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ENHANCING RAILWAY SECURITY WITH DEEP LEARNING-BASED PERSON RE-IDENTIFICATION AND TRACKING SYSTEMS

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ABSTRACT:

The difficulties in recognizing and monitoring suspicious persons via several surveillance cameras provide a considerable concern for public safety in densely populated transportation systems, such as the Indian Railways. This work introduces a deep learning-based Person Re-Identification (Re-ID) system designed to enhance railway security via the automated identification and recognition of suspects in surveillance video. The suggested system utilizes Convolutional Neural Networks (CNNs) to extract strong characteristics related to body posture and face recognition, hence enhancing identification effectiveness, in contrast to standard methods that depend on manually produced features, which may be susceptible to errors.The system process entails creating a database of questionable individuals, employing convolutional neural network (CNN) models for feature extraction, training machine learning classifiers like Support Vector Machine (SVM) and Random Forest, and ultimately implementing a real-time video surveillance system for railway security personnel. Administrators may promptly react after the assessment of alerts derived from CCTV video. The system provides monitoring modules for both administrative and staff levels, developed using Python and MySQL. The suggested method significantly improves public safety in Indian Railways via automated and scalable intelligent monitoring, as seen by the Random Forest classifier's better accuracy and less false positives.

Keywords: Person Re-Identification (Re-ID), Indian Railways, Surveillance System, Public Safety, Suspicious Person Detection, Real-Time Video Monitoring, Feature Extraction, Intelligent Surveillance.

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I.INTRODUCTION

Ensuring a safe and dependable railway network is a significant and formidable obligation in a country as vast and populous as India. The establishment of extensive monitoring systems at train stations to identify and observe suspicious individuals is a primary responsibility. Adapting to variations in appearance, posture, and illumination from different camera angles is a significant problem for conventional person identification systems that rely on manually designed image features. These algorithms often exhibit inadequate accuracy.

This study presents a Deep Learning-based Person Re-Identification (Re-ID) method to

address these constraints. The aim is to accurately identify and match individuals in diverse CCTV video using Convolutional Neural Networks (CNNs) via the extraction of general facial and postural information. Classification techniques, such as Random Forest and Support Vector Machine (SVM), are used to analyze these elements in order to detect and flag questionable persons within current crime datasets.

The many elements of this system were shaped by the Indian Railways context, which includes:

- The administration interface manages dataset uploads, supervises model training, and regulates staff access restrictions.
- A system enabling staff to monitor recorded or live CCTV footage and initiate alerts upon the recognition of certain individuals.
- A system that alerts administrators to any anomalous behavior and maintains a record of all detections.
- The software architecture consists of a MySQL database and a web server developed in Python. This system is an effective instrument for enhancing railway security and public safety, since it enables real-time video monitoring, intelligent alert generation, and centralized management.

II.LITERATURE SURVEY

In 2014, W. Li, R. Zhao, and X. Wang proposed an innovative deep learning methodology for Person Re-Identification using Convolutional Neural Networks (CNNs) [1]. They ceased the use of manually generated features in favor of obtaining powerful feature representations from photos. The test findings demonstrated a significant increase in identification accuracy across various camera angles. Nonetheless, enough labeled datasets were crucial for effective model training. This research lays the groundwork for human re-identification by CNN-based feature extraction, making it particularly pertinent to the suggested technique.

The comprehensive Market-1501 dataset for human re-identification research was presented by L. Zheng et al. (2016) [2]. Their research included using deep learning algorithms for feature extraction and gathering annotated photos from many camera angles. The results demonstrated that deep learning models using extensive datasets surpass conventional

techniques. Nonetheless, issues persist, including biases in the datasets and inconsistencies in the actual world. The results of this research support the idea that the suggested strategy might improve human re-identification algorithms via the use of structured datasets.

Triplet Loss was introduced by Hermans, Beyer, and Leibe (2017) [3] to enhance the accuracy of individual re-identification. The approach increases feature discrimination by increasing the separation of different pictures and reducing the separation of similar images. The experimental findings demonstrated a significant enhancement in feature learning efficacy. The method's complexity stems from the need for comprehensive sampling of training data. This study is significant since it enhances deep learning-based re-identification systems via improved feature learning.

In 2015, S. Liao et al. used metric learning in conjunction with Local Maximal Occurrence (LOMO) characteristics for individual re-identification. Their technique isolates significant local elements to account for changes in perspective and lighting. A comparison of the results with prior handmade feature-based algorithms revealed a marginal improvement. Nonetheless, in comparison to deep learning methodologies, the methodology proved insufficient. The research supports the shift to CNN-based models inside the proposed system and illustrates the shortcomings of conventional feature extraction methods.

In 2015, F. Schroff, D. Kalenichenko, and J. Philbin presented FaceNet, a facial recognition model using embedding learning, in their study on deep learning [5]. The approach projects facial photographs into a diminished Euclidean space to enable the comparison of similarities. The results of face matching activities showed a notable level of accuracy. Nevertheless, substantial computer resources and extensive datasets are necessary to train the model. The suggested person re-identification technique mostly relies on face feature extraction, making this research relevant.

Residual Networks (ResNet) were introduced by K. He and associates in 2016. They mitigate

the vanishing gradient issue using skip connections, facilitating the construction of very deep neural networks. This approach enhances the quality of feature extraction and the efficacy of learning. The results demonstrated considerable advancement in image recognition tasks. However, computational complexity increases with increasingly intricate systems. This study promotes the use of sophisticated CNN architectures to derive superior characteristics for human re-identification.

III.EXISTING SYSTEM

The existing security framework of Indian Railways depends on manually produced visual characteristics for human identification via many surveillance cameras. These first algorithms use fundamental visual signals to correlate an individual's images obtained from several cameras. However, the precision in recognizing these manufactured attributes is markedly inadequate due to their fragility and vulnerability to variations in illumination, posture, attire, and camera angle. The use of massive railway networks for monitoring and tracking suspicious or criminal persons is a significant challenge. Furthermore, real-time detection and alerting are ineffective and unreliable owing to the lack of an autonomous learning mechanism.

DISADVANTAGES

Identifying persons from many viewpoints using traditional methods might sometimes provide inaccurate results owing to dependence on manually created picture attributes.

Continuously monitoring several video streams is a laborious and error-prone task performed by human operators for surveillance purposes.

IV.PROPOSED SYSTEM

The suggested approach utilizes deep learning methods, namely Convolutional Neural Networks (CNNs), to improve individual re-identification and rectify the deficiencies of current systems. The automated extraction of face and postural traits from video material, followed by comparison with a preloaded suspect database, improves surveillance efficiency. To guarantee accurate identification, these attributes are also categorized using machine learning techniques such as Support Vector Machines (SVM) and Random Forest. Employees may access live video feeds from the railway, while administrators can oversee data uploads, feature extraction, and model training via their own interfaces. The gadget swiftly triggers alarms upon detecting a match, enabling quicker and more efficient responses to possible threats and enhancing public safety at railway locations.

ADVANTAGES

Augments manually crafted features via the use of Convolutional Neural Networks (CNNs) to extract resilient facial and spatial characteristics.

The system use preloaded picture libraries to autonomously recognize and match suspicious individuals in video streams.

V.SYSTEM MODEL

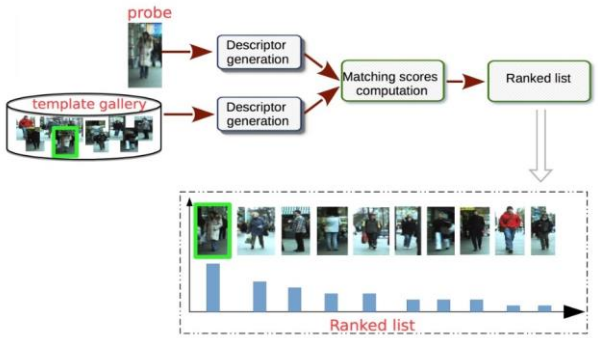


Fig 1.System Model

VI.MODULES OVERVIEW

1. Admin Interface:

•**Admin Login:** Authentication security for the railway administrator.

•**Load Data:**Establish a database of persons demonstrating dubious conduct online.

•**Extract CNN Features**:Employ CNN on the photos to extract features related to face characteristics and posture.

•**Train Models:**Employ feature extraction to train classifiers, including Support Vector Machines and Random Forest.

•**Add Employees**:Engage railway staff to record and report surveillance video.

•**View Alerts:**Analyze the logs and warnings produced by the uploaded films.

2. Employee Interface:

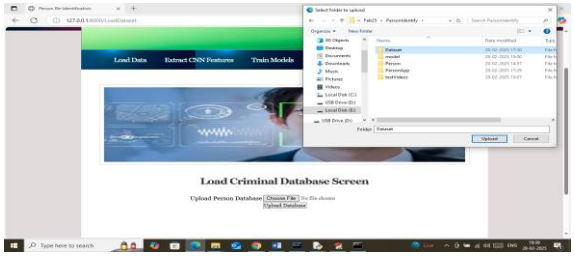
•**Employee Login:** Access to critical places is restricted to registered railway staff only.

•**Monitor Railway Videos:**Distribute security footage. Upon identifying a suspicious individual in the footage, the system will examine the content, re-identify the suspect, and then send an alert.

VII.SCREEN SHOTS

Click the "Railway Admin Login" link on the previous screen to access the next page.

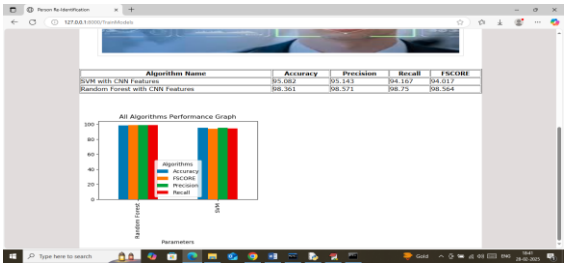
Upon logging in, the administrator will be sent to the following page.



Select the Upload buttons on the previous screen to import the dataset containing the names of offenders or suspicious individuals; the next page will load thereafter.

A varied collection of photos obtained from many criminal databases is shown on the previous screen. Choose the "Extract CNN Features" option to get features. This will guide you to the site below.

Choose the "Train Models" option on the screen above to train algorithms using the extracted characteristics. Consequently, the subsequent page will be shown.

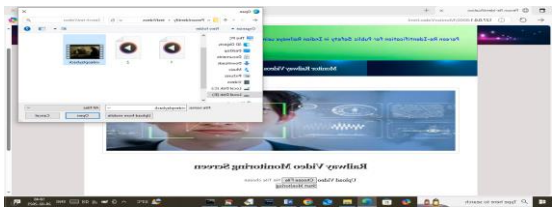


The results of both algorithms—Random Forest and SVM—trained on characteristics derived from CNN are shown on the top panel, with the former achieving much higher accuracy. The Random Forest exhibited remarkable accuracy in both approaches, as seen in the comparison graph above. The x-axis denotes the method names, while the y-axis depicts several metrics, including accuracy, represented by differently colored bars. The administrator has trained all algorithms and set them to oversee the films shown on the screen above. Next, go to the subsequent page by choosing the "Add employee" option.

Administrators may enter new personnel information in the top area of the page and then go to the bottom section by clicking the button.

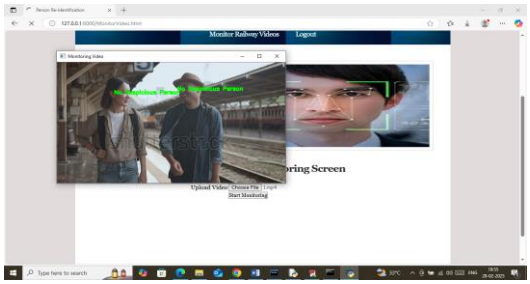
Upon logging in, the employee will see the page shown below, as demonstrated in the previous screen.

To access the next page, choose the "Monitor Railway Video" option on the previous screen.

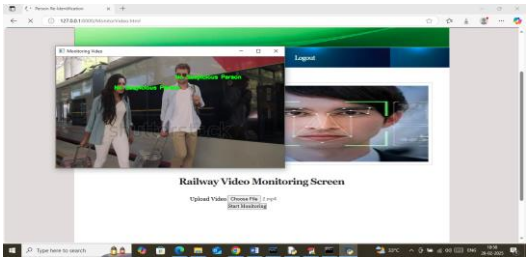


Select and upload a movie from the top screen, then use the buttons to go to the subsequent page. Please be patient while the model initializes; the video will start soon afterward.

The video above shows the system recognizing a suspicious individual referred to as "OSAMA," whose facial characteristics matched a database record, so triggering an alarm.



You may assess any more films in a similar manner; the one you just submitted was marked as "no Suspicious person" on the display above.



Log out and then log in as an administrator to see notifications. The previously listed videos were similarly labeled as "No suspicious.

Administrators may see a compilation of videos that include both those including and not featuring likely "Re-identified" individuals in the aforementioned snapshot.

VIII.CONCLUSION

The results of using Deep Learning in the Indian Railways' Person Re-Identification (Re-ID) system to improve public safety have shown promise. The strategy significantly enhanced the accuracy of detecting suspicious persons across various camera angles and video streams by substituting CNN-based feature extraction with conventional hand-crafted picture characteristics. Furthermore, excellent classification and recognition were achieved by the use of Random Forest and SVM algorithms,

with Random Forest demonstrating superior accuracy throughout testing. Administrative and staff processes were interconnected modularly, allowing efficient dataset administration, model training, and real-time monitoring. The project's pragmatic and scalable security monitoring system might improve safety at railway stations and other heavily populated public spaces.

XI.FUTURE ENHANCEMENTS

Future improvements may be applied to the planned Person Re-Identification (Re-ID) system to increase its effectiveness and utility for public safety on Indian Railways. The integration of advanced deep learning architectures like ResNet, Vision Transformers (ViT), and attention-based models improves feature extraction and recognition in intricate surveillance settings. Triplet Loss and contrastive learning are two metric learning techniques that may improve feature discrimination and decrease the occurrence of false matches across different camera angles. The technology enables rapid real-time surveillance of extensive railway networks via its deployment on edge devices and cloud-based platforms. In situations including occlusions and low-quality video, identification accuracy may be improved using multimodal biometric recognition, which includes gait analysis, face recognition, and body posture assessment. Improving the system's resilience, scalability, and effectiveness in enhancing public safety and intelligent surveillance within Indian Railways may require future developments, such as the application of extensive real-world datasets, privacy-preserving AI techniques, and automated alert systems connected to law enforcement databases.

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