

SurveilFind :AI-Based Missing Person Detection and Intelligent Surveillance Monitoring System

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Abstract: The rapid rise in missing person incidents has created serious challenges for public safety organizations and law enforcement departments. Conventional surveillance approaches mainly depend on manual monitoring of CCTV footage, public notices, and time-consuming investigation procedures, which often delay identification and recovery processes. This paper introduces SurveilFind, an AI-enabled surveillance platform designed to automate missing person detection using Computer Vision and Deep Learning technologies.

The proposed system continuously monitors live CCTV streams and identifies individuals through advanced facial recognition techniques. Deep Learning models including FaceNet, DeepFace,

MTCNN, and OpenCV are integrated to perform face detection, feature extraction, and identity matching operations. Detected facial patterns are compared with records stored in a centralized missing-person database using embedding similarity algorithms

Keywords: Artificial Intelligence, Computer Vision, Deep Learning, Facial Recognition, Missing Person Detection, Smart Surveillance, OpenCV, FaceNet, Surveillance Analytics.

1. INTRODUCTION

The growing number of missing person cases has become a major concern for governments, police departments, and public safety authorities worldwide. Traditional investigation approaches such as printed notices, manual CCTV inspection, and eyewitness reporting consume significant time and resources while often producing limited results. Although surveillance cameras are widely deployed in public spaces,

continuously observing large volumes of video footage manually is impractical and inefficient.

Recent developments in Artificial Intelligence and Computer Vision have transformed the capabilities of modern surveillance systems. Deep Learning-based facial recognition technologies can automatically analyze surveillance footage, identify individuals, and assist authorities in real-time monitoring operations. These technologies improve detection speed, reduce human dependency, and increase surveillance accuracy.

SurveilFind is proposed as an intelligent surveillance monitoring platform capable of automatically identifying missing individuals from live CCTV feeds. The system combines Machine Learning, Deep Learning, and image-processing algorithms to perform facial detection, feature extraction, and identity verification efficiently.

Technologies such as FaceNet, DeepFace, OpenCV, MTCNN, React, and Python are integrated to develop a reliable and scalable AI-based surveillance solution. Whenever the platform detects a matching face from the missing-person database, alert notifications are generated instantly for authorities with associated surveillance details.

The main objective of SurveilFind is to automate surveillance analysis, improve missing person identification efficiency, enhance public security, and support smart-city monitoring infrastructure using intelligent AI technologies.

2. LITERATURE REVIEW

Research in intelligent surveillance and facial recognition systems has progressed significantly with advancements in Deep Learning and Artificial Intelligence technologies.

Earlier surveillance mechanisms primarily relied on human observation and conventional image-processing methods. These approaches were inefficient for handling large-scale video data and lacked automated recognition capabilities. Manual monitoring frequently resulted in delayed responses and inaccurate identification.

The emergence of Deep Learning models improved facial recognition performance considerably. Schroff et al. introduced FaceNet, which enabled embedding-based face representation for similarity comparison and accurate recognition. DeepFace later enhanced

verification accuracy through deep neural network architectures capable of learning complex facial patterns.

Researchers further improved facial detection using Multi-task Cascaded Convolutional Networks (MTCNN), which provided robust face alignment and detection under different environmental conditions. OpenCV-based frameworks contributed significantly to real-time image processing and surveillance analysis.

Modern surveillance systems integrate Deep Learning models such as ArcFace, YOLO, CNN-based detectors, and embedding comparison techniques for automated monitoring applications. These systems demonstrated improved recognition accuracy in crowded environments and varying lighting conditions.

Despite these advancements, many existing surveillance solutions still rely heavily on costly infrastructure, cloud-based processing, or extensive manual supervision. Some systems also struggle with scalability, response delays, and real-time alert management.

SurveilFind addresses these limitations by combining intelligent facial recognition, automated CCTV monitoring, centralized database management, and instant alert generation into a software-driven surveillance platform designed for practical public safety applications.

3. PROBLEM STATEMENT

Traditional surveillance systems face significant challenges in efficiently identifying missing individuals from continuously generated CCTV footage.

Large-scale surveillance networks produce massive amounts of video data every day, making manual observation difficult, slow, and prone to human error. Existing monitoring methods often fail to provide immediate identification and rapid response during investigations.

Several limitations observed in conventional systems include:

- Dependence on manual CCTV observation
- Delayed identification and response generation
- Limited capability for handling multiple video streams

- Inconsistent recognition accuracy
- Increased workload for surveillance authorities

Therefore, an intelligent surveillance solution is required that can:

- Detect and recognize faces automatically
- Monitor surveillance feeds continuously
- Generate real-time alerts
- Improve investigation efficiency
- Reduce manual monitoring efforts

SurveilFind is developed to overcome these challenges through the integration of Artificial Intelligence, Computer Vision, and Deep Learning-based facial recognition technologies

Large digital documents often contain important.

4. PROPOSED SYSTEM

SurveilFind is an AI-driven surveillance platform developed for automatic missing person identification using real-time CCTV analysis and facial recognition algorithms.

The platform consists of multiple interconnected modules that collaboratively perform intelligent monitoring and alert generation.

4.1 Surveillance Acquisition Module

This module captures live video streams from surveillance cameras installed at different public locations and forwards frames for further analysis.

4.2 Face Detection Module

The captured frames are processed using MTCNN and Haar Cascade classifiers to accurately identify human faces from surveillance footage under varying environmental conditions.

4.3 Feature Encoding Module

Facial images extracted from surveillance frames are converted into numerical embeddings using Deep Learning models such as FaceNet and DeepFace.

4.4 Identity Verification Module

Generated embeddings are compared with facial records stored in the missing-person database using cosine similarity and Euclidean distance calculations.

4.5 Intelligent Alert Module

Whenever the system identifies a valid match, real-time notifications are generated containing:

- Camera Identification
- Timestamp Information
- Captured Surveillance Image
- Matching Confidence Level
- Missing Person Details

4.6 Surveillance Database Module

The database stores missing-person records, surveillance history, facial embeddings, detection logs, and generated alerts for future investigation and analysis.

5. SYSTEM ARCHITECTURE

The SurveilFind platform follows a modular layered architecture to achieve efficient surveillance monitoring, intelligent facial recognition, and automated alert management. The architecture is divided into several functional layers including Frontend Layer, Backend Layer, AI Processing Layer, and Data Storage Layer.

This layered design improves maintainability, scalability, modularity, and processing performance.

1. Front End Layer

The Front End Layer provides interaction between surveillance authorities and the monitoring platform. Developed using React, the interface offers a responsive dashboard for monitoring live surveillance activities.

Key functionalities include:

- Live CCTV monitoring dashboard
- Missing person registration interface
- Alert visualization panel
- Surveillance activity analytics
- Detection history management
- Real-time notification display

The frontend simplifies surveillance operations and improves accessibility for authorities.

2. Back End Layer

The Back End Layer acts as the core processing component of the platform and is implemented using Python technologies.

Primary backend operations include:

- Video frame extraction
- Image preprocessing
- Facial detection
- Embedding generation
- Similarity analysis
- Alert processing
- Database communication

The backend coordinates communication between AI modules, databases, and the frontend dashboard.

3. AI Processing Layer

The AI Processing Layer performs intelligent facial analysis and identity verification operations.

Integrated AI technologies include:

- FaceNet models
- DeepFace recognition
- MTCNN facial detection
- OpenCV image processing
- Deep Learning classifiers
- Similarity matching algorithms

These AI models analyze surveillance footage, generate facial embeddings, and perform accurate recognition tasks.

4. Data Storage Layer

The Data Storage Layer maintains:

- Missing-person information
- Facial embeddings
- Surveillance records
- Alert logs
- Monitoring analytics

- Detection history

The centralized database ensures efficient retrieval and secure management of surveillance information.

5. System Workflow

Initially, CCTV surveillance footage is captured and processed by the backend server. Video frames are extracted and forwarded to the AI Processing Layer for facial analysis.

The AI model performs:

- Face Detection
- Feature Encoding
- Identity Matching

Generated embeddings are compared with records stored in the centralized database. If a valid similarity match is identified, the platform instantly generates notifications and displays alerts on the monitoring dashboard.

The modular architecture enables efficient surveillance analysis, intelligent decision-making, and scalable deployment for real-world smart surveillance environments.



Fig 5.1 System Architecture

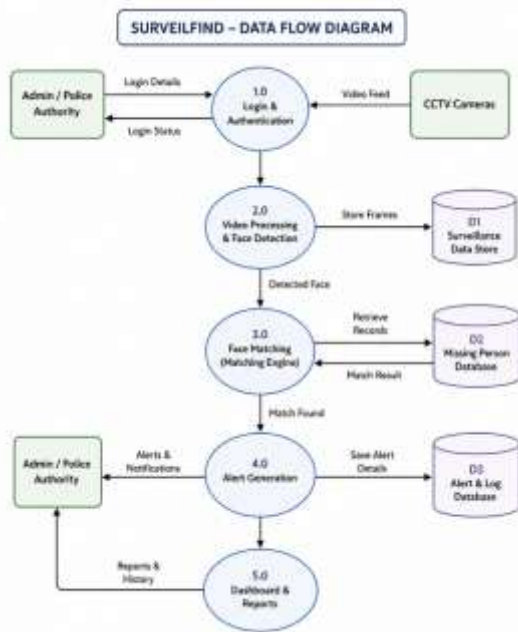


Fig 5.2 DFD Diagram

6. METHODOLOGY

The methodology of SurveilFind focuses on intelligent surveillance automation and real-time missing person identification using Deep Learning and Computer Vision techniques.

Initially, surveillance feeds are collected from CCTV cameras deployed at public locations. The captured video streams are divided into frames and preprocessed using image enhancement techniques such as normalization, resizing, grayscale conversion, and noise filtering to improve visual quality.

After preprocessing, facial regions are identified using MTCNN and Haar Cascade-based detection methods. The detected faces are then processed through Deep Learning models including FaceNet and DeepFace to generate unique facial embeddings.

The generated embeddings are compared with records available in the centralized missing-person repository using similarity comparison techniques such as cosine similarity and Euclidean distance measurement. If the similarity score exceeds the predefined threshold value, the system recognizes the detected individual as a potential match.

Once a valid match is identified, the platform immediately generates alert notifications containing surveillance details including location, timestamp, confidence level, and captured facial image. Detection

records and monitoring history are stored for future investigation purposes.

By integrating facial recognition, intelligent surveillance analytics, and automated alert mechanisms, SurveilFind provides a practical and scalable AI-powered monitoring solution.

7. IMPLEMENTATION

The SurveilFind platform is implemented as an AI-enabled surveillance monitoring system using React for frontend development and Python for backend processing and AI integration.

The React-based frontend provides an interactive dashboard that enables authorities to monitor surveillance activities, manage missing-person records, and review generated alerts. The backend is developed using Python and handles image processing, database management, and Deep Learning operations.

The implementation process begins with capturing live CCTV video feeds. Video frames are extracted continuously and processed using OpenCV-based preprocessing methods.

Facial detection is carried out using MTCNN and Haar Cascade algorithms. The detected facial regions are then transformed into embeddings through FaceNet and DeepFace models.

These embeddings are compared against stored missing-person records using similarity matching techniques. When the system identifies a valid match, alert notifications are generated automatically and displayed on the monitoring dashboard.

The system additionally maintains:

- Detection history
- Surveillance reports
- Alert records
- Facial embeddings
- Missing-person datasets

The implementation improves monitoring automation, reduces human dependency, and strengthens surveillance efficiency through AI-based analysis.

8. RESULTS AND DISCUSSION

The SurveilFind platform was successfully implemented and evaluated using multiple surveillance

datasets and CCTV recordings under different environmental conditions.

Experimental analysis demonstrated efficient real-time surveillance monitoring and reliable facial recognition performance. The system effectively analyzed live surveillance streams and generated accurate identification results using Deep Learning-based recognition techniques.

Observations during testing indicated that:

- Multiple surveillance feeds were processed efficiently.
- Facial recognition performance improved through embedding-based comparison methods.
- Alert notifications were generated instantly after successful identification.
- The monitoring dashboard simplified surveillance management.

The integration of React and Python technologies improved communication performance, system responsiveness, and backend scalability.

The proposed system reduced manual monitoring workload significantly and enhanced missing-person identification efficiency during surveillance operations.

Certain limitations were observed in situations involving:

- Extremely poor lighting conditions
- Dense crowd environments
- Motion-blurred video frames
- Partial facial obstruction

However, overall system performance remained effective and suitable for intelligent surveillance and public safety applications.

9. FUTURE SCOPE

SurveilFind offers extensive opportunities for future enhancements in intelligent surveillance and public safety systems.

Potential future developments include:

- Cloud-enabled surveillance deployment
- Mobile-based monitoring applications

- Advanced Deep Learning architectures
- OCR-enabled identity extraction
- Smart city infrastructure integration
- AI-based behavioral analysis
- Multi-camera synchronization support
- Edge AI implementation for faster processing

The platform can further be integrated with law enforcement infrastructures and large-scale government surveillance networks to improve public security operations.

10. CONCLUSION

SurveilFind is an AI-powered Missing Person Detection and Intelligent Surveillance Monitoring System developed using React, Python, Deep Learning, and Computer Vision technologies.

The platform successfully automated CCTV surveillance analysis, facial recognition, and intelligent alert generation through real-time video monitoring. Integration of FaceNet, DeepFace, MTCNN, and OpenCV improved recognition efficiency and enabled accurate identification of missing individuals.

The software-oriented architecture minimized dependency on expensive hardware infrastructure while improving scalability, flexibility, and monitoring performance.

The project demonstrates the practical application of Artificial Intelligence and Computer Vision in enhancing public safety, improving surveillance efficiency, and reducing manual monitoring efforts through intelligent automation.

With future technological advancements and scalability improvements, SurveilFind has the potential to evolve into a robust smart surveillance platform suitable for large-scale security and public safety environments.

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