A Scalable Cloud-Edge-Enabled Driving and Activity Monitoring Platform for Naturalistic Driving Studies

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Abstract

This study implements a scalable cloud-edge enabling platform for monitoring and analyzing driving behaviors in naturalistic driving studies. Naturalistic driving studies (NDS) are becoming increasingly popular as a method for comprehending natural traffic behaviors. Naturalistic driving studies offer a broader perspective into day-to-day driving behaviors using expensive in-vehicle data acquisition systems (DAS) for recording data of the driver, vehicle, and environment. This study implements a scalable cloud-edge enabled driver and vehicle activity monitoring platform using a smartphone for data acquisition instead of the costly in-vehicle DAS to address this gap. This study developed a mobile application capable of continuously monitoring and recording the driving behaviors of the driver, vehicle, and environment using smartphones' various onboard hardware and sensors. Data collected by the platform include but are not limited to driver monitoring video, road view video, motion, environmental, and vehicle CAN Bus data. The platform can also communicate with smartwatches to collect physiological data from drivers. Driving maneuver event detection methods were also used in this study to gain insight into the data collected using an Energy Maximization Algorithm (EMA) capable of extracting driving events, such as stop and lane-keeping events, lane changes, left-right turning movements, and horizontal curve maneuvers, using machine learning models to classify segmented driving events. This study demonstrates that developing a smartphone-based driver and vehicle activity monitoring platform will provide a low-cost data capture system, allowing us to take data collection to the next level, reaching thousands of individuals worldwide. It will be simple to add new features with a click of a button as the available sensors and smartphone capabilities grow.