Project SRS on

**RailVision- AI Integration in Railways**

Submitted as a part of course curriculum for

### Bachelor of Technology

in

**Computer Science**

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**Under the Supervision of Dr. Rajkumar**

**Add. Head of the Department**

**Department of Computer Science**

**Submitted by**

Aarohi Saxena (2200291520002)

**KIET Group of Institutions, Ghaziabad Department of Computer Science**

**Dr. A.P.J. Abdul Kalam Technical University 2024-2025**

# INTRODUCTION

The **AI Integration in Railways (RailVision)** project is a transformative initiative designed to enhance the safety, operational efficiency, and passenger experience across railway stations. Leveraging advanced **Machine Learning (ML)** and **Computer Vision** technologies, the system analyzes real-time CCTV footage to address critical challenges such as crime detection, crowd management, and operational monitoring. By automating anomaly detection, the platform eliminates reliance on manual surveillance, significantly reducing human error and response delays.

The system employs state-of-the-art ML models like **ResNet50** to identify anomalies, including suspicious activities, overcrowding, and unattended baggage, in real-time. Integrated with **OpenCV**, the platform preprocesses video feeds and provides actionable insights via alerts and dashboards. Administrators and security personnel can access these insights through an intuitive, web-based interface, enabling rapid decision-making. Additionally, the system supports emergency response integration, allowing services like medical assistance or security reinforcements to be activated instantly with a single click.

Designed for scalability and compliance, the platform can seamlessly integrate with existing railway infrastructure while ensuring data privacy and ethical standards. Its modular architecture supports future expansions, such as predictive maintenance and multi-station deployments. By combining automation with advanced analytics, this project redefines railway operations, creating a smarter, safer, and more passenger-centric railway ecosystem.

## PURPOSE

The purpose of this document is to establish the software requirements for the **AI Integration in Railways** project, serving as a comprehensive guideline for system development. The system is designed to integrate **Machine Learning (ML)** and **Computer Vision** to automate the analysis of CCTV footage and address critical challenges in railway operations.

* **Crime Detection**: Leverage AI and ML algorithms to detect anomalies like suspicious activities, unattended baggage, and unauthorized access in real-time, ensuring enhanced safety.
* **Crowd Management**: Use AI-based analytics to estimate crowd density, monitor passenger movements, and predict congestion, enabling smooth and efficient station operations.
* **Operational Monitoring**: Automate staff activity supervision, such as maintenance and cleaning, while generating real-time insights to enhance overall operational efficiency.
* **Passenger Experience**: Improve passenger comfort and safety through enhanced security measures, reduced crowding, and timely alerts during travel disruptions.
* **Scalability and Integration**: Design a flexible system capable of integrating with existing railway infrastructure and scalable for future enhancements across multiple stations.
* **Reduction in Human Error**: Minimize reliance on manual processes by automating anomaly detection and decision-making, thereby reducing human errors and delays.

## SCOPE

### Anomaly Detection:

Detect suspicious activities such as unattended baggage, unauthorized access, or potential security threats.

Identify overcrowding and congestion points to prevent disruptions and ensure passenger safety.

### Real Time Alert and Notification:

### Generate immediate alerts upon detecting anomalies, ensuring rapid response by security personnel.

### Provide video clips of detected anomalies for easy validation and decision-making.

### Dashboard and Reporting:

Offer interactive dashboards for administrators to monitor station operations in real time.

Generate detailed reports with insights into operational performance, anomalies, and staff efficiency.

### Seamless Infrastructure Compatibility:

Integrate with existing railway CCTV systems and operational frameworks to ensure smooth adoption.

Support the addition of IoT sensors for enhanced monitoring and data collection.

* **Emergency Response Services**:

Enable future integration with ambulance and emergency services for rapid assistance during medical or security incidents.

Provide a one-click notification system for immediate action in critical situations.

## PRODUCT OVERVIEW

### PRODUCT PERSPECTIVE

* + - * **Standalone System**: Integrates seamlessly with existing railway CCTV and management systems.
      * **Anomaly Detection**: Detects suspicious activities, overcrowding, and inefficiencies using AI and ML algorithms.
      * **Real-Time Alerts**: Provides immediate notifications for anomalies, enabling rapid response.

### PRODUCT FUNCTIONS

* + - * **Crime Detection**: Automatically identify suspicious activities or unattended baggage and alert authorities.
      * **Crowd Management**: Monitor and manage crowd density to prevent congestion and improve passenger flow.
      * **Work Monitoring**: Ensure operational compliance and staff efficiency using automated monitoring.
      * **Emergency Services**: Provide one-click notifications for rapid response during medical or safety incidents.

### USER CHARACTERISTICS

* + - * **Security Personnel: Responsible for responding to anomalies and ensuring station safety.**
      * **Administrators: Oversee overall operations and monitor system performance.**
      * **Passengers (Indirect): Benefit from improved safety and streamlined operations.**

### ASSUMPTIONS AND DEPENDANCIES

* + - * Reliable access to high-resolution CCTV feeds.
      * Adequate computational resources for real-time processing.
      * Compliance with privacy and ethical standards.

# REQUIREMENTS

## FUNCTIONS

* Enable real-time anomaly detection from CCTV feeds for crime, crowd, and operational inefficiencies.
* Use AI models like ResNet50 and OpenCV to identify suspicious activities, overcrowding, and unattended baggage.
* Provide automated, editable reports for administrators based on detected anomalies and operational insights.

## PERFORMANCE REQUIREMENTS

* Support real-time processing of CCTV feeds from a minimum of 100 cameras simultaneously.
* Generate alerts and anomaly video clips within 5 seconds of detection.

## USABILITY REQUIREMENTS

* Provide an intuitive dashboard for security personnel, administrators, and operational staff.
* Accessible on modern browsers and mobile devices without requiring additional installations.

## INTERFACE REQUIREMENTS

### System Interfaces:

Integration with IoT sensors and AI models for real-time monitoring.

APIs for external systems like emergency response and predictive maintenance tools.

### User Interfaces:

Web-based UI with clear navigation and accessibility options.

Mobile-responsive design for on-the-go anomaly alerts and validations.

### Hardware Interfaces:

Compatible with high-resolution IP cameras, standard webcams, and IoT devices.

### Software Interfaces:

Uses REST APIs for AI and collaborative tools.

## LOGICAL DATABASE REQUIREMENTS

* Store anomaly logs, video clips, and system reports securely while ensuring GDPR compliance.
* Maintain operational data and anomaly records for at least one year.

## DESIGN CONSTRAINTS

* Must be cloud-hosted or compatible with on-premise deployment for security-critical environments.
* Ensure low latency during real-time video analysis and alert generation

## SOFTWARE SYSTEM ATTRIBUTES

* Reliability: Guarantee 99.9% system uptime for uninterrupted operations
* Scalability: Handle scaling as the number of railway stations or camera feeds increases

# VERIFICATION

* **Crime Detection**: Verify that AI models accurately identify suspicious activities and unattended baggage based on pre-defined criteria.
* **Crowd Management**: Ensure crowd density predictions and congestion alerts align with real-world scenarios.
* **Operational Monitoring**: Validate staff performance reports and protocol adherence metrics generated by the system.

# APPENDICES

## ASSUMPTIONS AND DEPENDENCIES

* Dependency on AI models like ResNet50 for anomaly detection.
* Adequate computational resources for real-time processing.

## ACRONYMS AND ABBREVIATIONS

* AI: Artificial Intelligence
* **REST**: Representational State Transfer
* **UI**: User Interface
* **ML**: Machine Learning
* **CCTV**: Closed-Circuit Television