Driving behavior Analysis from multi-modal data

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Objectives

In this work, we investigate how multi-modal data in real driving scenarios can be used to analyse user's driving behavior. This will allow identifying the driver's physiological and psychological internal states.

- Data collected for multi-modal analysis: vehicle speed, engine RPM, throttle position, facial images, thermal images.
- Data Correlation will be conducted to identify user's driving style.
- A human-car interaction model will be established based on multi-source data.

Introduction

According to the World Health Organization, it has been estimated that 1.35 million traffic fatalities occurred worldwide in 2016, and the number continues to rise annually. Traffic accidents are one of the main causes of death all over the world and are the leading cause of death for the younger population. For most reported crashes, the critical reason is the user's unsafe driving behaviors, such as being distracted and speeding. In order to prevent and mitigate traffic accidents caused by drivers, the automotive industry has devoted itself to developing technologies that could improve driving safety. In our work, we try to identify the driver's style, behavior variance, and the relationship with the user's personality traits from time-series and image data.

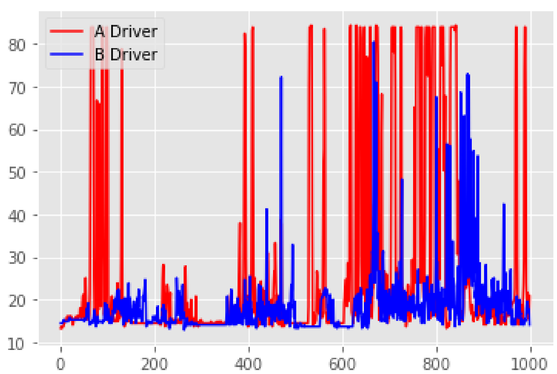

Figure 1:Driver A and Driver B speed data for the same trajectory/trip

Methodology

The following types of data are analyzed

- Facial Images
- Facial Thermal Images
- Road Images
- Vehicle Speed
- Vehicle Engine RPM
- Vehicle Throttle Position
- GPS

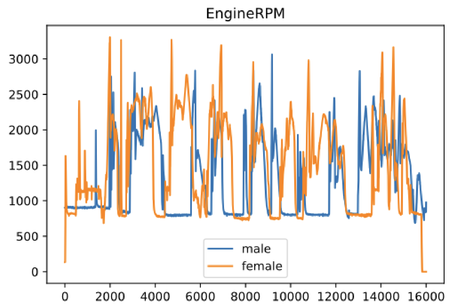

Figure 2:Male and Female Engine RPM data for the same trajectory/trip

Figure 1 illustrates the speed data for two drivers for the same trajectory. Figure 2 shows the engine data for the same trajectory between the male and the female drivers. From the figures, we can see an obvious difference in the distribution between the drivers. Figure 3 shows the drivers' thermal images in the vehicle. In summary, we collected different multi-modal data at the same time, on the same road, and for different drivers.

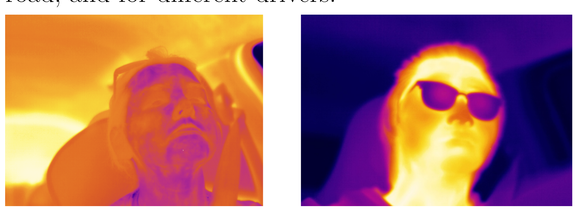

Figure 3:Female and Male Drivers Thermal Images during the driving behavior

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Experimental Design

- 5-10 Drivers Participants
- 2 vehicles and 1 AVsimulator
- Sensors: RGB Camera x 2, Thermal Camera, CAN data Collector, GPS
- Road condition: Campus, Country Road, High-way

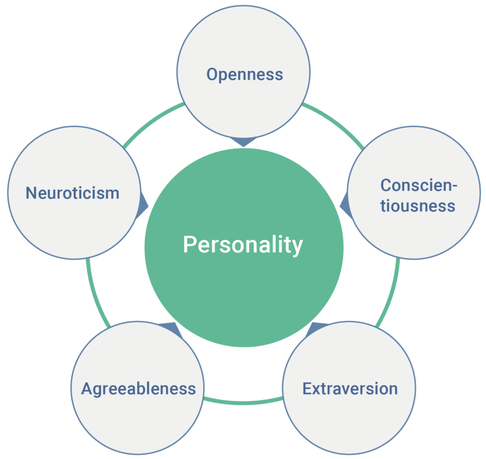

Figure 4:Big Five Personality

All the participants need to fill in two questionnaires pre-experiment. The first one is the Big Five Personality Questionnaire like Figure 4 and the second one is the Driver Style Questionnaire. The two questionnaires will be used to discover the relationship between our data and the driver's driving style and personality traits.

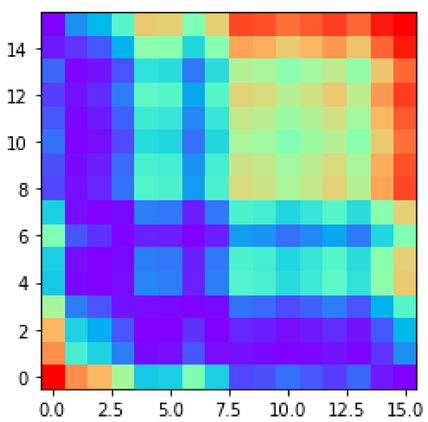

Figure 5:Time-series to image: Using Gramian Angular Field method to convert sequence to image to process

Current Result

This is ongoing research work. We have finalized the development of the experimental platform and for the moment we collected one driver's data. We need to deal with multiple time series like speed and engine RPM. The entropy of the sequences may represent a potential solution to represent the style of the driver. Furthermore, like Figure 5, converting series data to images could also be beneficial for processing.

Conclusion

Driving Behavior Analysis can be used to predict and recognize the driver's psychological and physiological internal state. To some extent, a Human-Vehicle Model is important to help us to access driver's cognition when we drive. Utilizing multi-modal data to analyze driving behavior can help us to achieve a more comfortable and safe driving experience. For future work, we intend to do data collection and find a correlation between the features.

References

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