Unified Metro AI Surveillance System

Presented by: Adithya Anand
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Real-time Passenger Density Monitoring

Unidentified Object Detection

Fire and Smoke Detection

Fall Detection

Violence Detection

→ *"Ensuring safety, security, and operational efficiency with real-time AI surveillance."*

☑ **Real-time Passenger Density Monitoring** to prevent overcrowding.

Object Detection to identify suspicious or unattended items.

🔥 **Fire and Smoke Detection** for rapid hazard alert and evacuation response.

Fall Detection for immediate response to emergencies.

⚔ **Violence Detection** to catch security incidents as they happen.

🖥 **Centralized Web Dashboard** for real-time monitoring and alerts.

Problem Statement | Metro Safety at a Crossroads

→ "Rising safety concerns in metro systems demand smarter surveillance."

Increasing incidents of overcrowding, theft, and passenger emergencies.

Manual surveillance is inefficient and lacks real-time insights.

Need for automated, intelligent, and cost-effective safety systems.

Literature Review / Research Backing

→ *"Grounded in proven face detection advancements for public safety and surveillance."*

Key Studies Supporting Our Solution:

Hybrid Detection Approaches:
- Traditional methods (e.g., Haar cascades) enhanced with deep learning (CNNs) significantly boost real-time detection performance — especially for small, occluded, or rotated faces
- Face Detection in Surveillance Environments:
- Embedded hardware solutions and edge AI offer low-latency, high-speed detection ideal for metro surveillance scenarios

People Counting via Face Detection:
- Face-based people count estimation improves accuracy in dense environments using hybrid methods combining frontal and profile detection models

Deep CNN-Based Models:
- Advanced models like Faceness-Net, ScaleFace, and Improved SSD are highly effective for detecting faces across varying scales, angles, and lighting — supporting robustness in metro conditions

Bayesian & Eye-Region Techniques:
- Probabilistic networks and eye-region-focused Adaboost models reduce false positives and enhance detection under occlusion

Conclusion:
- Our system architecture reflects current best practices in AI surveillance — integrating robust detection models and edge deployment strategies validated by recent academic literature.

Objectives | 🎯 Our Mission: Zero-Delay Incident Response

→ *"Transforming metro safety with cutting-edge AI solutions."*

Primary Goals

👥 **Real-Time Passenger Monitoring**: Estimate crowd levels to prevent overcrowding.

🧳 **Suspicious Object Detection**: Identify unattended objects or potential threats.

🚨 **Emergency Recognition**: Detect incidents such as fire, fainting, violence, or falls.

• 🗄 **Centralized Management**: Store incident logs, analyze trends, and visualize insights.

User Specific Portals

👤 **Passenger Portal**: View real-time crowd density per coach.

• 🛡 **Security Officer Portal**: Receive live alerts with incident details.

→ *"Proactive security monitoring minimizes risks and ensures passenger safety."*

Key Benefits:

- ⚡ **Faster Response Times**: Real-time alerts accelerate emergency handling.

- 👤 **Enhanced Passenger Experience**: Avoid overcrowding and ensure smoother commutes.

- 🔧 **Operational Efficiency**: Reduces manual monitoring with automation.

- 💰 **Cost-Effective Deployment**: Edge computing reduces server load and bandwidth costs.

Modules and System Overview

→ *"Modular architecture for scalable, real-time metro surveillance."*

Crowd Density Estimation	Suspicious Object Detection Module
Fire Detection Module	Fall Detection Module
Violence Detection Module	Central Logging and Alerts Module
Web Portals Module	

Crowd Density Estimation Module

- Detects and classifies passenger density in each coach.
- Outputs: Low / Medium / High crowd **tags**.

Suspicious Object Detection Module

- Detects unattended baggage.
- Flags anomalies for security teams..

Fire and Smoke Detection Module

- Detects fire and smoke instantly using AI vision.
- Triggers evacuation alerts for rapid safety response..

Fall Detection Module

- Identifies sudden posture changes.
- Sends real-time alerts to onboard staff.

Violence Detection Module

- Detects aggressive gestures or fights using motion and object analysis.

Central Logging and Alerts Module

- Collects, stores, and manages all incident data in a structured format.
- Prevents duplicate entries and maint
- ains timestamps.

Web Portals Module

- Passenger Portal: View live coach density.
- Security Portal: Receive alerts, view logs, monitor trends.

→ "Seamless integration of AI, surveillance, and web technologies."

Architecture Components:

🎥 **RTSP Cameras**: Capture live video from metro coaches.

🧠 **Edge AI Models**: Detect objects, falls, and violence locally on-device.

🌐 **Flask Web Server**:

Hosts both **Passenger** and **Security** portals.

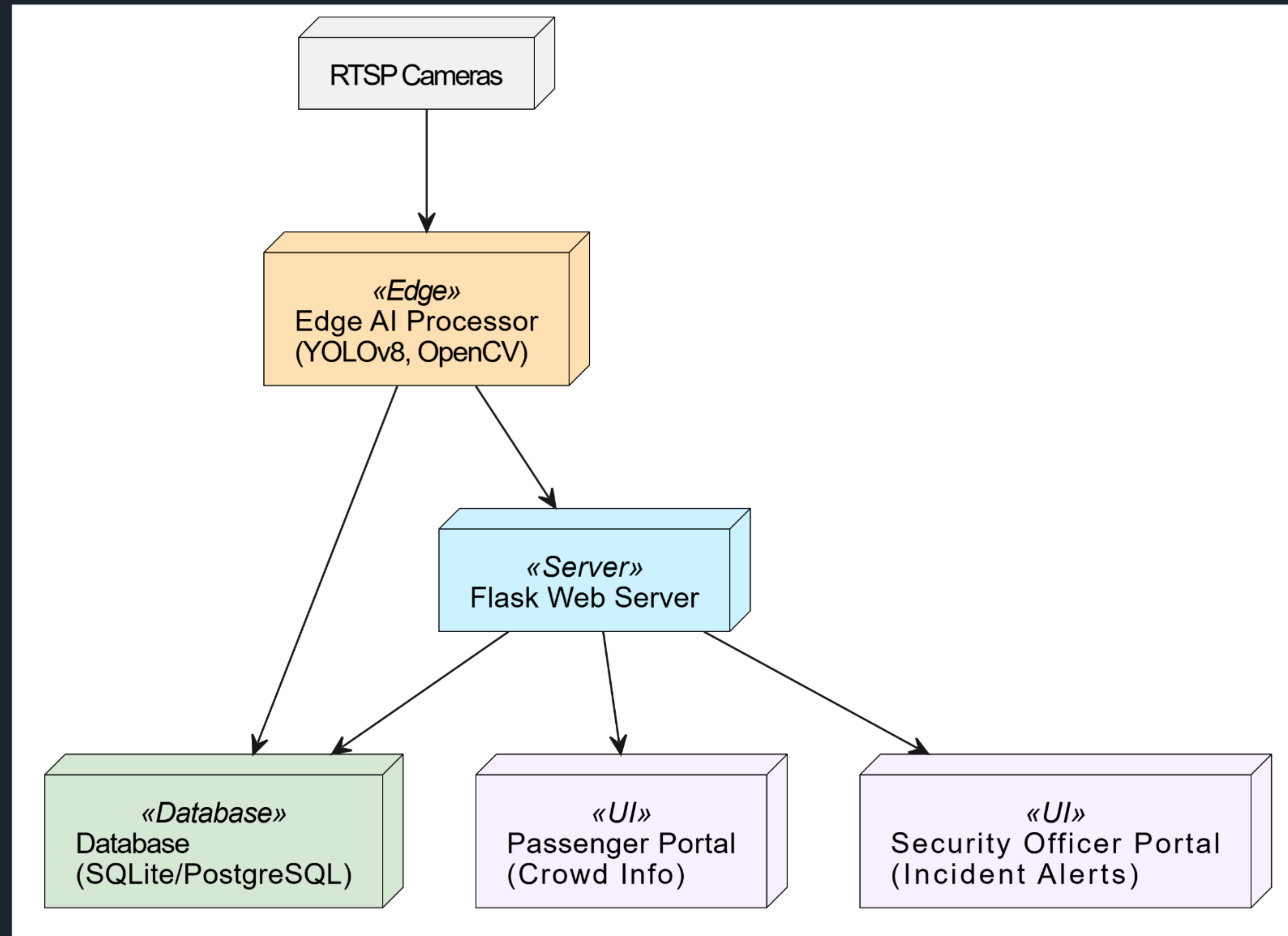Serves real-time incidents and crowd density data.

🗄 **Database (SQLite/PostgreSQL)**: Stores incidents, logs, and passenger counts.

🖥 **Web UI**: Visual interface showing crowd levels and alert notifications.
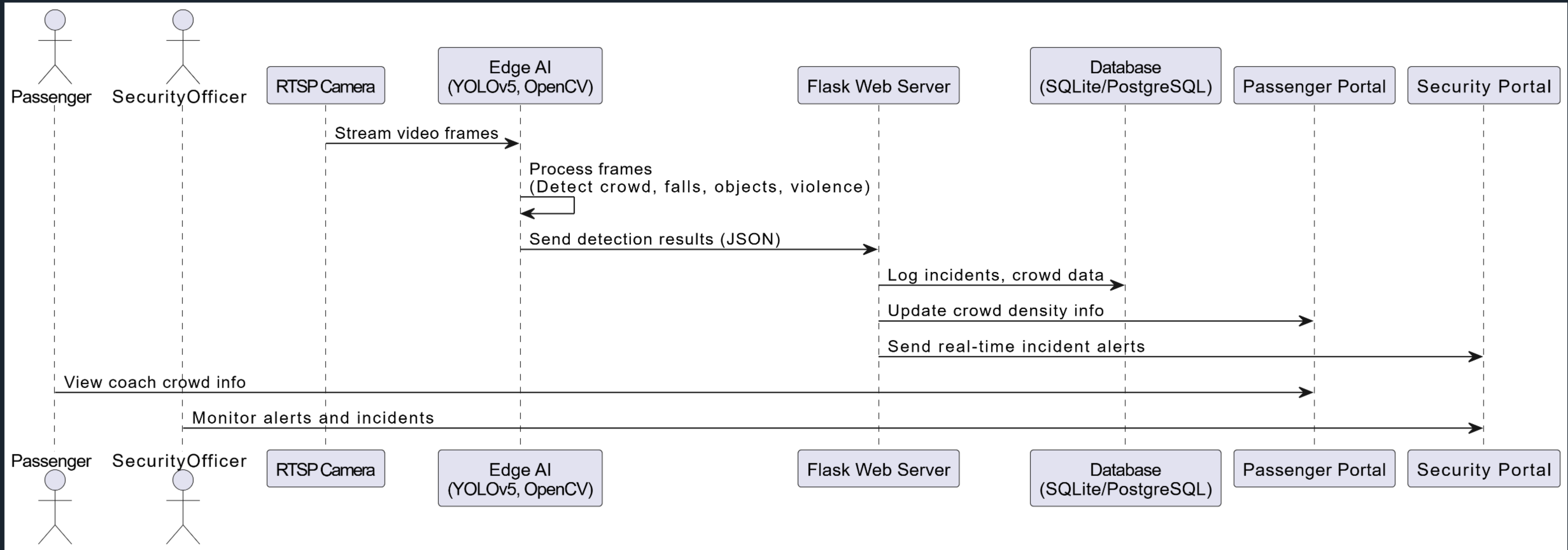
System Architecture Diagram

→ **"End-to-end system design integrating AI, edge processing, and real-time dashboards.**
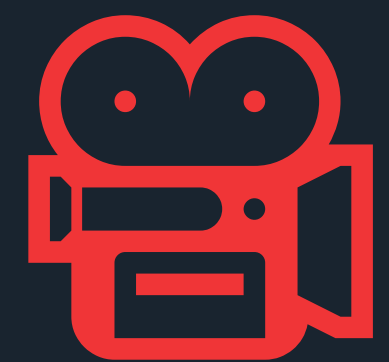
→ "Step-by-step flow of AI surveillance from detection to real-time response."

Demo

→ **"Experience metro safety in action with real-time AI detection and alerts."**

Demo

See It in Action: Real-Time Metro Safety

Let's Make Metro Travel Safer – Together.

→ "AI-Powered Safety. Web-Driven Control. Metro-Ready Surveillance"

Smarter Surveillance. Not tomorrow—today.

From detection to decision in real-time.

Edge AI that acts before disaster strikes.

Scalable. Affordable. Metro-ready.

Let's deploy intelligent safety where it matters most.

🚀 Behind the Scenes: Real Outputs from Our System

→ "Live detections and real-time alerts, captured during system testing"

Thank You