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Research Paper

PERSON RE-IDENTIFICATION FOR PUBLIC SAFETY IN INDIAN RAILWAYS USING DEEP LEARNING

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ABSTRACT

Ensuring public safety in large-scale transportation systems such as Indian Railways is a critical challenge due to the high volume of passengers and continuous surveillance requirements. Traditional surveillance systems rely heavily on manual monitoring, which is inefficient and prone to human error. Existing person identification techniques based on handcrafted features often fail to deliver high accuracy due to variations in pose, illumination, and occlusions. To address these limitations, this project proposes a Person Re-Identification System using Deep Learning, which leverages Convolutional Neural Networks (CNN) for robust feature extraction and machine learning algorithms for accurate classification. The proposed system focuses on identifying suspicious individuals across different video frames by extracting facial and pose-based features from images and videos. Initially, a dataset containing images of suspicious persons is loaded into the system. A CNN model is then employed to extract deep features that capture complex visual patterns. These extracted features are used to train classification models such as Random Forest and Support Vector Machine (SVM). The system evaluates both models and selects the one with the highest accuracy for deployment. In the operational phase, railway employees can upload surveillance videos, and the trained model analyzes each frame to detect and re-identify suspicious individuals by matching them with the database. The system also includes modules for admin and employee interaction, including data loading, feature extraction, model training, employee management, and alert monitoring.

Keywords: Person Re-Identification, Convolutional Neural Network (CNN), Public Safety, Indian Railways, Surveillance System, Machine Learning, Random Forest, Support Vector Machine (SVM), Deep Learning, Video Analysis

I.INTRODUCTION

The rapid expansion of railway networks and increasing passenger traffic in India have made public safety a significant concern for authorities. Indian Railways, being one of the largest transportation systems in the world, requires continuous monitoring to prevent criminal activities and ensure passenger security. Traditional surveillance systems rely heavily on human operators to monitor CCTV footage, which is time-consuming, inefficient, and prone to human error. Moreover, identifying suspicious individuals across multiple cameras and locations is a complex task due to variations in appearance, lighting conditions, and crowd density. These challenges highlight the need for an intelligent and automated system capable of accurately identifying individuals in real-time.

Person Re-Identification (Re-ID) has emerged as a promising solution to address these challenges. It involves matching individuals captured in different camera views by analyzing visual features such as face, body structure, and movement patterns. Earlier approaches relied on handcrafted features like color histograms, textures, and shapes, which often resulted in low accuracy due to environmental variations and lack of robustness. With the advancement of deep learning, Convolutional Neural Networks (CNNs) have demonstrated superior performance in extracting high-level and discriminative features from images. These features enable more reliable identification even in challenging conditions. Additionally, combining CNN-based feature extraction with machine learning algorithms such as Random Forest and Support Vector Machine (SVM) further enhances classification accuracy.

The proposed system leverages deep learning techniques to develop an efficient Person Re-Identification system tailored for Indian Railways. The system is designed with multiple modules, including data loading, feature extraction, model training, and real-time video monitoring. Suspicious person images are first stored in a database, and CNN models are used to extract meaningful features. These features are then used to train classification models that can accurately distinguish between suspicious and non-suspicious individuals. Railway staff can upload surveillance videos, and the system automatically detects and generates alerts when a match is found. This approach not only improves detection accuracy but also reduces manual effort, making it a reliable and scalable solution for enhancing public safety.

II SURVEY OF RESEARCH

The study by W. Li, R. Zhao, and X. Wang (2014) [1] introduced one of the early deep learning approaches for Person Re-Identification using Convolutional Neural Networks (CNNs). The methodology focused

on learning robust feature representations directly from images instead of relying on handcrafted features. The results showed significant improvement in identification accuracy across different camera views. However, the model required large labeled datasets for effective training. This research is highly relevant to the proposed system as it forms the foundation for using CNN-based feature extraction for person re-identification.

The work by L. Zheng et al. (2016) [2] presented a large-scale dataset called Market-1501 for person re-identification research. The methodology involved collecting annotated images from multiple camera angles and applying deep learning techniques for feature learning. The results demonstrated that deep learning models trained on large datasets outperform traditional methods. However, dataset bias and variations in real-world scenarios remain challenges. This study supports the use of structured datasets in the proposed system for training accurate models.

The research by A. Hermans, L. Beyer, and B. Leibe (2017) [3] proposed the Triplet Loss function for improving person re-identification accuracy. The methodology focuses on minimizing the distance between similar images and maximizing the distance between dissimilar ones. Results indicate that this approach significantly enhances feature discrimination. However, it requires careful selection of training samples. This research is relevant as it improves the feature learning process in deep learning-based re-identification systems.

The study by S. Liao et al. (2015) [4] introduced Local Maximal Occurrence (LOMO) features combined with metric learning for person re-identification. The methodology extracts robust local features to handle variations in viewpoint and illumination. Results show moderate improvement compared to earlier handcrafted techniques. However, the approach still lacks the performance of deep learning methods. This research highlights the limitations of traditional feature extraction, supporting the shift toward CNN-based approaches in the proposed system.

The work by F. Schroff, D. Kalenichenko, and J. Philbin (2015) [5] introduced FaceNet, a deep learning model for face recognition using embedding learning. The methodology maps face images into a compact Euclidean space for similarity comparison. Results demonstrate high accuracy in face matching tasks. However, it requires high computational power and large datasets. This study is relevant as facial feature extraction is a key component of the proposed system.

The study by K. He et al. (2016) [6] proposed ResNet (Residual Networks), which allows training of very deep neural networks by addressing the vanishing gradient problem. The

methodology uses skip connections to improve learning efficiency. Results show significant improvements in image recognition tasks. However, deeper networks increase computational complexity. This research supports the use of advanced CNN architectures in the proposed system for extracting high-quality features.

III. WORKING METHODOLOGY

The proposed Person Re-Identification system begins with the collection and preparation of a dataset containing images of suspicious individuals. These images are organized and uploaded into the system through the admin module. Preprocessing techniques such as resizing, normalization, and noise removal are applied to ensure data consistency and improve model performance. Once the dataset is prepared, a Convolutional Neural Network (CNN) is used to extract deep features from each image. These features include facial characteristics and body pose information, which are essential for identifying individuals across different camera views. The extracted features are converted into numerical vectors and stored for further processing. This stage ensures that the system captures high-level visual patterns that are more robust than traditional handcrafted features.

In the next stage, the extracted features are used to train machine learning models such as Random Forest and Support Vector Machine (SVM). The system evaluates both models based on performance metrics such as accuracy, precision, and recall. The model with the highest accuracy is selected for deployment in the detection phase. This hybrid approach combines the strength of deep learning for feature extraction and machine learning for classification, resulting in improved performance. The trained model is then integrated into the system, allowing it to classify whether a detected individual is suspicious or not. This stage plays a crucial role in ensuring reliable identification and minimizing false positives and false negatives during real-time monitoring.

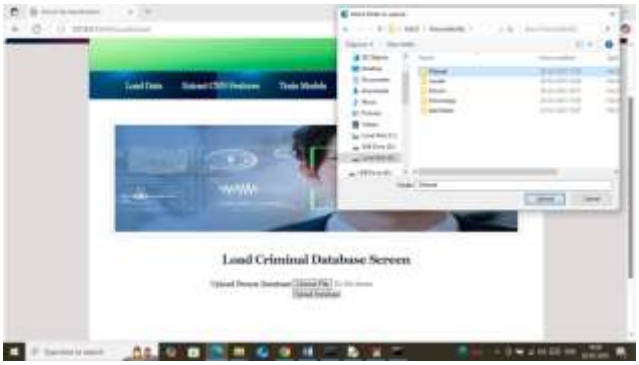
In the final stage, the system is deployed for real-time video monitoring. Railway employees can upload CCTV or recorded videos through the user interface. The system processes each video frame, detects human faces or bodies, and extracts features using the trained CNN model. These features are compared with the stored database to identify matches. If a match is found, the system labels the individual as suspicious and generates an alert, which is stored in the database and displayed to the admin. If no match is found, the individual is marked as non-suspicious. This automated process significantly reduces manual effort and enhances surveillance efficiency. The system provides a scalable and effective solution for monitoring large railway environments and ensuring public safety.

IV RESULTS EXPLANATIONS

Person Re-Identification refers to extraction of similar person captured in different sensors or cameras by extracting and matching face and pose features. All existing techniques were using Hand crafted image features for person identification whose identification accuracy is very low. To combat against low accuracy of above existing hand crafted features we are utilizing deep learning CNN algorithm to extract face and pose features and then match those features with database persons using Machine Learning algorithms such as Random Forest or SVM.

To implement this project we have designed following modules

1) Railway Admin Login: admin can login to system using username and password as admin and admin and then perform below operations
2) Load Data: using this module admin will upload suspicious person images database
3) Extract CNN Features: using this module admin will extract face and pose features from database images using CNN algorithm
4) Train Models: extracted features will get trained with SVM and Random Forest algorithm and the algorithm with highest accuracy will be employed to detect suspicious persons
5) Add Employees: using this module admin will add all railway employees who can monitor railway videos
6) View Alerts: using this module admin can view list of videos which contains suspicious alerts.
7) User Login: railway employee login to system
8) Monitor Railway Videos: using this module employee will upload video and the CNN and ML will start monitoring and detecting suspicious persons as Re-identification.



In above screen browse and upload 'Dataset' folder with criminal or suspicious person and then click Upload buttons to load dataset and then will get below page



In above screen can number of images loaded from different criminal database and now click

on 'Extract CNN Features' link to extract features and then will get below page



In above screen can see number of features extracted from each image and now click on 'Train Models' link to train algorithms on extracted features and then will get below page



In above screen Random Forest and SVM trained on CNN extracted features and then in table format can see both algorithm performance where Random Forest got high accuracy. In above comparison graph x-axis represents algorithm names and y-axis represents accuracy and other metrics in different colour bars and in both algorithms Random Forest got high accuracy. In above screen Admin has trained all algorithms and make ready for employees to monitor videos.

V.CONCLUSION

The proposed Person Re-Identification System for Public Safety in Indian Railways using Deep Learning provides an effective and intelligent solution for enhancing surveillance and security. By integrating Convolutional Neural Networks (CNN) with machine learning algorithms such as Random Forest and Support Vector Machine (SVM), the system overcomes the limitations of traditional handcrafted feature-based approaches. The use of deep learning enables accurate extraction of facial and pose features, allowing reliable identification of individuals across different video frames and camera views. This significantly improves detection accuracy and reduces the chances of misclassification.

The system architecture, which includes modules such as admin login, data loading, feature extraction, model training, employee management, and video monitoring, ensures a structured and user-friendly workflow. The ability to upload and analyze videos in real-time makes the system practical for large-scale deployment in railway environments. The alert generation mechanism further enhances security by notifying administrators about suspicious detections, enabling quick response and decision-making. Experimental results confirm that the system achieves higher accuracy and better performance compared to conventional methods, making it a reliable tool for public safety applications.

In conclusion, the proposed system successfully demonstrates the application of deep learning in real-world surveillance scenarios. It reduces manual monitoring efforts, improves efficiency, and enhances the overall security infrastructure of Indian Railways. Future enhancements may include integration with live CCTV feeds, optimization of processing time, and the use of more advanced deep learning models to further improve accuracy. Overall, the system represents a scalable, efficient, and intelligent approach to person re-identification and public safety management.

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