

Spatiotemporal methods for activity analysis of occupants of self-driving cars using RGB+D sensors

Type : Research internship

Supervision:

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Keywords: deep learning, action detection, self-driving cars, in-cabin activity analysis

Context: Self-driving cars (SDC) have gained significant attention since the progress of artificial intelligence for visual scene understanding in the 2010s. Technology companies such as Waymo and Tesla now compete with established car manufacturers in the development of SDCs. Cruise and Waymo have already deployed robot taxi services in a few cities in the United States. However, research on what will be the typical activities of the occupants of an SDC is still an open problem, particularly in vehicles of automation levels 3 and 4 (SAE¹ standard). In this context, the AURA AutoBehave project (2019-2023) seeks to develop methods to automatically analyze the activities of passengers of SDCs, and to study how the changes brought by the usage of SDCs may influence our lives in terms of in-vehicle postures and actions. Changes in such behavioral patterns may affect our in-vehicle comfort, security and how we value our travel time.

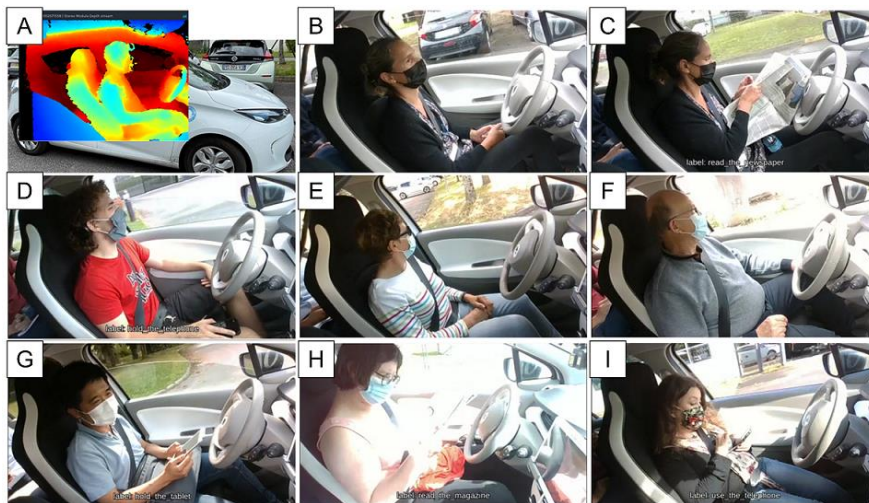


Figure 1. Examples of actions in AutoBehave dataset

Objectives: This internship will study spatiotemporal architectures of deep neural networks that can help to automatically analyze and describe the actions of passengers of a self-driving car (SDC) using RGB/+D sensors.

Methodology: In the first part of this internship will study and prepare a novel computer vision task on human activity analysis using the multimodal dataset acquired by the project AURA AutoBehave 2019-2023. In this dataset, the occupant of the SDC is asked to carry out a series of activities for a 15 minutes-period, while the vehicle autonomously drives around the streets and the parking of the campus of the Ecole Centrale de Nantes. The dataset contains video recordings of 30 passengers (Intel

¹ Society of Automotive Engineers

RealSense and GoPro cameras) complemented with data from questionnaires about their internal states, their sociodemographic characteristics, and their attitudes towards the AV. We will work in close relationship with experts in the economy of transport and cognitive sciences to analyze the database in a mono- and multi-disciplinary fashion. In the second part of the internship, we will evaluate the performance of existing methods for action detection on the context of the dataset. The idea here is to study the limitation of current methods at the challenging task of automatic action detection and their precision and robustness for exploitability by other sciences. The intern will also collaborate on the writing of an international paper to disseminate the obtained results, as well introduce the novel benchmark task to the computer vision community.

Profile of the candidate:

We are looking for a motivated candidate with a strong background in computer science and applied mathematics. Experience in image processing, computer vision, and/or machine learning will be a plus. The intern will have the opportunity to participate in a major conference in the field of computer vision. This participation will give him/her the opportunity to interact with major players in the industry and build professional relationships that can be used as a starting point for future work opportunities.

Required skills:

- Language Python
- OpenCV library

The following skills would be counted as a plus:

- Versioning tools (GIT)
- Framework PyTorch or TensorFlow.

Starting date : February/March 2024

Salary : “gratification de stage” in France

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Bibliographic references

1. Crispim-Junior, C.F., et al., “AutoExp: A Multidisciplinary, Multi-Sensor Framework to Evaluate Human Activities in Self-Driving Cars”. In proceedings of 26th IEEE International Conference on Intelligent Transportation Systems ITSC, 2023, Bilbao, Bizkaia, Spain.
2. Guesdon, R., “Synthetic Driver Image Generation for Human Pose-Related Tasks”. International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISAPP), Feb 2023, Lisbon, Portugal.
3. Guesdon, R, et al. (2021) DriPE: A Dataset for Human Pose Estimation in Real-World Driving Settings. 2nd Autonomous Vehicle Vision (AVVision) - International Conference on Computer Vision (ICCV) Workshop, Oct 2021, Virtual Conference, France. (hal-03380579)
4. Crispim-Junior, C. F., et al. (2016), "Semantic Event Fusion of Different Visual Modality Concepts for Activity Recognition," in IEEE Trans. Pattern Anal. Mach. Intell., vol. 38, no. 8, pp. 1598-1611, August.