ENHANCING CRIMINAL IDENTIFICATION: A FACIAL RECOGNITION-BASED APPROACH FOR PROACTIVE CRIME PREVENTION

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Abstract— The primary difficulty faced by law enforcement agencies pertains to preventing crimes and identifying individuals involved in criminal activities. as they tirelessly strive to protect life and property. However, the availability of police personnel is inherently limited, prompting the necessity for innovative solutions to optimize their efforts. This research project endeavors to revolutionize criminal identification by introducing a system that promises heightened accuracy, improved response rates, and an initial foray into video surveillance. By leveraging insights into the criminal psyche, the system aims to discern patterns of recurring criminal behavior or involvement in unlawful activities, with a particular emphasis on tracking individuals with a history of criminal offenses. Developed on Python 3.10.8 and incorporating advanced algorithms like Haar cascade classifier, LBPH, and face recognition, the system utilizes cutting-edge technologies to achieve its objectives. Storing detailed information, including images and relevant data, in an SQLite database ensures efficient data retrieval and rapid deployment of results in real-world scenarios. This investigative study not just addresses the imperative of proactively identifying individuals with criminal histories but also underscores the significance of integrating advanced technologies into law enforcement strategies. It stands as a testament to the ongoing evolution of crime prevention and criminal identification methodologies, providing a robust foundation for future advancements within the domain.

Keywords— Face Recognition, Surveillance, Crime, Detection, Face matching.

I. INTRODUCTION

In contemporary law enforcement, the pivotal challenges of crime prevention and the prompt and efficient recognition of individuals with prior criminal records necessitate innovative approaches to optimize limited resources. This research endeavors to revolutionize current practices by introducing a comprehensive framework that integrates advanced technologies, specifically focusing on facial recognition and psychosocial insights. The aim is to proactively enhance crime prevention measures by accurately identifying individuals with prior criminal convictions.

With law enforcement personnel facing constraints in availability, the proposed system offers a solution characterized by heightened accuracy, improved response rates, and an initial exploration into video surveillance. By delving into the nuances of the criminal psyche, the system seeks to discern patterns of recurring criminal behavior and unlawful activities, particularly emphasizing the tracking of individuals with a history of criminal offenses.

Built on Python 3.10.8 and incorporating cutting-edge algorithms such as Haar cascade classifier, Local Binary Pattern Histogram (LBPH), and face recognition, the framework utilizes technological advancements for efficient data retrieval. The storage of comprehensive information, including facial images and pertinent details, in an SQLite database ensures rapid deployment of results in real-world scenarios.

This study not only focuses on the imperative of proactive criminal identification but also emphasizes the importance of integrating advanced technologies into law enforcement strategies. The forthcoming sections delve into the details of this innovative framework, highlighting its potential to reshape the landscape of crime prevention and criminal identification methodologies.

A. Python:

The framework is built on Python 3.10.8, providing a robust and versatile programming environment. Python's extensive libraries and community support facilitate seamless integration of advanced algorithms.

B. Haar Cascade Classifier:

The Haar cascade classifier is employed for object detection, particularly for facial features. This technology enhances the precision of facial recognition by identifying specific patterns in images.

C. Local Binary Pattern Histogram (LBPH):

LBPH is utilized for facial recognition, capturing intricate details in facial textures. This contributes to a more nuanced analysis, improving the capability of the system to distinguish between individuals.

D. Face Recognition:

Face recognition algorithms are implemented to match detected faces with existing criminal databases. This technology forms the core of the system's identification process, ensuring swift and accurate results.

E. OpenCV:

OpenCV serves as an essential and integral part of the framework, offering a robust library for various computer vision tasks. Its versatile capabilities, spanning image processing, object detection, and facial recognition, are crucial for the effective implementation of the proposed system. The multifaceted functionalities, including image manipulation, feature extraction, and facial landmark detection, significantly elevate the system's accuracy and efficiency in facial recognition tasks.

II. LITERATURE SURVEY

This study [1] improves crime prediction through machine learning in Chicago and Los Angeles. Notably, XGBoost and KNN demonstrate high accuracy, providing valuable insights into crime categorizations and temporal patterns. The ARIMA model predicts a modest rise in crime rates for Chicago and a decrease in Los Angeles, underscoring the importance of computational forecasts for shaping law enforcement strategies and guiding future improvements.

This review [2] explores the susceptibility of face recognition systems (FRSs) to morphing attacks, particularly in border control applications. It discusses morph generation techniques, MAD algorithms, and the challenges in generalizing methods amidst evolving deep learning landscapes. Emphasizing the necessity for diverse databases, the article underscores the significance of addressing morphing attacks on FRSs for robust security applications.

This paper [3] highlights the role of face recognition systems in enhancing security, particularly in criminal identification through video surveillance. The proposed system addresses challenges like poor image resolution and lighting conditions, evaluating detection models for accuracy and speed, and employing pre-processing techniques for effective face recognition.

The authors [4] present an innovative approach to expression recognition utilizing cognition and mapped binary patterns. The methodology involves the use of LBP for extracting facial contours, a pseudo-3D model for segmentation, and mapped LBP for feature extraction. The classification is performed through two models, namely support vector machine and SoftMax., classify emotions based on basic and circumplex models. Results show effectiveness, with the circumplex model outperforming. The study enhances understanding for future expression recognition in complex conditions.

This study [5] introduces a novel forensic facial recognition framework, using 2D facial images to generate 3D face meshes with real-time detection and leveraging 468 MediaPipe landmarks. The method achieves high-quality 3D reconstructions and, validated through hyperparameter optimization, shows the Extreme Gradient Boosting classifier with superior accuracy (78%). This method shows promise for future scale-up and research in forensic facial recognition.

III. METHODOLOGY

Our intricate criminal identification system, akin to a detective with digital eyes, offers two paths to hunt down potential offenders: video surveillance or photo uploads. Facial recognition algorithms compare the input to its vast database, flashing identified names on a list alongside crucial intel like aliases, descriptions, and criminal history. But it doesn't stop there. Video analysis tackles elusive subjects, meticulously dissecting each frame for matches, adding them to the list. Clicking a suspect's name unlocks their detailed profile, a chilling tapestry of past misdeeds to aid investigations. For the unidentified, manual registration expands the database, allowing future connections. Enhancements like filtering, confidence indicators, and even automated alerts for high-risk individuals further refine its effectiveness. This multifaceted system, a fusion of human intuition and algorithmic precision, empowers law enforcement to navigate the intricacies involved in criminal identification, ultimately paving the pathway to a safer future where even the most cunning leave their digital footprints.

Accompanying this narrative, a visual flow chart encapsulates the systematic process, offering a condensed yet insightful depiction of the operational pathways. This graphical representation serves as a guide, elucidating the interconnected stages of identification, data enrichment, and investigative depth.

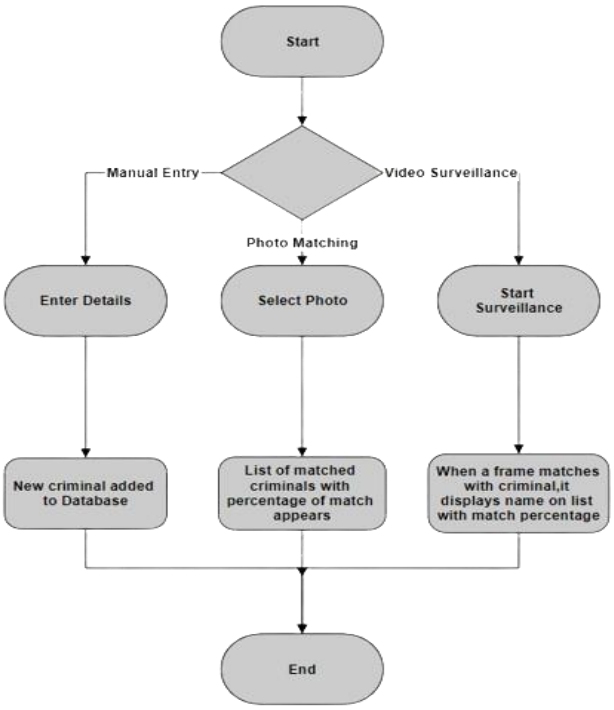

Fig 3.1: Flow Chart

IV. RESULTS

This section presents a visual exploration of the developed criminal identification system, demonstrating its efficacy in

real-world scenarios. The snapshots below offer a glimpse into the user interface and functionality across different modules, showcasing the system's versatility and impact on law enforcement efforts.

4.1 Home Page:

Figure 4.1 showcases the user-friendly home page, serving as the central control hub for law enforcement personnel. The

intuitive design ensures easy navigation and access to crucial functionalities, facilitating efficient use of the system.

4.2 Manual Entry:

Figure 4.2 illustrates the manual entry module, allowing seamless registration of individuals into the system. This functionality enriches the database with detailed information, strengthening law enforcement to establish comprehensive profiles for potential identification.

4.3 Photo Matching:

In Figure 4.3, the photo matching module is highlighted, demonstrating the system's prowess in facial recognition. Uploaded photos are swiftly contrasted with the extensive database, providing identified names and critical details for effective criminal identification.

4.4 Video Surveillance:

Figure 4.4 delves into the video surveillance feature, showcasing the system's meticulous frame-by-frame analysis. This dynamic module contributes to a proactive approach in identifying potential offenders captured on camera, enhancing the system's overall effectiveness.

Fig 4.1: Home page

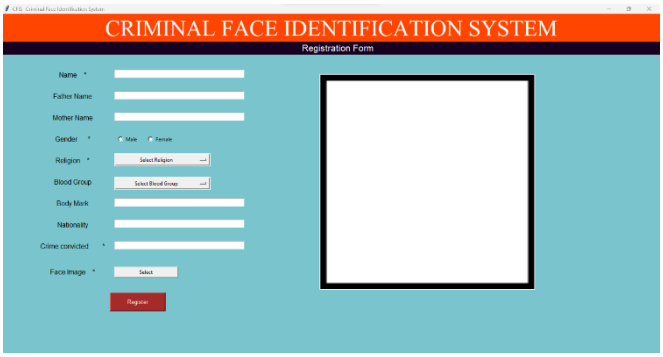

Fig 4.2: Criminal Registration

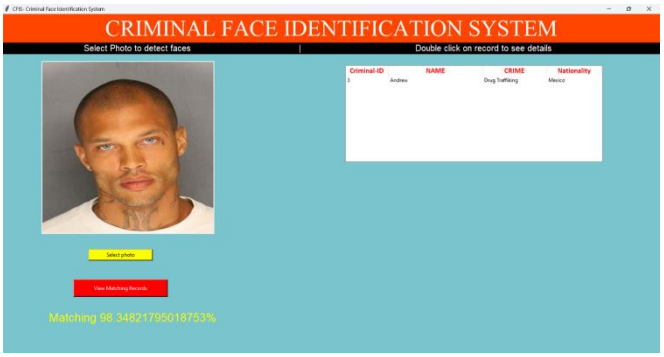

Fig 4.3: Face identification using Photo Match

Fig 4.4: Detection in Video surveillance

V. CONCLUSION

In conclusion, Our research introduces an cutting-edge criminal identification system leveraging advanced technologies like facial recognition and video surveillance. Built on Python 3.10.8 with computational methods like Haar cascade classifier and LBPH, the system promises heightened accuracy and improved response rates for law enforcement. The framework addresses challenges in crime prevention by proactively identifying persons with criminal histories, emphasizing patterns of recurring criminal behavior. Utilizing OpenCV for tasks related to computer vision and storing data in an SQLite database ensures efficiency in real-world scenarios.

The research underscores the significance of integrating advanced technologies into law enforcement strategies, providing a robust foundation for the evolving landscape of crime prevention. This multifaceted system, combining human intuition and algorithmic precision, empowers law enforcement in navigating the intricacies of criminal identification for a safer future.

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