CAN-based IVN data used for drowsiness detection

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Researchers from the Izmir Bakircay University (Turkey) and engineers from Tofas Turk Otomotiv Fabrikasi (Turkey) have published a study on a driver drowsiness detection system. The AI-based (artificial intelligence) system uses only data from the CAN-based in-vehicle networks (IVN) to detect a driver's drowsiness.

In earlier driver drowsiness studies, the measurement methods developed for driver monitoring are categorized into three groups as vehicle-based, behavioral and physiological measurements. In vehicle-based measurements, driver drowsiness is achieved through various metrics during driving, such as lane-position deviations, steering-wheel movement, driving speed, accelerator-pedal pressing, and vehicle-yaw angle. All these data can be collected from CAN-based in-vehicle networks. The data can be recorded from real drivers or through driving simulators. "However, studies using simulators can provide misleading results as they do not replicate real-life conditions," stated the Turkish researchers. "For instance, when driving in bad weather or on poorly maintained roads, a driver may deviate from their lane more frequently. Similarly, a vehicle driven over rough terrain may exhibit greater variance in steering wheel movements than a simulator."

The Izmir Bakircay University researchers identified the following questions to be answered by their study:

- Is it possible to quickly and accurately collect physiological data from drivers during driving?
- Can a drowsiness measurement be proposed that simultaneously considers both physiological data and vehicle-based measurements of drivers?
- Besides the parameters identified in previous studies on vehicle-based measurements, are there other parameters that influence driver drowsiness?

The focus of the study was on real-time capturing of data from real drivers. The evaluated results of detected drowsiness were categorized in three classes by analyzing the messages communicated on the CAN-based IVNs. The recorded data was given to machine-learning algorithms. "To better understand which vehicle parameters were most influential in the detection of driver drowsiness, we conducted a feature importance analysis using the Random Forest classifier," explained the researchers. The figure shows the importance of parameters mapped into CAN data frames for the drowsiness detection.

"In our study, by examining both ECG (electrocardiogram) and CAN data, an integrated measurement classification was performed, unlike a system based only on ECG. In this way, drowsiness detection was attempted without the need for ECG data, based only on CAN data, and the classification performances were analyzed," explained the researchers. They summarized: "The methodology included gathering physiological and vehicle-related components in real-time under a range of traffic and environmental circumstances from several drivers. Heart rate variability (HRV), a crucial indication of ▷

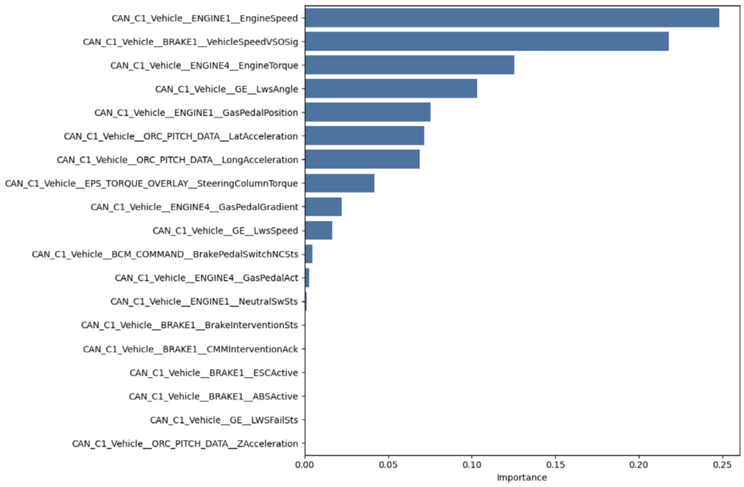

Figure: Importance of parameters mapped into CAN data frames for the drowsiness detection of car conductors (Source: Izmir Bakircay University)

tiredness, was obtained via ECG measures, while critical vehicle metrics like speed, steering wheel tilt, and braking pressure were obtained from CAN data." The achieved 85-percent accuracy rate represented an improvement over previous research that relied solely on ECG data, where accuracy rates were typically less than 70 percent in the case of multi-class drowsiness detection. The data collected within the scope of this study was collected from drivers at different times and was not collected under equal conditions due to traffic density. Although 10 hours of data collection time seem sufficient, the researchers think that this period should be extended in order to increase the performance of the study and to generalize it. The results of the study were applied to the engineers from the Tofas Turk Otomotiv Fabrikasi research partner. Future developments will focus on optimizing the model for embedded platforms by addressing real-time inference constraints, processing power, memory limitations, and cost-effectiveness to ensure reliable deployment in production vehicles. ◀

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