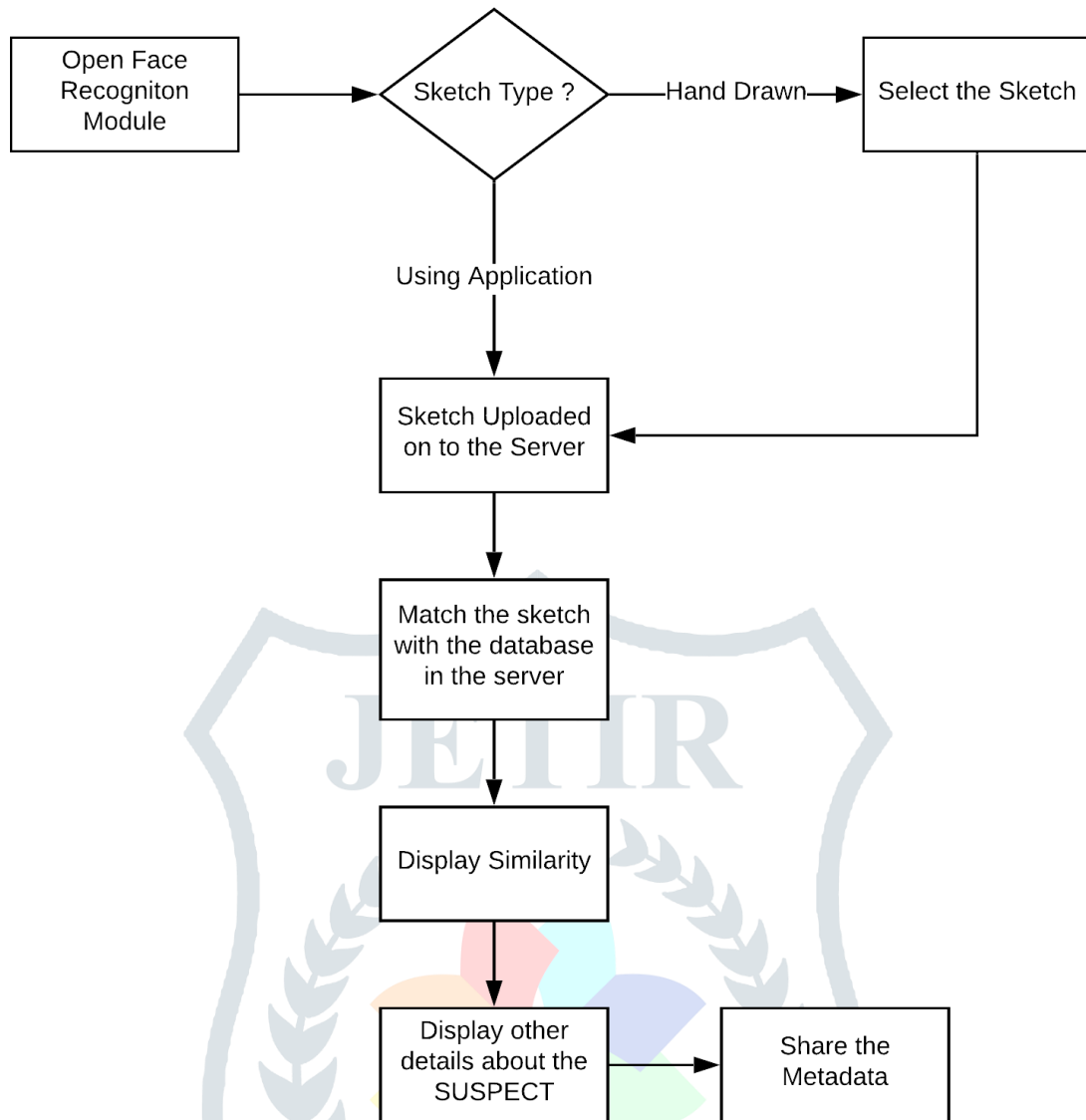

Fig 4.5 Flow Chart for Recognizing a sketch in the application

The platform provides accurate face sketches without professional training, saving time and resources. It can be used by law enforcement or eye witnesses, ensuring security protocols are maintained.
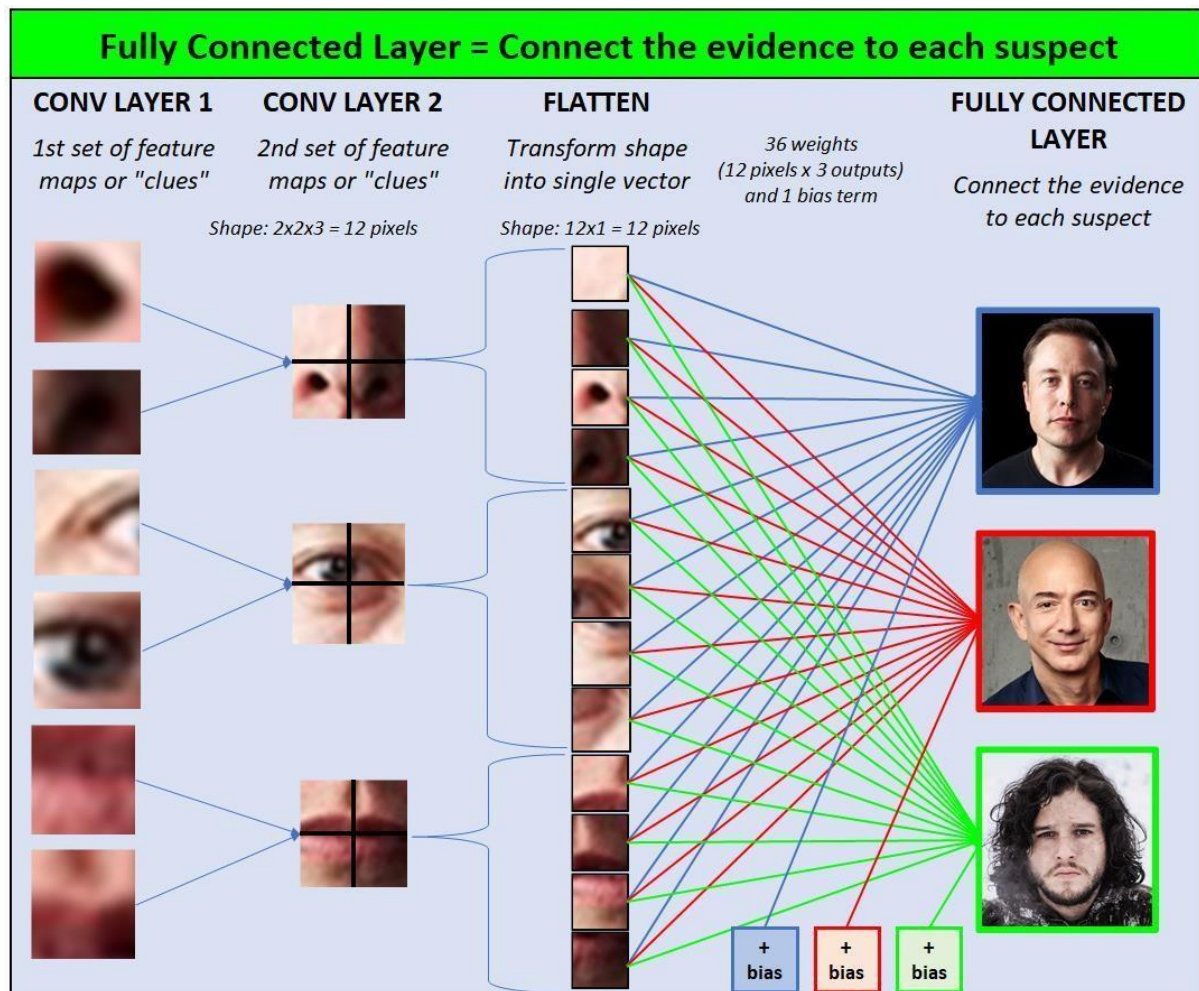
Fig 4.9 Feature extraction by the Platform

The platform uses existing law enforcement records to train and assign IDs to face photos. It breaks each photo into smaller features and assigns IDs. The module runs on the law enforcement server for security protocols, tracing and mapping features to match face photos.

5.   TECHNOLOGYSTACK

Our platform utilizes advanced technology to enhance the law enforcement department's security features, accuracy, and efficiency, thereby improving crime solving rates and efficiency.

5.1   Machine Locking:

The machine locking technique prevents tampering and system operation of an installed application using one software and one hardware locking parameter.

HDID–Volumeserialofhard-drivewithOS. NET ID – Hardware ID – MAC Address.

5.2   **OTP (One Time Password):**

Law enforcement users use an official email ID to log in to an application, requiring a one-time password (OTP) for authentication. OTPs are more secure than static passwords and can be delivered through SMS, email, or a dedicated application. However, NIST plans to deprecate SMS for 2FA and OTP systems.

5.3   **Java:**

Java, a programming language and computing platform, was first released in 1995 by Sun Microsystems. It offers high cross-functionality, portability, and is widely used in various applications. Java is stable, mature, and popular at enterprise, embedded, and network levels. Its latest version, Java 8, offers new features and compatibility with JavaScript.

5.4   **JavaFX:**

JavaFX is a set of graphics and media packages that allows developers to design, create, test, debug, and deploy rich client applications across diverse platforms. It is written as a Java API, allowing developers to reference APIs from any Java library. JavaFX applications can be customized using CSS, FXML, WebView, Swing interoperability, built-in UI controls, Canvas API, multitouch support, hardware-accelerated graphics pipeline, high-performance media engine, and a self-contained application deployment model. It supports network-aware applications deployed across multiple platforms and features audio, video, graphics, and animation.

5.5   **AWS(Amazon Web Services):**

Amazon Web Services (AWS) is a subsidiary of Amazon that offers on-demand cloud computing platforms and APIs to individuals, companies, and governments. AWS provides a pay-as-you-go model, offering a variety of services, including Amazon Elastic Compute Cloud (EC2), which provides a virtual cluster of computers. AWS dominates 34% of all cloud computing, with its services accessed over HTTP.
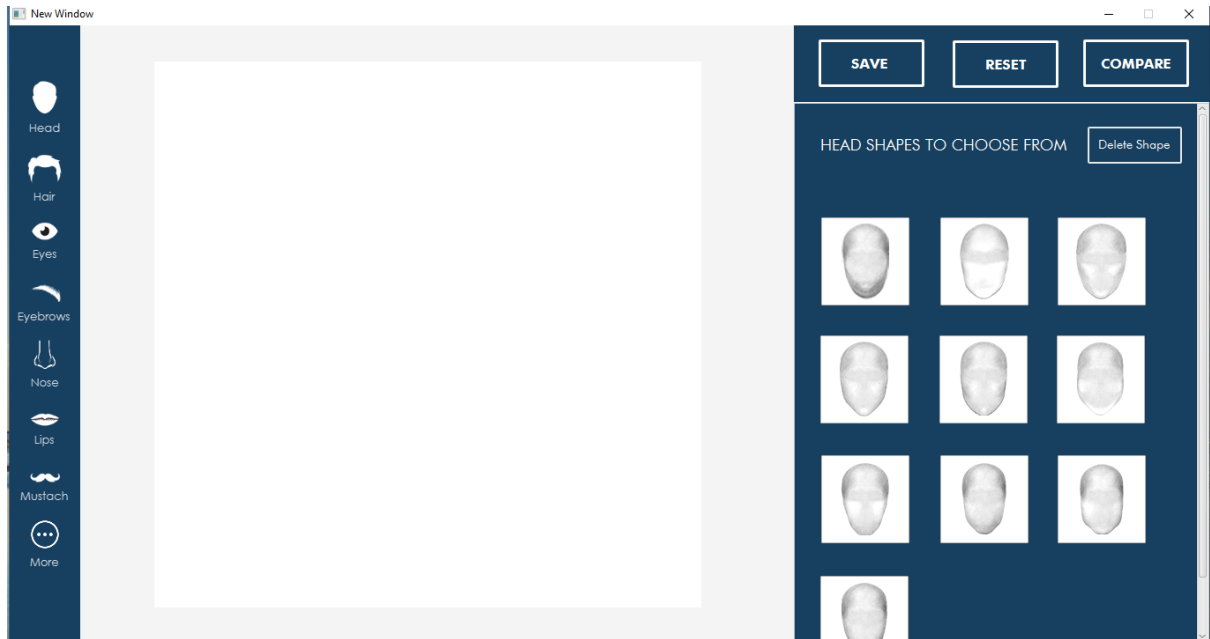
6 APPLICATION DESIGN:

Fig 6,1 Dashboard to Createa Facial Sketch

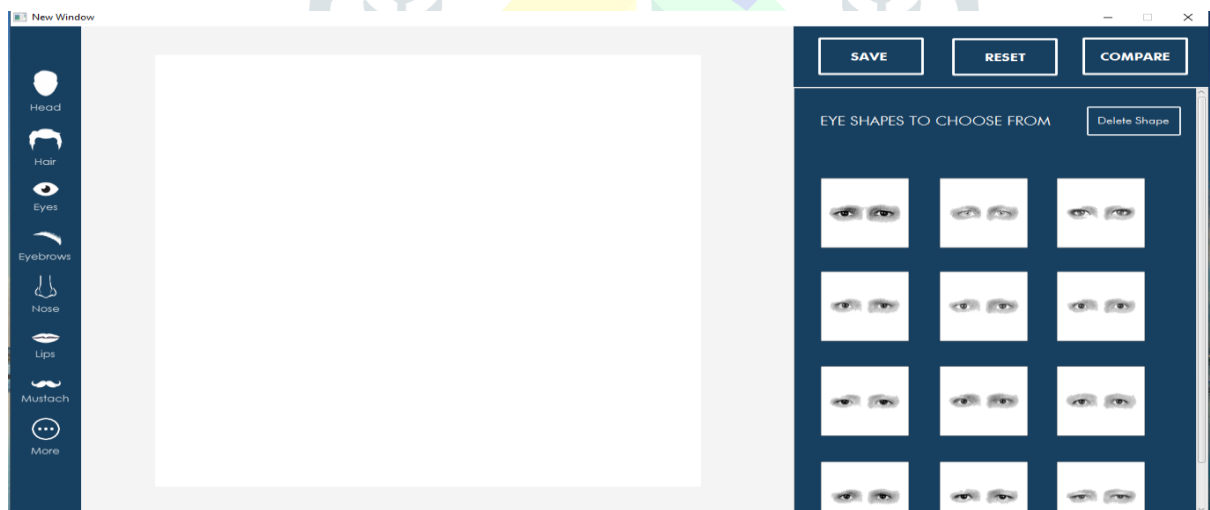(Dashboard with the Head Element Selected showing the various head shapes)
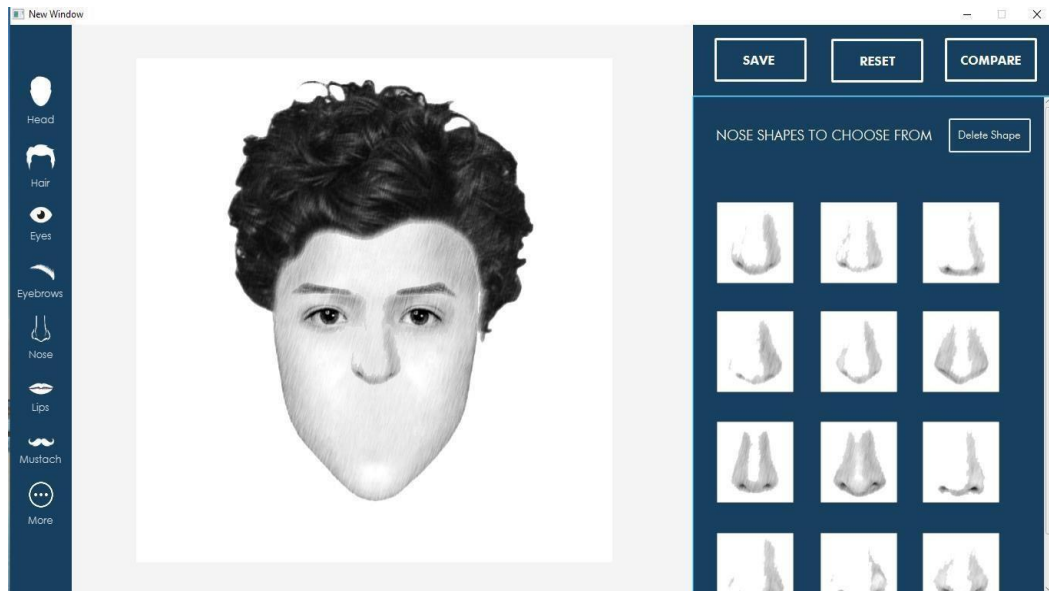

Fig 6,2 Dashboard to Createa Facial Sketch

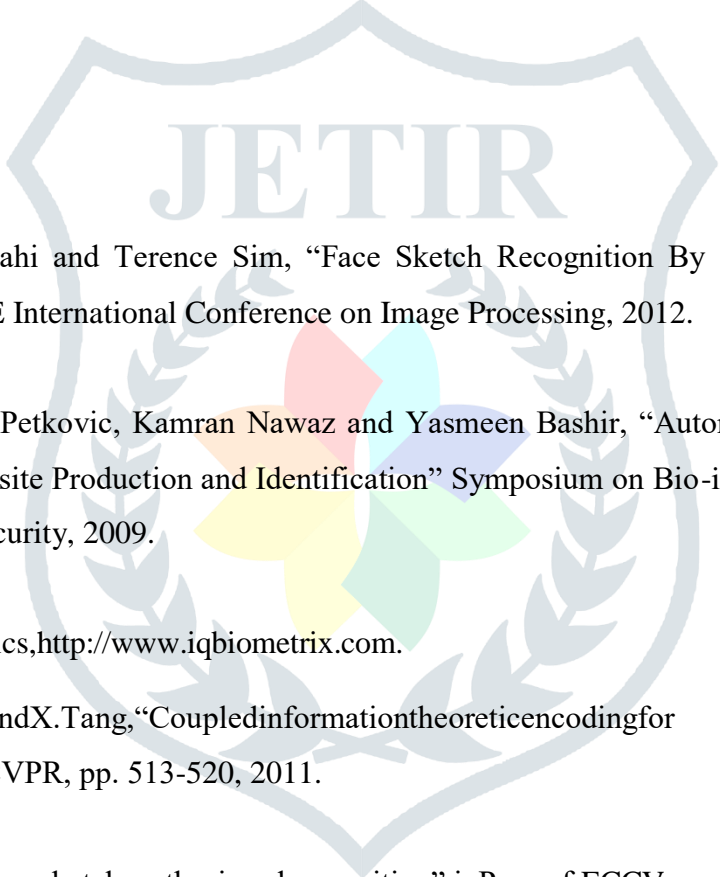**Fig 6.3 Other Shape to selected in Dashboard**

7.   RESULTS AND CONCLUSION

The 'Forensic Face Sketch Construction and Recognition' project focuses on security, privacy, and accuracy in real-world scenarios. The platform blocks use if MAC Address and IP Address don't match user credentials, and provides high accuracy and speed, outperforming related studies.

8.   FUTURE SCOPE

The 'Forensic Face Sketch Construction and Recognition' project focuses on matching face sketches with law enforcement photos. Future enhancements include 3D mapping, 3D imaging, and integration with social media for more accurate face recognition. This unique and easy-to-upgrade platform enhances security and accuracy.

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