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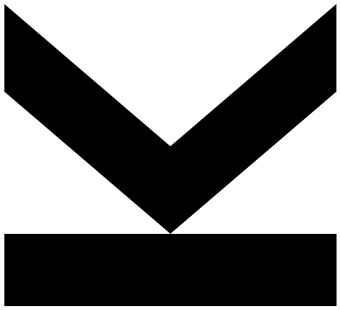
DEEPLEARNIG APPROACH FOR DRIVING MONITORING SYSTEMS



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TEMPLATE FOR SCIENTIFIC WORKS

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I. Research Idea

The advancement and development of Automated Driving Systems (ADS) has provided vehicles the capacity to perform the driving tasks normally performed by a human driver. Depending on the capabilities and tasks that the ADS can execute, SAE has divided these systems into 6 levels (from 0 or no automation to 5 or Full automation). At level 3 or Conditional automation, the system can take control of the vehicle in specific cases, allowing drivers to perform non-driving tasks. However, the driver must be alert to any eventuality since the system expects a response from users when a Take Over Request (TOR) is issued. Therefore, it is necessary to use Driver Monitoring Systems (DMS) that allow the system to establish the user's status and act accordingly.

Mostly, DMSs acquire data from drivers (commonly images) and based on predefined features, the system estimates the driver's state. This estimation is mostly based on computer vision algorithms that extract information from the data acquired by the cameras. In particular, there is a tendency to implement Convolutional Neural Networks (CNN) which allow the processing of complex data to make predictions. Thus, the objective of this thesis is the creation of models for the prediction of the driver's state based on images of the pose and face of the driver.

II. Scientific relevance of the research idea compared to related published work

There are different approaches that have been studied to determine the states and behavior of the drivers. In the literature there are several methods whose inputs can be both physiological responses of the driver as ECG or EEG signals, as well as physical states of the person (body pose or head pose). Although many studies demonstrate the effectiveness of using these signals to determine the driver's state, they require the extraction of specific features (joint angles, head pose angle, gaze direction, etc) that usually are not easy to obtain and require the use of specialized hardware.

The advance of computing, especially in the field of deep learning, have allowed the computer vision algorithms to process images and videos, creating relationships between high dimensional features. In this way, from images, information can be extracted from the in an environment from only the images of it. This thesis explores the use of deep learning algorithms to determine the state of the driver, only from images looking for a maximization not only in the accuracy of the model, but also in the processing time of it.

III. Goal of the thesis

- Study the existing literature related to driver monitoring and the development of driver models based on CNN.
- Implement State of the Art models to detect driver’s state
- Design and development of driver monitoring model to detect driver’s state (driving, talking on phone, writing on phone, drowsiness, etc)
- Creation of a dataset using the sensors and simulator available on the chair to train the designed model.
- Make an ablation study of the proposed model.
- Compare the designed model with State of the Art algorithms.
- Write a publication paper with the proposed work done in the thesis.

IV. Own research questions and hypotheses

- Which states can be predicted with the acquire data? Which states correlates to which features data?
- How does the different components on the proposed model, affects the output? Which components are more relevant?
- Which data can be introduced to the proposed model?
- How does the state of the surroundings correlates to the state of the driver?

V. Short presentation of the planned method

The planned method will consist in developing a novel model using Convolutional Neuronal Networks and depending on the scenario Recurrent Neuronal Networks can also be applied. Students are encouraged to develop novel modules inside their model architecture.

VI. Thesis structure design

The thesis will have a typical IMRAD structure, which consist in the following sections: Introduction, Methodology, Results and Discussion.

VII. Draft of time plan

The presented thesis is planned for a six month period, with the proposed time schedule:

- **1st month:** Study of the related literature of Driver Monitoring Systems and identify opportunities to design models for driver monitoring.
- **2nd-5th months:** Acquire data of drivers using the simulator present in the laboratory to train the designed model. Finetune the designed model to maximize the accuracy of the proposed method. Make an ablation study of the proposed model.
- **6th month:** Write master thesis and possible contribute in scientific paper.