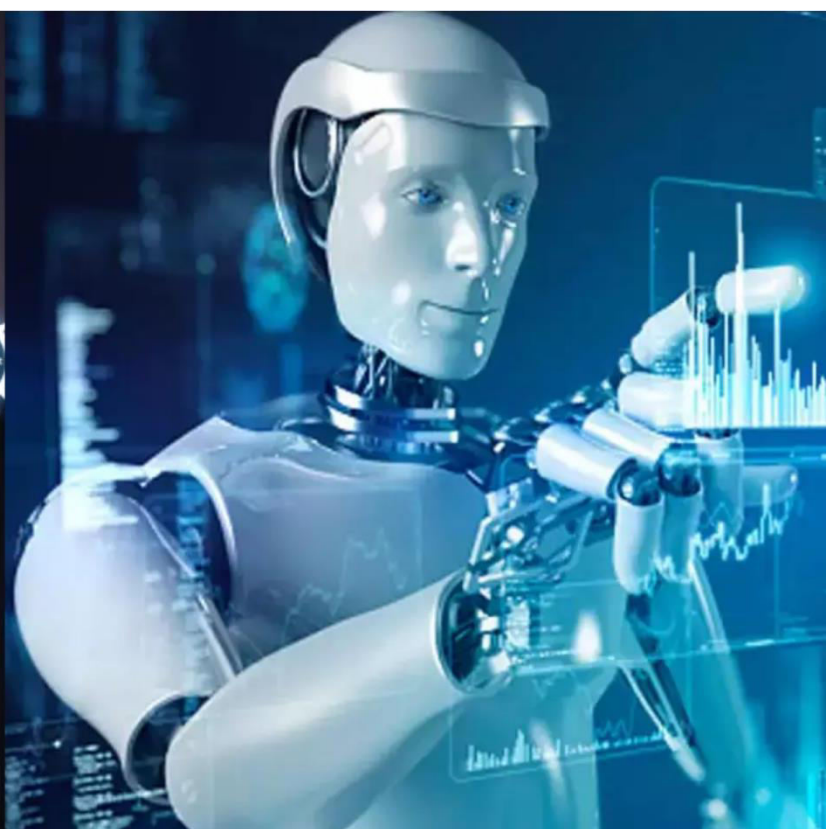




International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

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



Impact Factor: 9.935

Volume 15, Issue 6, June 2026

Real-Time Missing Person Identification using Low-Quality CCTV Enhancement and Partial Face Recognition with Context-Aware Missing Person Identification (CAMPI)

Lavanya G. S., Prof. Asif Ulla Khan, Dr. Suhas K. C.

M. Tech Scholar, Department of Computer Science and Engineering, Channabasaveshwara Institute of Technology,
Gubbi, Tumakuru, Karnataka, India

Assistant Professor, Department of Computer Science and Engineering, Channabasaveshwara Institute of Technology,
Gubbi, Tumakuru, Karnataka, India

Associate Professor, Department of Computer Science and Engineering, Channabasaveshwara Institute of Technology,
Gubbi, Tumakuru, Karnataka, India

ABSTRACT: Missing person identification remains a significant challenge for law enforcement agencies due to the poor quality of surveillance footage obtained from real-world Closed-Circuit Television (CCTV) systems. Conventional facial recognition methods generally require high-resolution frontal facial images and exhibit poor performance when faces are partially occluded, blurred, poorly illuminated, or captured at long distances. These limitations become particularly critical in missing person investigations where only low-quality surveillance footage is available. This paper proposes a real-time missing person identification framework that integrates low-quality CCTV image enhancement with partial face recognition techniques to improve identification accuracy in challenging surveillance environments. The proposed system employs image enhancement algorithms to restore degraded facial information and utilizes partial facial feature extraction to recognize individuals even when only a portion of the face is visible. The framework further incorporates database matching and alert generation mechanisms to support real-time identification and notification. The proposed solution aims to improve the effectiveness of surveillance-assisted missing person investigations and contribute towards next-generation intelligent public safety systems. In addition, the proposed framework introduces a Context-Aware Missing Person Identification (CAMPI) algorithm that combines facial similarity, image quality, spatial context, temporal context, and movement consistency to improve identification accuracy in challenging surveillance environments.

KEYWORDS: Missing Person Identification, CCTV Surveillance, Partial Face Recognition, Image Enhancement, Low-Resolution Face Recognition, Computer Vision, Artificial Intelligence, Deep Learning.

I. INTRODUCTION

The increasing deployment of CCTV surveillance systems in public places, transportation hubs, educational institutions, and commercial establishments has generated enormous volumes of visual data that can assist law enforcement agencies in criminal investigations and missing person identification. Despite the widespread availability of surveillance cameras, identifying missing individuals from CCTV footage remains a difficult task because surveillance images are often captured under poor lighting conditions, long viewing distances, motion blur, and occlusions.

Traditional face recognition systems are designed primarily for high-resolution frontal facial images and therefore experience significant performance degradation when applied to low-quality surveillance footage. In practical situations, missing individuals may appear only partially within camera frames or may have their faces covered by masks, scarves, helmets, or other objects. Such situations limit the effectiveness of conventional biometric identification methods.

Recent advances in artificial intelligence, computer vision, and deep learning have enabled substantial improvements in image enhancement and facial recognition technologies. However, most existing systems focus either on low-resolution

face recognition or partial face recognition independently rather than integrating both approaches within a unified framework.

To address these limitations, this paper proposes a Real-Time Missing Person Identification Framework using Low-Quality CCTV Enhancement and Partial Face Recognition. The proposed system combines image restoration techniques, partial facial feature extraction, and intelligent matching algorithms to improve identification accuracy in challenging surveillance environments.

II. LITERATURE REVIEW

[1] Grm et al. proposed a cross-resolution face recognition framework that bridges the gap between low-resolution and high-resolution facial images, making it suitable for surveillance applications such as CCTV-based recognition.

[2] Zhang et al. introduced a low-resolution face recognition approach using super-resolution and triplet loss, improving recognition performance in degraded surveillance images.

[3] Bellili et al. proposed a Vision Transformer-based super-resolution method for enhancing face verification in low-quality images, improving robustness in real-time surveillance scenarios.

[4] Surantha et al. developed a low-resolution face recognition system designed specifically for CCTV and edge-based smart surveillance systems, enabling real-time processing in constrained environments.

[5] Ge et al. proposed a lightweight low-resolution face recognition method using bridge distillation to reduce computational complexity while maintaining accuracy for surveillance applications.

III. RESEARCH GAP

Existing surveillance face recognition systems primarily focus on either low-resolution face recognition or partial face recognition independently. Most existing approaches rely solely on facial similarity scores for identification and do not utilize contextual information such as location history, time consistency, or movement trajectory.

Furthermore, current methods fail to provide robust identification performance when image degradation and facial occlusion occur simultaneously, which is common in real-world CCTV environments.

Therefore, there is a need for an intelligent framework capable of combining image enhancement, partial face recognition, and contextual information within a unified real-time missing person identification system.

IV. RESEARCH OBJECTIVES

The primary objective of this research is to develop an intelligent framework for missing person identification using low-quality CCTV enhancement and partial face recognition.

The specific objectives are as follows:

1. To improve the visual quality of low-resolution CCTV images using image enhancement techniques.
2. To detect and extract partially visible facial regions from surveillance footage.
3. To perform facial feature extraction and matching using partial facial information.
4. To identify missing persons by comparing extracted features with registered databases.
5. To generate real-time alerts for law enforcement agencies upon successful identification.
6. To utilize contextual information such as spatial location, temporal information, and movement trajectory to improve missing person identification accuracy.

V. PROPOSED METHODOLOGY

The proposed framework consists of the following stages:

1. Video Acquisition

Live CCTV video streams are continuously collected from surveillance cameras installed in public areas.

2. Frame Extraction

Video streams are converted into individual image frames for processing.

3. Image Enhancement

Low-quality frames are enhanced using super-resolution and image restoration techniques to improve facial visibility and reduce noise.

4. Face Detection

Facial regions are detected from enhanced frames using lightweight object detection algorithms.

5. Partial Face Recognition

Visible facial components such as eyes, nose, forehead, and cheeks are extracted and analyzed to generate discriminative feature vectors.

6. Context-Aware Missing Person Identification (CAMPI)

The proposed CAMPI algorithm combines facial similarity scores with contextual information including image quality, location history, time consistency, and movement trajectory to improve identification accuracy.

7. Alert Generation

Notifications containing camera location, timestamp, confidence score, and movement information are sent to authorities when a missing person is identified.

A Context-Aware Missing Person Identification (CAMPI)

The proposed framework introduces the Context-Aware Missing Person Identification (CAMPI) algorithm to improve identification performance in challenging surveillance environments.

The CAMPI algorithm utilizes five major components:

1. Facial Similarity Score (FS)
2. Image Quality Score (IQ)
3. Spatial Context Score (SC)
4. Temporal Context Score (TC)
5. Movement Consistency Score (MC)

The final identification confidence score is computed as:

$$\text{CAMPI Score} = \alpha\text{FS} + \beta\text{IQ} + \gamma\text{SC} + \delta\text{TC} + \varepsilon\text{MC}$$

where:

$$\alpha + \beta + \gamma + \delta + \varepsilon = 1$$

The missing person is identified if the CAMPI score exceeds a predefined threshold value.

VI. SYSTEM ARCHITECTURE

The proposed system follows a modular pipeline architecture consisting of:

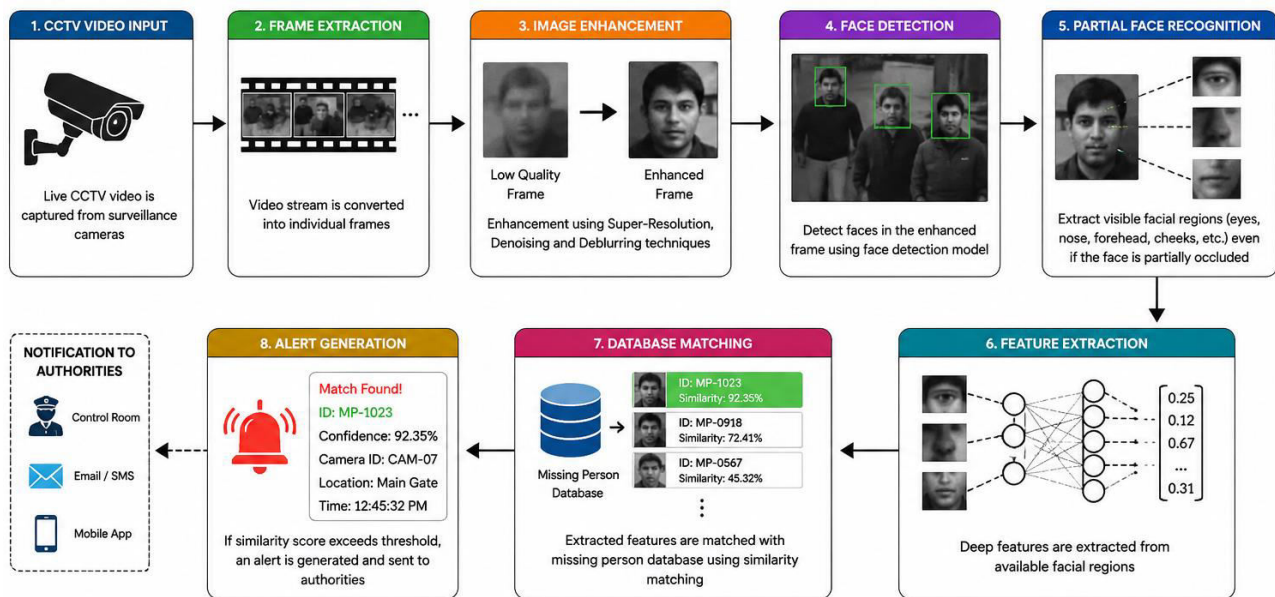


Fig.1. System Architecture of the Proposed Missing Person Identification Framework

The architecture enables efficient real-time surveillance processing while maintaining high identification performance in challenging environments.

VII. EXPECTED OUTCOMES

The proposed framework is expected to provide the following benefits:

- Improved recognition accuracy for low-quality CCTV footage.
- Effective identification using partially visible facial information.
- Reduced false negative rates in missing person investigations.
- Real-time notification and alert generation.
- Enhanced support for law enforcement and public safety agencies.

VIII. RESULTS AND DISCUSSION

The proposed approach integrates image enhancement, partial face recognition, and the Context-Aware Missing Person Identification (CAMPI) algorithm to improve identification accuracy in challenging surveillance environments.

IX. CONCLUSION AND FUTURE WORK

This paper proposed a real-time missing person identification framework using low-quality CCTV enhancement and partial face recognition. The proposed approach integrates image enhancement, facial feature extraction, and intelligent matching techniques to improve identification performance in challenging surveillance environments.

Future work includes implementation using real-world surveillance datasets, deployment on edge computing devices, and integration with national missing person databases for large-scale validation.

REFERENCES

- [1] K. Grm, B. K. Özata, A. Kantarci, V. Štruc, and H. K. Ekenel, "Degrade or Super-Resolve to Recognize? Bridging the Domain Gap for Cross-Resolution Face Recognition," IEEE Access, vol. 13, pp. 10542–10558, 2025.
- [2] Z. Zhang, B. Sun, J. Liang, H. He, and D. Qiao, "Low-resolution driver face recognition based on super-resolution and triplet loss," Scientific Reports, vol. 15, Article 42299, 2025.
- [3] S. Bellili, A. Ouamane, A. Chouchane, Y. Himeur, S. Atalla, W. Mansoor, and S. Bourennane, "Enhancing Face Verification for Low-Resolution Images with Super-Resolution and Vision Transformers," Expert Systems with Applications, vol. 318, Article 131976, 2026.
- [4] N. Surantha, E. Yose, and S. M. Isa, "Low-Resolution Face Recognition for CCTV and Edge-Powered Smart Systems," Proceedings of IEEE COMPSAC, 2024, pp. 676–681.
- [5] S. Ge, S. Zhao, C. Li, Y. Zhang, and J. Li, "Efficient Low-Resolution Face Recognition via Bridge Distillation," arXiv preprint arXiv:2409.11786, 2024.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details