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Strengthening Mobility and Revolutionizing Transportation Stage 1

Commuter Rail Advanced Vision Analytics

Objective

The project aims to enhance commuter rail safety and efficiency through advanced vision analytics by leveraging NVIDIA Jetson-based vision models, GPS, vehicle performance data, and existing camera systems for real-time detection and monitoring of CapMetro commuter rail operations. By integrating these technologies, the system will provide precise location data, monitor vehicle performance, and utilize vision models to detect and classify safety-critical events such as trespassers, right-of-way encroachments, and near misses. Additionally, the project will incorporate data from on-board Positive Train Control (PTC) systems and save all notable events to a data warehouse for further analytics, enabling comprehensive reporting and planning.

This advanced monitoring will facilitate the creation of actionable insights, such as trespasser and ROW encroachment heat maps, allowing for the effective placement of security resources and deterrents, ultimately improving overall rail safety and operational efficiency.

Key Goals

- Safety Improvement: Implement real-time detection of trespassers, right-of-way (ROW) encroachments, and near misses to prevent accidents and improve overall safety.
- Efficiency Enhancement: Use intelligent camera based infrastructure to optimize rail operations and reduce delays.
- System Integration: Seamlessly integrate advanced technologies with existing wayside signal and commuter rail vehicle systems for enhanced functionality and performance.
- Data Utilization: Collect and process high-quality data to support decision-making and proactive measures.

Technology and Implementation

- NVIDIA Jetson AGX Orin**:** Selected for its robust performance in running fine-tuned vision models and real-time data processing.
- Vision Models: Deployed to detect and classify various safety-critical events along the rail right of way.
- GPS Integration: Combined with vision models to provide precise location data for detected events, enhancing situational awareness.
- On-board PTC (Positive Train Control): Leveraged to provide additional vehicle and operator performance data and enhance real-time monitoring.
- Edge Processing: Real-time data processing on Jetson devices to minimize latency and ensure timely responses.
- Data Warehouse: All notable events are saved to a data warehouse for further analytics, supporting comprehensive reporting and strategic planning.
- Existing Camera Systems**:** Leveraging cameras on commuter rail vehicles and at fixed wayside positions to capture visual data for analysis.

Expected Outcomes

- Enhanced Safety: Significant reduction in accidents and safety incidents due to real-time detection and monitoring.
- Operational Efficiency: Improved efficiency in rail operations through better monitoring and quick response to potential hazards.
- Data-Driven Insights: High-quality data collection leading to actionable insights for future infrastructure improvements and policy making.
- Scalability: A scalable solution that can be replicated in other transportation systems for broader impact.

Key Analytics and Reports

- Trespasser and ROW Encroachment Heat Map: A notable report that visualizes high-risk areas for trespassing and ROW encroachments, enabling strategic placement of security resources and deterrents.
- Operator Performance Dashboard: A comprehensive dashboard providing real-time and historical data on operator performance metrics, allowing for proactive training, performance optimization, and better decision-making.

Budget and Funding

- Total Funding Requested: $2,000,000
- No Cost Sharing Required: Full funding provided for Stage 1.

Project Timeline

Phase 1 - Request for Proposal and Project Initialization (4 months): Initial 120 days focused on detailed planning, issuing requests for proposals, and project initialization.

Phase 2 - Implementation and Testing (8 months): Deployment of vision models, integration of GPS, and initial testing of the system.

Go Live (12 months): Full operational deployment of the system.

Phase 3 - Optimization and Reporting (4 months): Final 4 months for optimizing the system, collecting comprehensive data, and preparing final reports.

Partners and Stakeholders

- Project Delivery: CapMetro Rail Department
- Technology: NVIDIA
- Vehicle: Stadler
- Data and Cloud Services: Microsoft Azure

Goals and Objectives alignment

- Safety and reliability: Improve the safety of systems for pedestrians, bicyclists, and the broader traveling public. Improve emergency response.
- Integration: Improve integration of systems and promote connectivity of infrastructure, connected vehicles, pedestrians, bicyclists, and the broader traveling public.
- Resiliency: increase the reliability and resiliency of the transportation system.
- Fit, Scale and adoption: Right-size the proposed solution to population density and demographics, the physical attributes of the community and transportation system and the transportation needs of the community.

Eligible Project alignment

- Connected Vehicles
- Intelligent, Sensor-Based Infrastructure

Closing Statement

This project represents a significant step forward in enhancing the safety and efficiency of commuter rail operations through advanced vision analytics and intelligent stream analysis. By leveraging cutting-edge technology and integrating it seamlessly with existing systems, we aim to set a new standard for transportation safety and operational excellence.

The successful implementation of this project will not only benefit CapMetro's commuter rail operations but also provide a scalable model that can be replicated in other transportation systems, contributing to a safer and more efficient future for all. Your support is crucial in driving this innovative initiative forward, ensuring that we can achieve these ambitious goals and make a lasting impact on transportation safety and efficiency.