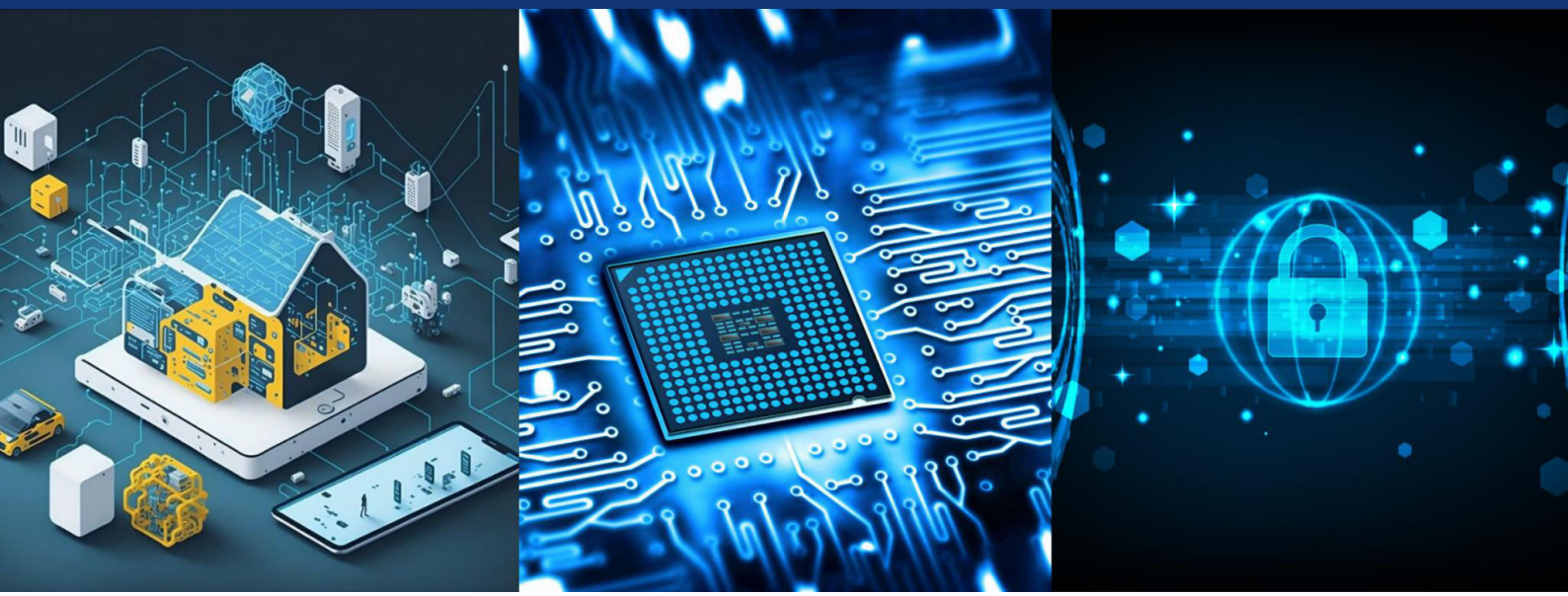
IJIRCCE

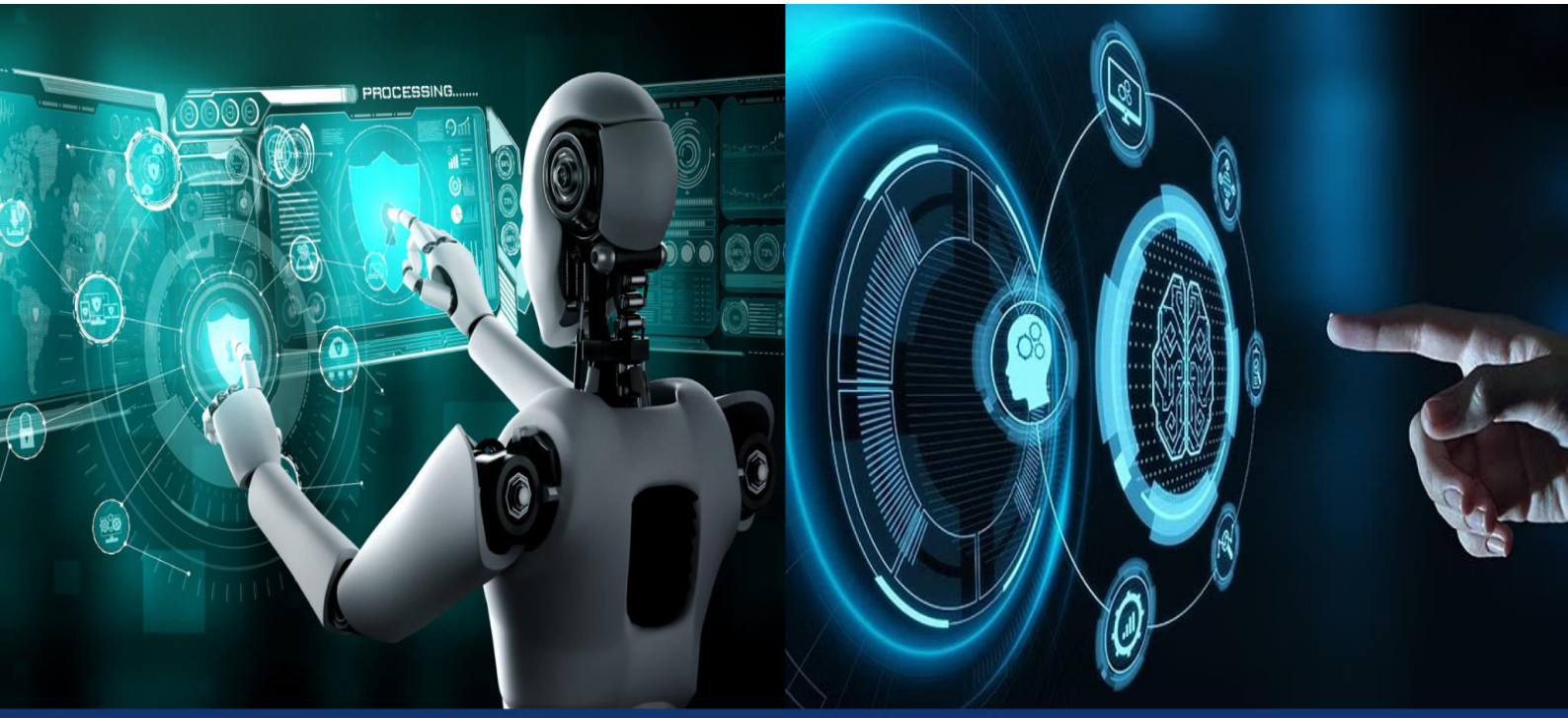
ISSN(O): 2320-9801

ISSN(P): 2320-9798



International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 9.927

Volume 14, Issue 7, July 2026

© 2026 IJIRCCE | Volume 14, Issue 7, July 2026 DOI: 10.15680/IJIRCCE.2026.1407056

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Facial Recognition Based Criminal Alert System with Blockchain Secured Evidence Storage

Dr. R. Sridevi, Satu Sai Sanjana Yadav

Professor, Department of Computer Science Engineering, Jawaharlal Nehru Technological University, Hyderabad, Telangana, India

Post-Graduate Student, Department of Computer Science Engineering, Jawaharlal Nehru Technological University, Hyderabad, Telangana, India

ABSTRACT: Facial recognition has become an essential technology in modern surveillance and law enforcement for the automatic identification of individuals from images and video streams. Conventional facial recognition techniques often experience reduced accuracy due to variations in illumination, facial pose, occlusion, low-quality images, and aging effects. To address these challenges, this paper proposes a Blockchain-Based Criminal Recognition and Evidence Management System that integrates advanced deep learning models with secure blockchain technology. The proposed system employs Multi-task Cascaded Convolutional Networks (MTCNN) for accurate face detection and facial alignment, followed by StyleGAN for age progression and age transformation to generate age-invariant facial representations while preserving the individual's identity. The transformed facial images are then processed by a Convolutional Neural Network (CNN)-based facial recognition model to extract discriminative facial features and accurately identify suspects by comparing them with a criminal database. Upon successful recognition, the system automatically generates real-time alerts for authorized personnel and securely stores recognition results, timestamps, confidence scores, and evidence metadata on a blockchain using Web3.py and Ganache, ensuring data integrity, transparency, traceability, and protection against unauthorized modification. By combining robust face detection, age-invariant facial recognition, and tamper-proof evidence management, the proposed system provides an accurate, secure, and reliable solution for modern criminal identification and digital forensic investigations.

KEYWORDS: Facial Recognition, Criminal Recognition, Multi-task Cascaded Convolutional Networks (MTCNN), StyleGAN, Age Progression, Age Transformation, Convolutional Neural Network (CNN), Blockchain, Digital Evidence Management, Real-Time Surveillance.

I. INTRODUCTION

The rapid advancement of artificial intelligence, computer vision, and intelligent surveillance technologies has transformed the way law enforcement agencies monitor public spaces and investigate criminal activities. Facial recognition has emerged as one of the most effective biometric technologies for identifying individuals from images and video streams, offering significant advantages over traditional manual identification methods. Applications of facial recognition have expanded across airports, railway stations, border security, smart cities, public surveillance, and forensic investigations, where timely and accurate identification is essential for ensuring public safety.

Despite recent progress in deep learning-based facial recognition, existing systems continue to face challenges when operating under real-world conditions. Variations in illumination, facial pose, image quality, occlusion, facial expressions, and particularly aging can significantly reduce recognition accuracy. Criminal databases often contain photographs that are several years old, making it difficult to accurately identify suspects whose facial appearance has changed over time. Furthermore, many conventional surveillance systems rely on centralized databases for storing recognition records and digital evidence, making them vulnerable to unauthorized modification, data tampering, and single points of failure. These limitations reduce the reliability and evidentiary value of stored information during criminal investigations.

To address these challenges, this paper proposes a Blockchain-Based Criminal Recognition and Evidence Management System that integrates advanced deep learning techniques with blockchain technology for secure and reliable criminal identification. The proposed framework employs the Multi-task Cascaded Convolutional Network (MTCNN) to

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

accurately detect and align facial images from live surveillance feeds or uploaded photographs. To overcome the effects of aging, the system utilizes StyleGAN for age progression and age transformation, generating realistic age-invariant facial images while preserving the individual's identity. The transformed facial images are then processed using a Convolutional Neural Network (CNN)-based facial recognition model that extracts discriminative facial embeddings and compares them with registered criminal records to perform accurate identification.

Once a suspect is successfully recognized, the system automatically generates real-time alerts for authorized law enforcement personnel. Recognition results, confidence scores, timestamps, location information, and evidence metadata are securely recorded on a blockchain using Web3.py and Ganache. The decentralized and immutable nature of blockchain ensures transparency, traceability, and protection against unauthorized modification, thereby strengthening the integrity of digital forensic evidence and supporting legal investigations.

The primary objective of the proposed system is to develop an intelligent criminal recognition platform capable of accurately identifying suspects despite age-related facial changes while providing secure, tamper-resistant evidence management. By integrating MTCNN-based face detection, StyleGAN-driven age progression and transformation, CNN-based facial recognition, and blockchain-secured evidence storage, the proposed framework offers an accurate, secure, and scalable solution for modern surveillance, forensic analysis, and law enforcement applications.

III. RELATED WORK

Liu and Wang [1] proposed a Deep Cycle GAN with Bias Loss for face aging synthesis to improve age-invariant facial recognition. Their model generates realistic age-progressed facial images while preserving identity information, thereby improving recognition accuracy across different age groups. However, the proposed approach requires significant computational resources for real-time implementation.

Singh [2] developed a face detection and recognition system using digital image processing techniques based on Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA). The proposed system achieved satisfactory performance under controlled conditions but experienced reduced accuracy under variations in illumination, facial expressions, and aging. Vishwanatha et al. [3] presented a deep learning-based face recognition and identification framework using Convolutional Neural Networks (CNNs). The model automatically extracted discriminative facial features and achieved high recognition accuracy under different lighting conditions, facial poses, and expressions. However, the work focused mainly on recognition accuracy and did not consider secure evidence management.

Fuad et al. [4] reviewed recent advances in deep learning techniques for face recognition. Their survey demonstrated that CNN-based models significantly outperform conventional machine learning techniques while highlighting challenges such as computational complexity, dataset diversity, and real-world deployment.

Arsenovic et al. [5] proposed FaceTime, a deep learning-based face recognition attendance system using CNNs for automatic identity verification. The system demonstrated reliable real-time recognition performance but was primarily designed for attendance monitoring rather than criminal surveillance applications.

Robin et al. [6] investigated improvements in face and eye detection using Multi-task Cascaded Convolutional Networks (MTCNN). Their experimental results showed that MTCNN significantly improves face localization, facial landmark detection, and alignment accuracy under challenging environmental conditions, making it suitable for surveillance applications. Tithy et al. [7] developed a real-time face recognition system based on deep learning techniques. Their framework utilized CNN-based feature extraction to achieve efficient recognition from live video streams, demonstrating the effectiveness of deep learning for surveillance systems.

Teoh et al. [8] proposed a deep learning approach for face recognition and identification capable of extracting robust facial representations from large datasets. Their experimental evaluation demonstrated improved recognition accuracy compared with traditional machine learning approaches. Lawrence et al. [9] introduced one of the earliest Convolutional Neural Network (CNN)-based face recognition models. Their research demonstrated that CNNs automatically learn discriminative facial features and outperform traditional Eigenface methods, establishing the foundation for modern deep learning-based facial recognition. Zhao et al. [10] presented a comprehensive survey of face recognition techniques, reviewing classical approaches such as Eigenfaces, Fisherfaces, PCA, LDA, and neural network-based methods. The

© 2026 IJIRCCE | Volume 14, Issue 7, July 2026 DOI: 10.15680/IJIRCCE.2026.1407056

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

survey highlighted major challenges including illumination changes, facial expressions, pose variations, and aging effects.

Zhang et al. [11] proposed the Multi-task Cascaded Convolutional Network (MTCNN) for joint face detection and facial alignment. The three-stage cascaded architecture accurately detects facial regions and localizes facial landmarks, providing robust preprocessing for facial recognition systems.

Existing research has significantly advanced face detection, facial recognition, age-invariant recognition, blockchain security, and deep learning. However, most studies focus on individual components. The proposed system integrates MTCNN for face detection and alignment, StyleGAN for age progression and age transformation, CNN-based facial recognition for accurate criminal identification, and blockchain technology for secure, transparent, and tamper-proof evidence management within a unified criminal recognition framework.

III. METHODOLOGY

The proposed Blockchain-Based Criminal Recognition and Evidence Management System integrates MTCNN, StyleGAN, CNN-based facial recognition, and blockchain technology to accurately identify criminals while ensuring secure and tamper-proof evidence management. The methodology is divided into three major phases: facial image processing, criminal recognition and alert generation, and blockchain-based evidence management.

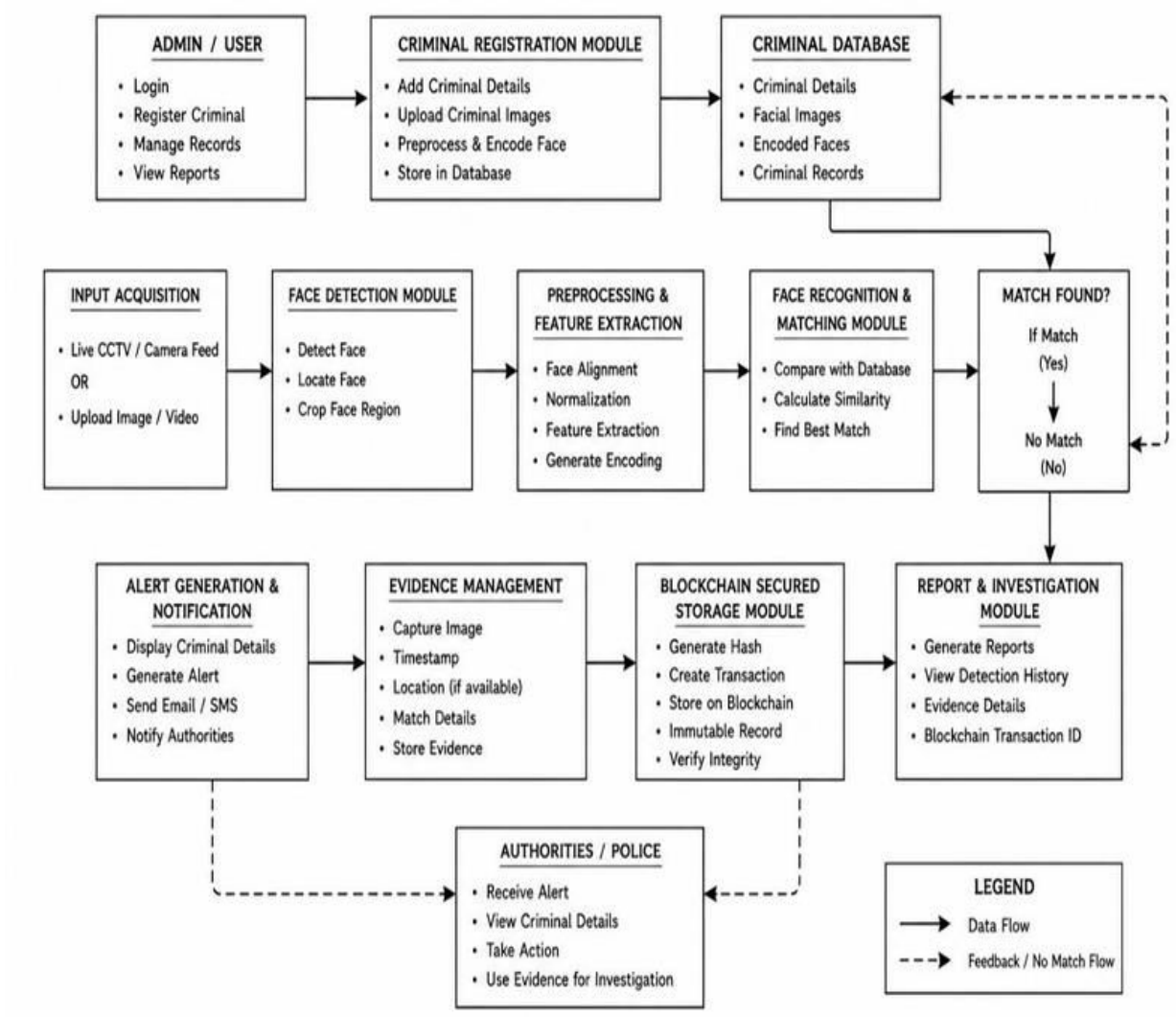


Fig. 1. System Architecture

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

A. *Facial Image Processing*

The system acquires facial images from live CCTV surveillance cameras or uploaded photographs through the web application. Initially, the input image undergoes preprocessing to improve image quality before face detection. The Multi-task Cascaded Convolutional Network (MTCNN) is employed to accurately detect facial regions and identify facial landmarks such as the eyes, nose, and mouth. Based on these landmarks, the detected face is aligned and normalized to minimize variations caused by head pose and image orientation. The aligned facial image is then processed using StyleGAN, which performs age progression and age transformation to generate realistic facial images corresponding to different age groups while preserving the individual's identity. This stage enables the system to recognize suspects even when the available criminal records contain outdated photographs.

B. *Criminal Recognition and Alert Generation*

The age-transformed facial image is passed to a Convolutional Neural Network (CNN) for facial feature extraction. The CNN generates discriminative facial embeddings that uniquely represent each individual. These embeddings are compared with the facial embeddings stored in the criminal database using a similarity matching algorithm. If the similarity score exceeds a predefined threshold, the individual is identified as a registered criminal; otherwise, the system classifies the person as unknown. Upon successful identification, the application automatically retrieves the corresponding criminal information and generates real-time alerts containing the suspect's identity, confidence score, detection timestamp, surveillance location, and captured facial image. This automated alert mechanism enables law enforcement agencies to respond quickly to potential threats without continuous manual monitoring.

C. *Blockchain-Based Evidence Management*

To maintain the integrity and authenticity of investigation records, every successful recognition event is securely recorded on the blockchain using Web3.py and Ganache. The stored information includes the criminal identification number, recognition confidence score, timestamp, evidence reference, surveillance location, and blockchain transaction details. Since blockchain operates as a decentralized and immutable ledger, stored records cannot be modified or deleted without authorization. This ensures transparency, traceability, and tamper-resistant storage of digital evidence, thereby enhancing the reliability of forensic investigations and supporting legal proceedings. The integration of blockchain with deep learning-based facial recognition provides a secure, scalable, and trustworthy framework for modern criminal identification and evidence management.

IV. RESULTS

The proposed Blockchain-Based Criminal Recognition and Evidence Management System was evaluated using criminal facial images collected from the registered database and real-time surveillance inputs. The performance of the system was analyzed based on face detection, age progression, facial recognition, alert generation, and secure evidence management. Experimental results demonstrate that the integration of MTCNN, StyleGAN, CNN-based facial recognition, and blockchain technology provides reliable criminal identification while ensuring the integrity of digital forensic records.

A. Criminal Recognition Results

The facial recognition module successfully detected and identified registered criminals from live camera feeds and uploaded images. Initially, MTCNN accurately detected and aligned the facial region before forwarding it to the recognition model. The CNN-based facial recognition model extracted facial embeddings and compared them with the criminal database. The system correctly displayed the criminal's identity, criminal ID, confidence score, threat level, and model information upon successful matching. Figure 2 illustrates the recognition result generated by the proposed system, where the detected face is correctly identified and the corresponding criminal information is displayed through the monitoring dashboard.

© 2026 IJIRCCE | Volume 14, Issue 7, July 2026 DOI: 10.15680/IJIRCCE.2026.1407056

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

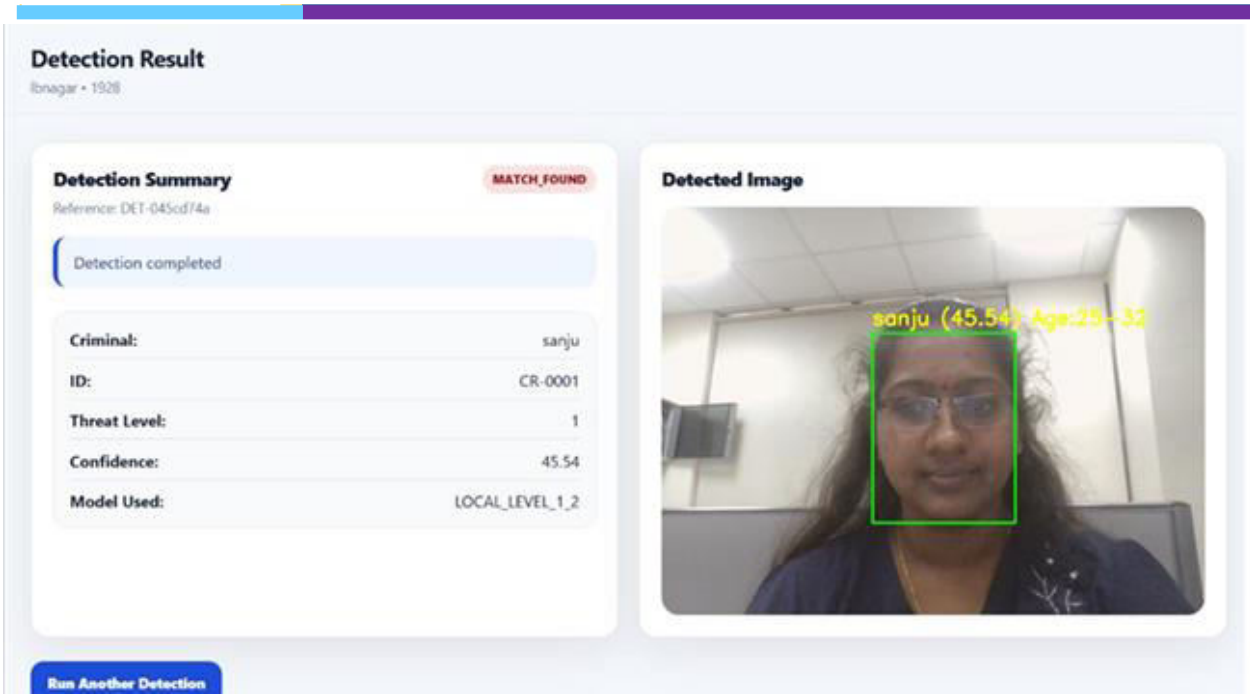


Fig. 2. Criminal recognition result showing successful face detection, identification, confidence score, and alert information.

B. Age Progression Results

To overcome the challenges associated with aging in criminal identification, the proposed system utilizes StyleGAN for age progression and age transformation. The generated age-progressed images preserve the facial identity while producing realistic appearances corresponding to different age groups. This capability improves recognition accuracy when the available criminal photographs are several years old. Figure 3 presents an example of the age transformation process, where the original facial image is transformed into an age-progressed version while maintaining essential facial characteristics.

Fig. 3. StyleGAN-based age progression and age transformation preserving facial identity across different age groups.

C. Blockchain Evidence Management Results

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

After successful recognition, the system automatically generated alerts and securely stored the recognition details on the blockchain using Web3.py and Ganache. The blockchain records included the criminal ID, recognition confidence score, timestamp, evidence reference, and transaction details. Since each record is stored in an immutable blockchain ledger, unauthorized modification of investigation evidence is prevented, thereby ensuring transparency, traceability, and forensic integrity. The experimental evaluation confirmed that all recognition events were successfully recorded and could be retrieved for future investigation and legal verification.

V. CONCLUSION AND FUTURE WORK

This paper presented a Blockchain-Based Criminal Recognition and Evidence Management System that integrates MTCNN, StyleGAN, CNN-based facial recognition, and blockchain technology to improve criminal identification and digital evidence security. The proposed framework effectively detects and aligns facial images using MTCNN, performs age progression and age transformation through StyleGAN to address age-related appearance changes, and employs a CNN-based recognition model for accurate identification of registered criminals. Upon successful recognition, the system automatically generates real-time alerts and securely stores investigation records on a blockchain using Web3.py and Ganache. The experimental results demonstrate that the proposed system accurately recognizes individuals from both live surveillance and uploaded images while maintaining the integrity, transparency, and immutability of forensic evidence. By combining deep learning with blockchain technology, the proposed solution provides a reliable, scalable, and secure framework for modern criminal investigation, surveillance, and digital forensic applications.

Although the proposed system demonstrates effective performance, several enhancements can further improve its capabilities. Future work will focus on integrating larger national and international criminal databases to increase identification coverage. More advanced deep learning models and transformer-based facial recognition techniques can be explored to improve recognition accuracy under challenging conditions such as severe occlusion, low illumination, extreme head poses, and poor image quality. The age progression module can be enhanced using newer generative models to produce even more realistic age-invariant facial representations. Future versions of the system can support real-time multi-camera tracking, cloud-based deployment, and edge computing for faster processing in large-scale surveillance environments. The blockchain framework may also be extended through smart contracts for automated evidence verification, secure inter-agency data sharing, and decentralized access control. Furthermore, integrating additional biometric modalities such as iris, fingerprint, and voice recognition can improve identification reliability, while incorporating explainable artificial intelligence (XAI) techniques can increase transparency and trust in automated decision-making for forensic investigations.

REFERENCES

1. T. J. Liu and C. C. Wang, "Face Aging Synthesis Using Deep Cycle GAN with Bias Loss," IEEE Transactions on Image Processing, vol. 32, 2023.
2. G. Singh, "Face Detection and Recognition System Using Digital Image Processing," International Journal of Computer Science and Information Technologies (IJCSIT), vol. 13, no. 4, 2022.
3. C. R. Vishwanatha, M. K. Shreyas, et al., "Face Recognition and Identification Using Deep Learning," in Proceedings of the IEEE International Conference on Advances in Computing, Communication, Embedded and Secure Systems (ACCESS), 2023.
4. M. T. H. Fuad et al., "Recent Advances in Deep Learning Techniques for Face Recognition," IEEE Access, vol. 9, 2021.
5. M. Arsenovic, S. Sladojevic, A. Anderla, and D. Stefanovic, "FaceTime: Deep Learning Based Face Recognition Attendance System," in Proceedings of the IEEE International Symposium on Intelligent Systems and Informatics (SISY), 2017.
6. M. H. Robin, M. M. U. Rahman, A. M. Taief, and Q. N. Eity, "Improvement of Face and Eye Detection Performance by Using Multi-task Cascaded Convolutional Networks," in Proceedings of the IEEE Region 10 Symposium (TENSYMP), 2020.
7. T. D. Tithy, S. Chakraborty, R. Islam, and A. Aziz, "A Deep Learning Based Approach for Real-Time Face Recognition System," in Proceedings of the IEEE International Conference on Electronics, Communications and Information Technology (ICECIT), 2021.
8. K. H. Teoh, R. C. Ismail, S. Z. M. Naziri, R. Hussin, M. N. M. Isa, and M. S. S. M. Basir, "Face Recognition and Identification Using Deep Learning Approach," Journal of Physics: Conference Series, 2021.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

9. S. Lawrence, C. L. Giles, A. C. Tsoi, and A. D. Back, "Face Recognition: A Convolutional Neural Network Approach," IEEE Transactions on Neural Networks, vol. 8, no. 1, pp. 98–113.
10. W. Zhao, R. Chellappa, P. J. Phillips, and A. Rosenfeld, "Face Recognition: A Literature Survey," ACM Computing Surveys, vol. 35, no. 4, pp. 399–458.
11. K. Zhang, Z. Zhang, Z. Li, and Y. Qiao, "Joint Face Detection and Alignment Using Multi-task Cascaded Convolutional Networks (MTCNN)," IEEE Signal Processing Letters, vol. 23, no. 10, 2016.
12. R. Sandhu and P. Singh, "Blockchain Technology for Secure Digital Evidence Management in Forensic Investigations," International Journal of Information Security, 2022.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details