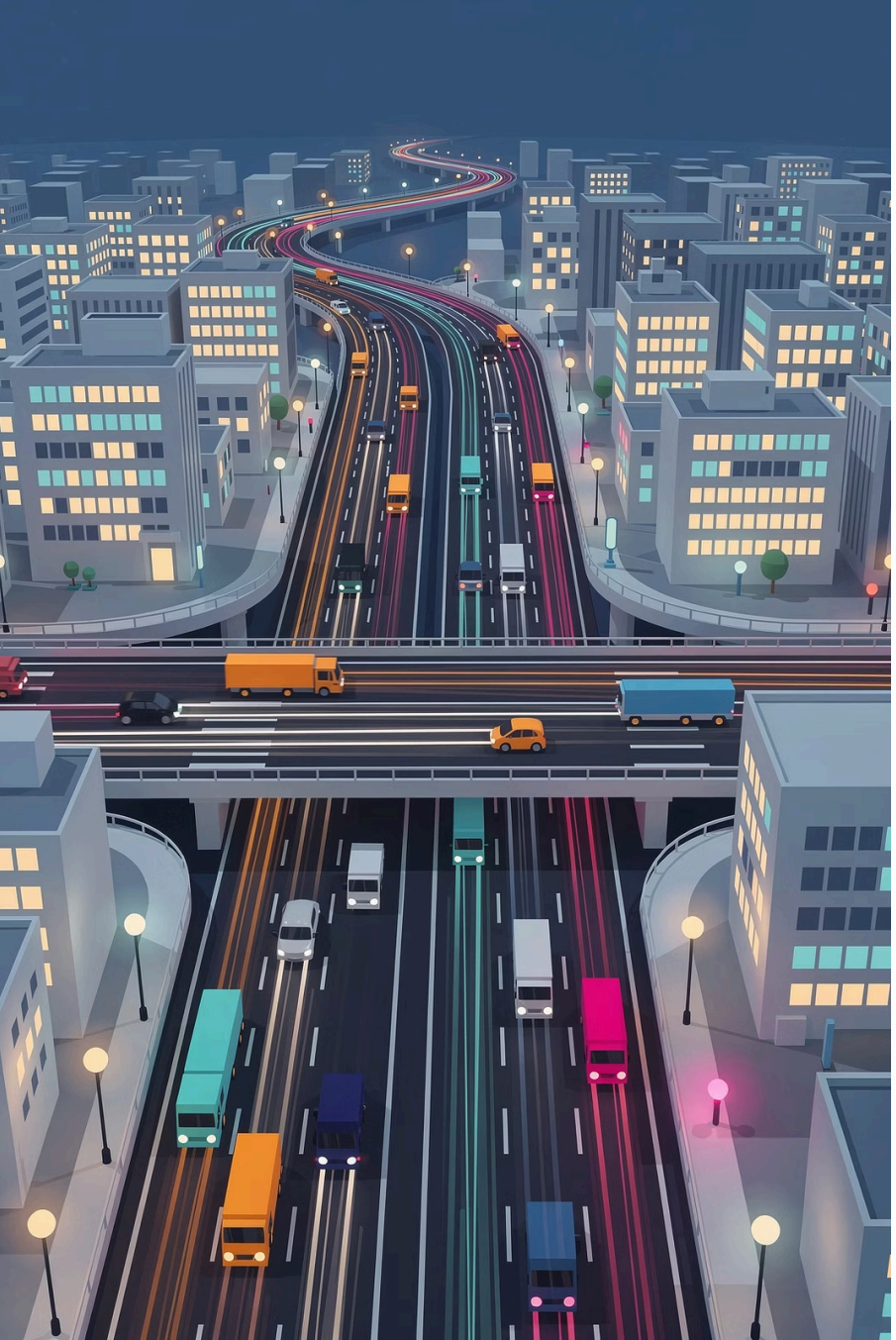


Beltways RTIIS

Real-Time Roadway Incident Intelligence System

Built to cut detection time from minutes to seconds.

Author: Sharath Chandra Odepalli

The Real Problem

Transportation agencies face a critical detection gap that costs millions in economic damage and puts lives at risk. Current incident detection systems are reactive, slow, and operationally overwhelming.

Detection Delays

Traffic incidents detected 5–10 minutes after occurrence, allowing secondary accidents and cascade failures to develop

Data Overload

Operators overwhelmed by raw sensor feeds with no intelligent filtering or prioritization

Escalating Costs

Secondary accidents and rising congestion costs compound with every minute of delay

> **"Every minute of detection delay increases severity and economic damage."**

Legacy systems provide data but not intelligence. The industry needs automated detection, contextual analysis, and actionable recommendations delivered in real-time.

The RTIIS Solution

RTIIS transforms raw sensor data into actionable intelligence through automated detection and AI-powered analysis. The system provides operators with everything they need to respond faster and more effectively.

01

Real-Time Sensor Ingestion

Continuous data streams from roadway sensors

02

Automated Detection

Instant identification of congestion, stopped vehicles, and slowdowns

03

AI-Powered Analysis

Contextual summaries with cause analysis and response recommendations

04

Interactive Visualization

Dashboard, map interface, and scenario simulation

05

System Health Monitoring

Real-time status tracking and reliability metrics

Architecture Overview

RTIIS is built on a modern, scalable architecture designed for production environments. The system integrates industry-standard technologies with custom detection logic and AI capabilities.

1

Sensor Simulator

Data generation layer

2

FastAPI Backend

Python API layer

3

Detection Rules

Incident identification

4

AI Module

OpenAI LLM analysis

5

Database

SQLite/Postgres

6

React Frontend

Dashboard + Map UI

Backend Stack

FastAPI framework with Python for high-performance async processing and REST API endpoints

Data Layer

SQLAlchemy ORM with SQLite for development and PostgreSQL for production scalability

AI Integration

OpenAI LLM for natural language incident summaries and intelligent recommendations

Frontend Stack

React + TypeScript for type-safe UI components, Leaflet.js for interactive mapping

Live Dashboard

Operator Experience

The RTIIS dashboard delivers a complete operational picture in a single view. Operators see real-time incident feeds with intelligent prioritization, color-coded severity levels, and AI-generated narratives that explain what's happening and why.

Flow and speed charts provide instant context for traffic conditions, while the incident timeline tracks event progression. Every element is designed for rapid comprehension and decisive action.

Real-Time Incident Feed

Continuous stream of detected events with automatic prioritization

Severity Color Coding

Visual hierarchy for instant impact assessment and triage

AI-Generated Narratives

Contextual incident descriptions with cause analysis

Flow & Speed Analytics

Real-time performance metrics and trend visualization

Incident Timeline

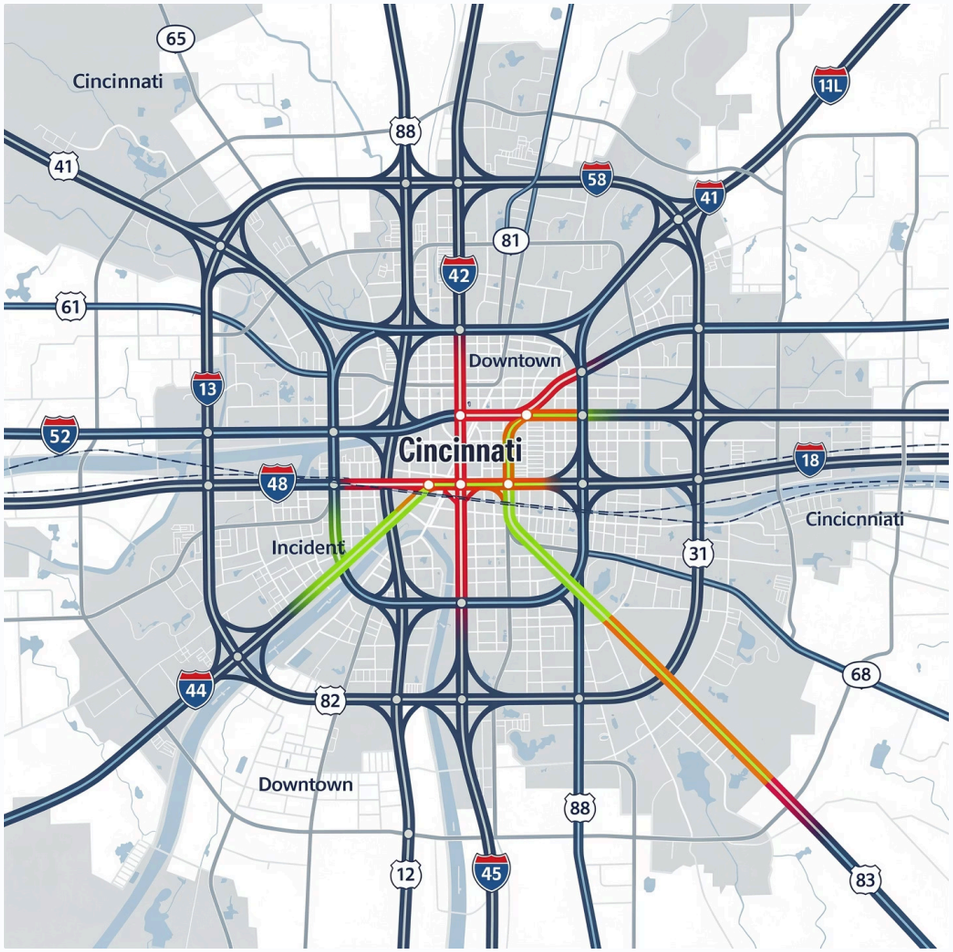
Complete event history and progression tracking

> "Built for speed, clarity, and operator decision-making."

Map View & Scenario Playground

RTIIS combines geographic visualization with operational simulation capabilities. The map view displays Cincinnati highways with real-time incident markers, while the operator playground enables scenario testing and system validation.

Interactive Map View



Real-time incident markers on Cincinnati highway network with dynamic updates, click-through incident details, and geographic context for response planning.

Operator Playground

Congestion Scenario

Simulate heavy traffic buildup conditions

Stopped Vehicle

Test detection of disabled vehicles

Multi-Lane Slowdown

Complex incident pattern simulation

Scenario buttons enable operators to validate system behavior, test response protocols, and train on realistic incident patterns before they occur in production.

Reliability & System Status

RTIIS is designed with production-minded observability and intelligent fallback logic. Continuous health monitoring ensures system reliability and provides operators with confidence in the data they're receiving.

99.9%

Backend Uptime

High-availability API with health check endpoints

100%

Database Connectivity

Real-time connection monitoring and retry logic

3

LLM Fallback Layers

Graceful degradation when AI services are unavailable

Sensor Ingestion Rate

Real-time monitoring of data throughput with alerts for anomalies or gaps in sensor coverage

Active Incidents

Live count of detected events with severity distribution and automatic escalation for critical situations

System Response Time

Sub-second detection latency tracking to ensure operators receive immediate notifications

> "Designed with production-minded observability and fallback logic."

Why This Matters for Beltways

RTIIS demonstrates end-to-end execution capability and deep understanding of transportation operations. This project showcases the ability to deliver production-ready intelligent systems that solve real problems for traffic management agencies.

Domain Understanding

Deep knowledge of traffic operations, incident detection requirements, and operator workflows

Full-Stack Execution

Complete system delivery from backend APIs to AI integration to interactive UI and mapping

Production-Ready Design

Built with reliability, observability, error handling, and scalability from day one

Immediate Extensibility

Architecture ready for real sensor integration and Beltways workflow customization

RTIIS shows that I understand Beltways' mission: reducing roadway risks through intelligent, automated, real-time systems.