MSc in Data Science: Driver Drowsiness Detection

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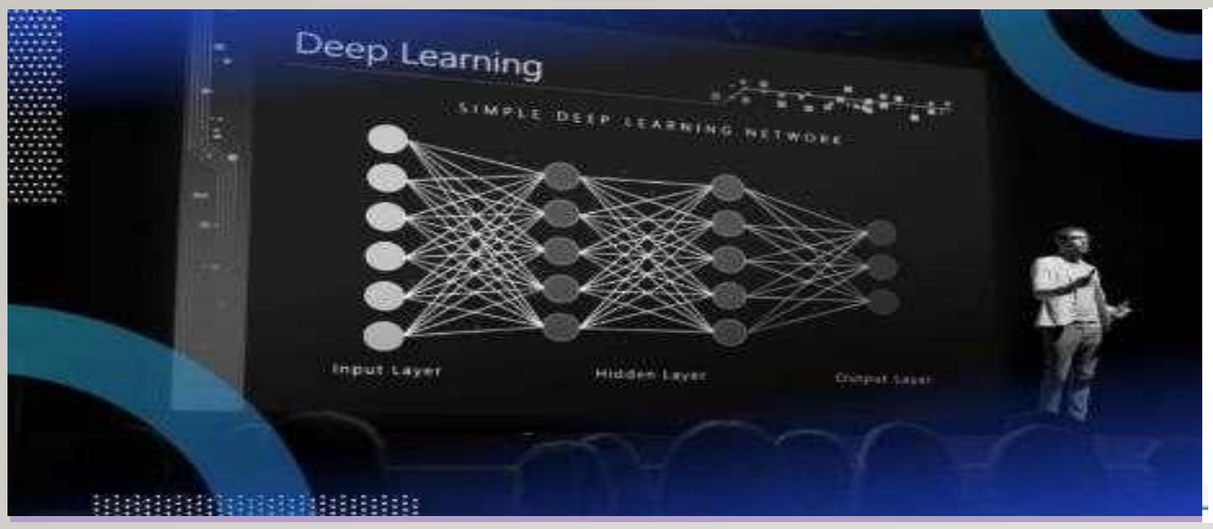
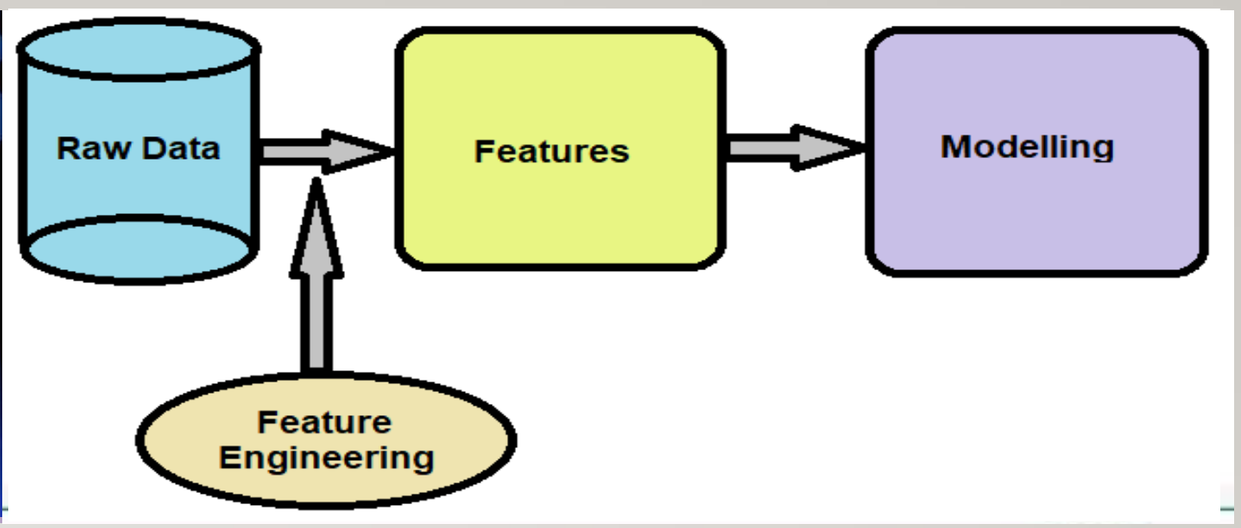
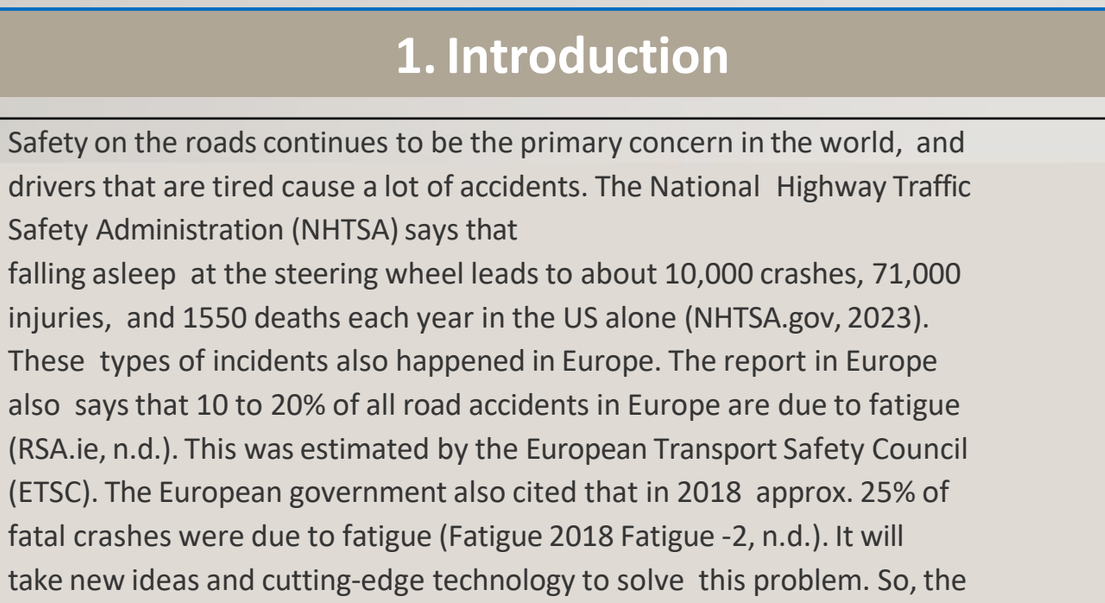




1. Introduction

Safety on the roads continues to be the primary concern in the world, and drivers that are tired cause a lot of accidents. The National Highway Traffic Safety Administration (NHTSA) says that falling asleep at the steering wheel leads to about 10,000 crashes, 71,000 injuries, and 1550 deaths each year in the US alone (NHTSA.gov, 2023). These types of incidents also happened in Europe. The report in Europe also says that 10 to 20% of all road accidents in Europe are due to fatigue (RSA.ie, n.d.). This was estimated by the European Transport Safety Council (ETSC). The European government also cited that in 2018 approx. 25% of fatal crashes were due to fatigue (Fatigue 2018 Fatigue -2, n.d.). It will take new ideas and cutting-edge technology to solve this problem. So, the main goal of the initiative is to make and test new deep-learning models that can tell if a driver is tired. The model will also do even better if a person looks into feature engineering techniques such as picture improvement, attention mechanisms, and fusion strategies.



2. Literature Review

Recent progress in the field is driven by deep learning, notably Convolutional Neural Networks (CNNs) for recognizing fatigue-related facial signals and Recurrent Neural Networks (RNNs) for capturing temporal correlations in video data.

Attention mechanisms focus on crucial facial areas indicative of exhaustion, while fusion approaches integrate multiple data sources like facial features and physiological signals to enhance detection efficiency.

Despite individual insights, there's a gap for a systematic review comparing various algorithmic approaches, including deep learning and feature engineering, for driver drowsiness detection.

3. Research Question

Can the integration of multimodal deep learning techniques, incorporating real-time physiological data from wearable sensors and environmental factors, revolutionize driver drowsiness detection systems to not only predict but also preemptively mitigate potential accidents, ensuring safer roads and reducing facilities?

4. The Data

The research will involve collecting and labeling diverse datasets consisting of images and/or videos depicting drivers exhibiting varying levels of alertness. These datasets will include samples captured under different environmental, situational, and individual factors known to influence driver fatigue. The data will be crucial for training and testing the deep-learning models, enabling them to learn and accurately detect fatigue-related patterns.

5. Methodology

- The project utilizes a deep learning structure that reliesprimarily on a recurrent neural network (RNN).
- The data will be cleansed, Pre-processed which involves Tokenization through Jupyter Notebook using pandas,nltk.
- Word and character embeddings performed using CNN andPOS tagging methods.
- The training set was used to train both the LSTM-CRF and BiLSTM-CRF models, which were subsequently assessed on the testing set.
- Finally, Evaluate the performance using metrics such as precision, recall, and F1 score.

6. Early Indicators

Preliminary indications suggest that the integration of deep- learning models with feature engineering techniques could significantly improve the accuracy of driver fatigue detection systems. Initial experiments with CNNs, RNNs, and Transformers show promising results in identifying fatigue-related patterns in driver behavior.

7. Next Steps

Further refinement of the deep-learning models by fine-tuning hyperparameters and optimizing architecture designs.
Conducting extensive testing and evaluation of the models using standardized metrics to assess their performance.

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