THESIS - AI-Driven Driver Safety Monitoring Using Edge Computing and Computer Vision

1 Background

Driver distraction and fatigue are major contributors to traffic accidents. Advanced Driver Assistance Systems (ADAS) aim to mitigate these risks by providing real-time alerts and actionable insights. Triona's FleetControl platform can leverage edge computing and AI to enhance driver safety without relying on cloud-based processing.

2 About FleetControl

FleetControl is a comprehensive product and service offering designed to enhance the value and operational efficiency of transportation businesses while minimizing the administrative costs associated with managing vehicle fleets. By continuously collecting, processing, and distributing data from various sensors and systems installed on vehicles, FleetControl enables real-time monitoring and intelligent management of fleets.

The system includes both hardware installed onboard the vehicles and cloud-based software services delivered as a subscription model. Customers pay a fixed monthly fee per vehicle, with service packages tailored to the chosen features and fleet size. FleetControl supports a wide range of functionalities, such as promoting eco-friendly driving through its Ecodrive service, vehicle diagnostics, alcohol interlock management, remote heating, and advanced vehicle automation with geofence and alarm capabilities.

Virtualization technology and edge computing play a key role by allowing flexible and scalable operations directly on the vehicle gateway. This architecture supports efficient data processing near the source and seamless integration with back-office systems for further analysis and decision support.

The suite of services is designed to optimize fleet utilization, improve driver behavior, enhance safety, reduce operational costs, and lower environmental impact. With FleetControl, transportation operators gain actionable insights and centralized control over their fleets, enabling smarter, data-driven management in a competitive industry.

3 General

This thesis is aimed at one or two students. At least 50% of the work should be carried out on Triona's premises.

4 Objective

The thesis will explore how Triona's IoT gateway (Eurotech Dynagate 10-14), equipped with an integrated AI and computer vision platform, can be used to:

- Connect an IP camera via Ethernet or Wi-Fi.
- Perform real-time image analysis locally using the gateway's NPU (2.3 TOPS AI accelerator).
- Detect unsafe driver behaviors such as mobile phone usage and fatigue.
- Integrate safety events into FleetControl's Eco-driving KPI and FleetAnalyzer for monitoring and reporting.

5 Scope of Work

System Setup

- Install and configure Dynagate 10-14 with a compatible IP camera.
- Deploy AI models for driver behavior detection using container technology on the gateway.

Real-Time Analysis

- Implement local image processing to minimize latency and reduce external data traffic.
- Generate alerts for drivers and transmit safety events to FleetAnalyzer.

Integration

- Display KPIs on the in-vehicle screen.
- Enable notifications for selected organizational roles.

Evaluation

- Assess detection accuracy under varying conditions (lighting, network stability).
- Analyze performance impact on bandwidth and response time.

6 Strategic Impact

The possible strategic impact includes:

- Improved traffic safety through proactive detection of fatigue and distraction.
- Competitive advantage through a modern AI-driven fleet safety solution.
- Data-driven insights as a foundation for future applications in driver management and safety optimization.

7 Customer Value

The possible customer value by the solution includes:

- Real-time safety alerts for drivers.
- Efficient data follow-up for training and risk reduction.
- Reduced bandwidth usage and improved response times through local AI processing.

8 Foreseen Risks and Challenges

The risks and challenges foreseen include:

- Accuracy of AI analysis under diverse conditions.
- Camera connectivity and network stability.
- Compliance with data security and integrity requirements.

9 Expected Result

The result is presented in a report and a demonstration.

The report should detail:

- Technical architecture and implementation steps.
- Evaluation of AI model performance and system reliability.
- Risk analysis (privacy, data security, environmental factors).

A prototype demonstrating real-time detection and alerting capabilities.

10 Budget

Triona dedicates a supervisor for supervision/discussion regarding requirements and functionality, as well as ensures access to work tools (computer, etc.) and a workplace.