PIP2001 Capstone Project
Review-4

Using existing CCTV network for crowd management, crime prevention, and work monitoring using AIML

Batch Number: COM22

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Introduction

- Managing crowds, security, and workforce in public transport hubs is challenging.
- Traditional CCTV monitoring is manual, inefficient, and error-prone.
- AI and ML enable transforming CCTV into intelligent surveillance systems.
- Real-time detection of crowd congestion, unusual behavior, and workforce issues.
- Provides automated alerts and predictive analytics for proactive management.
- Enhances safety, optimizes crowd movement, and improves workforce monitoring.
- Helps authorities prevent overcrowding, detect suspicious activities, and manage staff efficiently.

Abstract

- AI/ML-driven smart surveillance using existing CCTV networks
- Improves crowd management, crime prevention, and workforce monitoring
- Uses computer vision, deep learning, and real-time video analysis
- Detects crowd density, unusual activities, and workforce efficiency
- Features automated security alerts and predictive crowd analysis
- Provides actionable insights for railway authorities and law enforcement
- Optimizes security and resource allocation for safer public spaces
- Reduces human dependency and enhances control over large crowds

Literature Survey

Sl. No	Name	Implementation	Drawbacks
1	AI/ML-driven Surveillance	Uses AI/ML on CCTV footage for intelligent analysis	High computational resources needed
2	Crowd Management	Real-time crowd density and movement analysis using computer vision	Accuracy affected by poor video quality
3	Crime Prevention	Detects unusual activities with deep learning	False positives can cause unnecessary alerts
4	Workforce Monitoring	Tracks workforce efficiency via video analytics	Privacy concerns and staff resistance
5	Automated Alerts	Sends real-time alerts on anomalies	Alert fatigue if too frequent
6	Predictive Crowd Analysis	Forecasts crowd congestion and behavior with predictive analytics	Predictions may be inaccurate in dynamic cases
7	Resource Optimization	Provide[illegible]sights for efficient	Dependent on input data quality

Existing Methods and Their Drawbacks

Existing Methods

1. Manual CCTV Monitoring – Security staff manually observe live footage.
2. Traditional Surveillance Systems – Only record events without real-time AI-driven analysis.
3. Basic Crowd Control Measures – Relies on human estimates and physical barriers.

Drawbacks

- Human Error – Security personnel may miss critical events due to fatigue.
- Delayed Response – Manual monitoring does not allow real-time automated alerts.
- Limited Scalability – Inefficient when managing large railway stations.
- Lack of Predictive Insights – Cannot forecast crowd behavior patterns.

Proposed Method

The proposed AI/ML-based smart surveillance system will:

1. Extract live CCTV footage from existing railway camera networks.
2. Process video streams using deep learning algorithms for:
   - Crowd density detection (overcrowding alerts)
   - Behavioral anomaly detection (suspicious activity)
   - Workforce activity tracking (cleaning and maintenance monitoring)
3. Generate AI-powered alerts for railway security and management teams.
4. Provide an Admin Dashboard with data analytics and reports.

Objectives

- Develop an AI/ML-powered system to analyze CCTV footage in real-time.
- Implement crowd monitoring algorithms for predictive congestion control.
- Enable crime detection through behavioral anomaly recognition.
- Automate workforce monitoring to improve cleanliness & station management.
- Provide automated alerts to railway authorities for quick decision-making.
- Ensure privacy compliance and ethical AI implementation.

Methodology

Step 1: CCTV Data Collection & Processing

- Integrate existing CCTV feeds into the system.
- Preprocess video data by removing noise, enhancing images, and extracting key frames.
- Store structured video metadata in a MySQL database for retrieval.

Step 2: AI Model Development for Crowd & Crime Detection

Train computer vision models (YOLO, Faster R-CNN, OpenCV) to detect:

- Crowd congestion levels
- Unusual activities (loitering, aggressive behaviour, theft)
- Abandoned objects

Implement ML-based predictive analytics to anticipate crowd surges.

Methodology

Step 3: Real-time Alert System Implementation

- Develop an event-driven system to send real-time alerts to authorities.
- Use Deep Learning for anomaly detection in crowded areas.
- Implement an AI-based violation detection system (e.g., non-compliance with safety rules).

Step 4: Backend & Database Management

- Store processed video insights in a structured MySQL database.
- Implement a REST API to allow access to alert data for security personnel.

Step 5: Frontend Dashboard Development

- Develop a web-based dashboard using React.js or Angular for security personnel.
- Provide live video feed analysis and alerts.
- Implement analytics and heatmaps for crowd density visualization.

Methodology

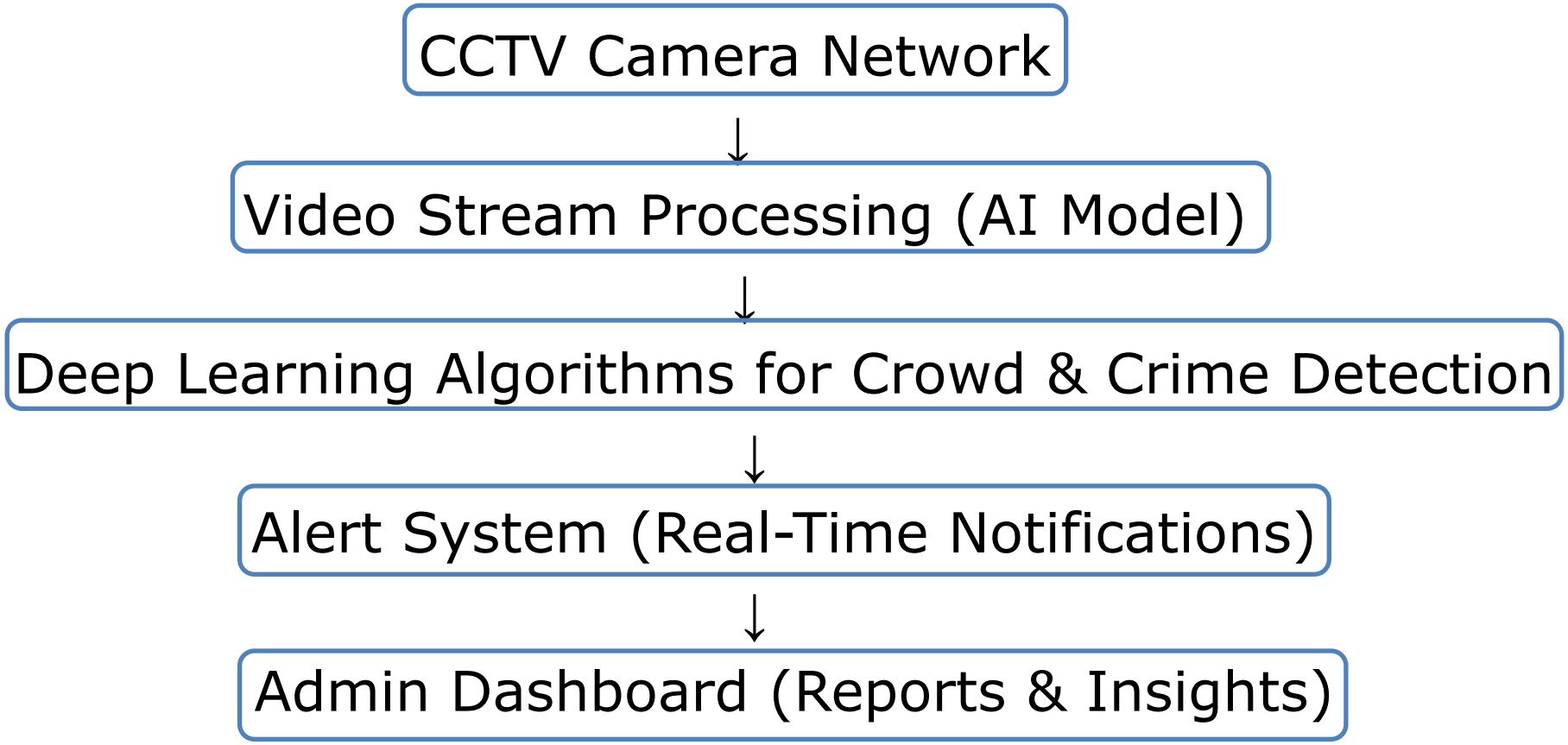
Step 6: Testing & Performance Evaluation

- Conduct stress testing on CCTV feeds to ensure real-time response.
- Evaluate false positive and false negative rates for AI models.
- Optimize AI model performance based on field test feedback.

Step 7: Deployment & Monitoring

- Deploy the system on cloud or local servers with real-time data processing capabilities.
- Provide training for railway security personnel to interpret AI-generated insights.
- Enable continuous monitoring and periodic AI model updates for improved accuracy.

Architecture Diagram



Modules

1. **Real-Time Crowd Analysis Module** – AI detects overcrowding patterns.
2. **Crime Prevention Module** – Identifies suspicious behavior using deep learning.
3. **Workforce Monitoring Module** – Tracks maintenance staff activities.
4. **Admin Dashboard Module** – Provides insights, alerts, and reports.
5. **Ethical & Privacy Compliance Module** – Ensures responsible AI implementation.

Hardware and Software Details

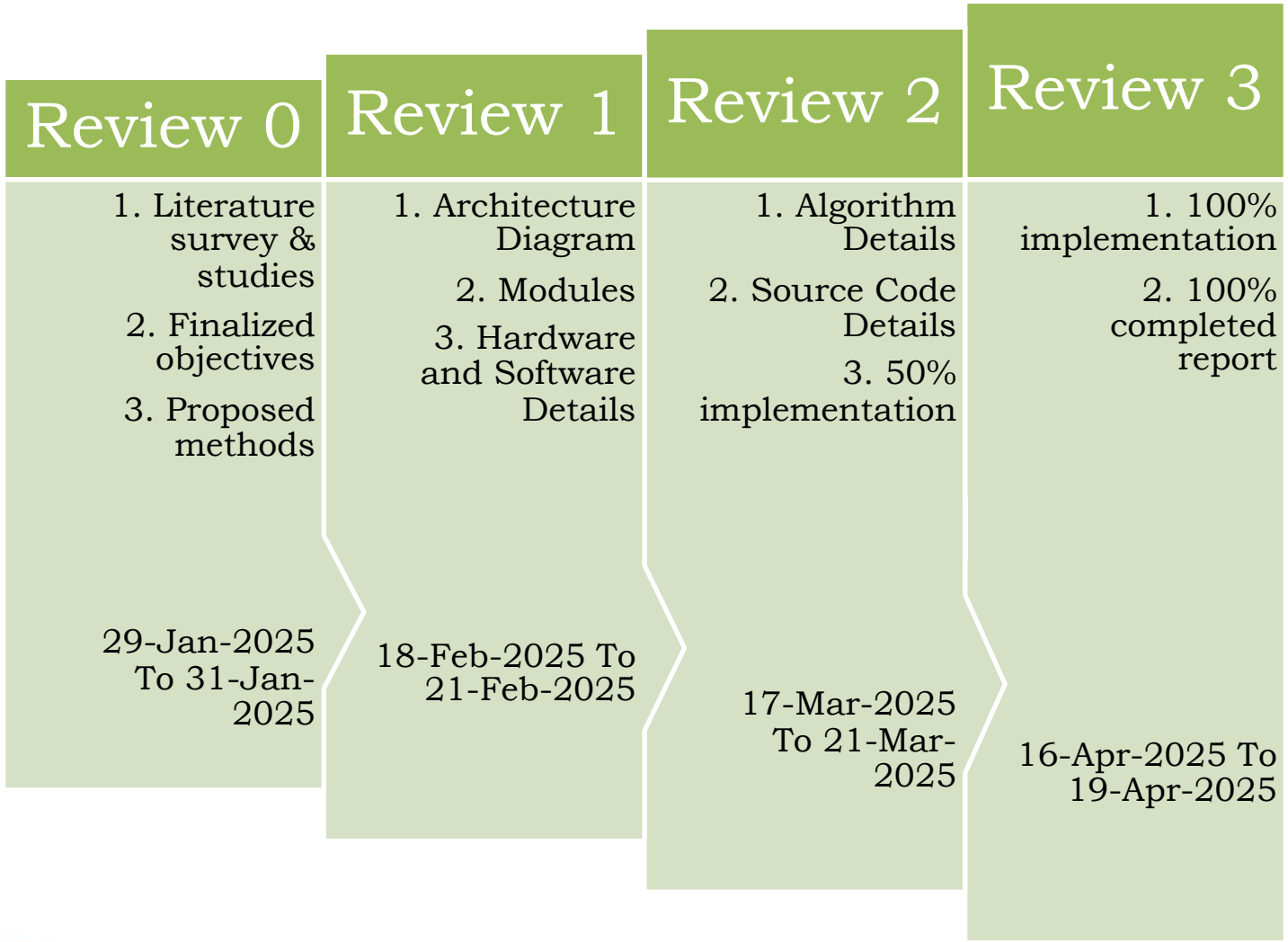
Hardware Requirements

1. CCTV Camera System – Existing railway surveillance cameras.
2. AI Processing Unit – High-performance GPU server.

Software Requirements

1. Python 3.x – AI model development.
2. OpenCV & TensorFlow – Image processing & deep learning.
3. Flask/Django – Backend for API & data management.
4. MySQL – Database for storing logs & reports.
5. JavaScript (React.js) – Web-based Admin Dashboard.

Timeline of the Project (Gantt Chart)



Expected Outcomes

- Enhanced passenger safety & security
- Optimized railway staff performance monitoring
- Reduced operational inefficiencies and response delays
- Data-driven decision-making for station management

Conclusion

This project presents an AI/ML-driven smart surveillance system that leverages existing railway CCTV networks to enhance crowd management, crime prevention, and workforce monitoring. By automating real-time video analysis, this system will improve railway security, optimize station operations, and ensure safer travel experiences for millions of passengers.

References

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Thank You