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SIEMENS Healthineers

SafeRoads

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Problem description

Speeding on roads is one of the main factors contributing to traffic accidents. There is a need for an automated traffic monitoring system that can:

- Measure vehicle speed using a radar sensor
- Capture high-quality photos of passing vehicles
- Automatically recognize license plate numbers
- Record violations with photo documentation
- Provide clear visualizations for analysis
- Operate autonomously with low energy consumption

Solution architecture

Hardware Sensor + Camera → Raspberry Pi Processing → Backend API + AI → Web Dashboard
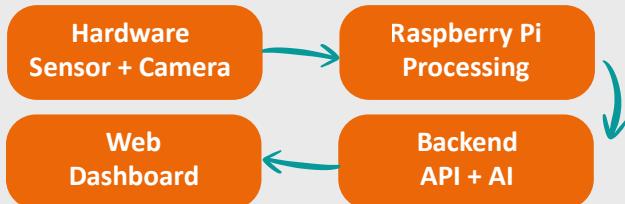
- **Hardware:** Custom box with camera, radar sensor, and Raspberry Pi Zero 2W
- **Backend:** FastAPI + YOLOv8 + fast-plate-ocr + SQLite database
- **Frontend:** React + TypeScript + TailwindCSS + Vite.js
- **Communication:** REST API, real-time data processing

Solution features

- **Compact hardware:** Custom box with integrated sensors
- **Radar sensor:** Accurate real-time vehicle speed measurement
- **HD camera:** Photo capture for license plate detection
- **AI license plate detection:** YOLOv8 model with high recognition accuracy
- **Severity classification:** Low, Medium, High, Critical according to the violation
- **Autonomous operation:** Low energy consumption
- **Real-time dashboard:** Web application with live updates
- **Export and reporting:** PDF reports, CSV export, statistics and graphs

Status - How to Use It

The system is functional and has been tested in real traffic:

- **Backend API -** receives data from Raspberry Pi, processes images, detects license plates
- **Web dashboard -** displays violations, statistics, graphs, and allows export
- **Database -** stores all records of violations with metadata
- **Real-world testing -** verified in practice with customized conditions

Usage: Raspberry Pi measures speed, captures a photo, sends it to the backend. The backend recognizes the license plate and saves the violation. The dashboard visualizes the data in real time. The system works in optimal lighting conditions and at controlled speeds.

Application hardware and screens
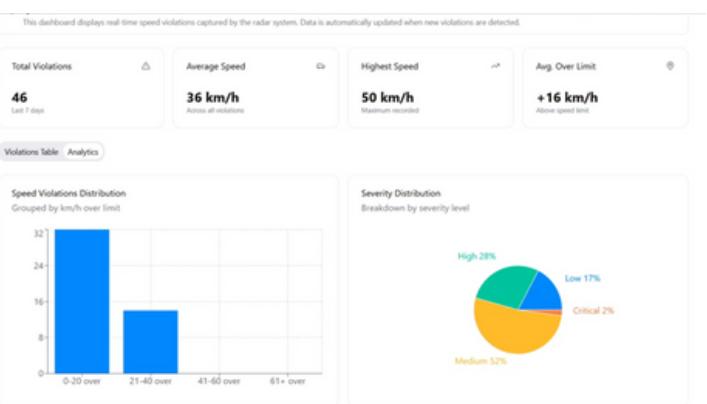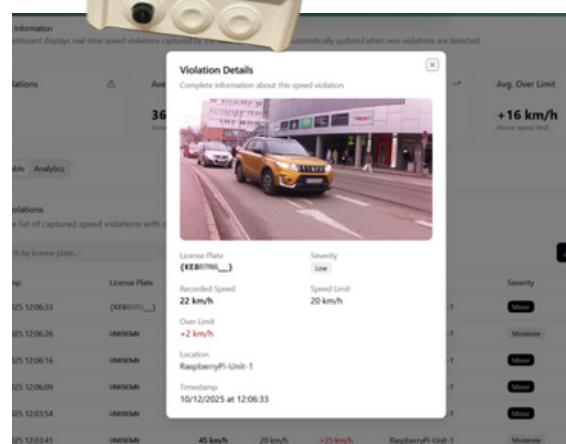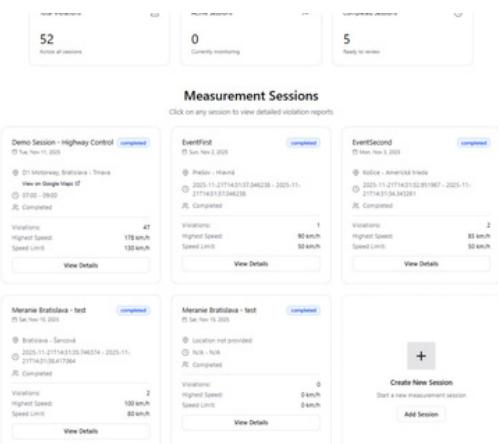
Evaluation of the solution

- **Achievements:** We have successfully created and tested a complete end-to-end system in real traffic – from physical hardware (custom box with camera and sensor) through processing on Raspberry Pi to a web application. The hardware is compact, portable, and ready to use. AI license plate detection using YOLOv8 achieves high accuracy in optimal conditions. The dashboard provides an intuitive and modern user interface with real-time updates.
- **Practical testing experience:** Real-world testing revealed important factors affecting accuracy: lighting quality, vehicle speed, and camera distance. The system works well in good lighting conditions (daytime, clear skies) and at moderate speeds. The use of modern frameworks (FastAPI, React, TypeScript) ensures scalability. The SQLite database provides simple and efficient persistence.
- **Expansion options (based on practical findings):** Higher camera quality for better license plate detection at high speeds and low light, support for multiple radars simultaneously, cloud synchronization and central monitoring, advanced analytics with ML (prediction of risk areas), night vision (IR camera).

kpi

LIVE IT PROJECT

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