Fatigue Detection using Convolutional Neural Networks

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1. Group Members

Abhijeet will contribute towards literature review and research. Mihir will be responsible for pre model aspects of the project, including data collection, preprocessing. All members will brainstorm and contribute towards model design, training, and evaluation and also handle the coding, testing, and debugging of the CNN model and the eye state analysis. Both members will be responsible for compiling the final report, managing project timelines, and ensuring that all deliverables are met by the deadline.

2. Collaboration

Project is not shared with any other class.

3. Motivation

In industries such as transportation and healthcare, fatigue plays a significant role in accidents and mistakes. Real-time fatigue detection can assist avert these mishaps by facilitating prompt actions. The objective of this project is to provide a non-intrusive way of fatigue detection for professionals, including medical staff, machine operators, and drivers. Applications in medical care, human-computer interaction, and vehicle fatigue monitoring systems can benefit from the capacity to identify early indicators of weariness based on eye behavior, such as prolonged eye closure and frequent blinking.

4. Literature Review

In order to give background and context, prior research [1] on the use of traditional image processing and filtering techniques will be reviewed. Novel techniques such as convolutional neural networks for facial feature identification, particularly eye state detection and feature extraction will be studied and pre trained models ((e.g., VGGNet and ResNet) for sleepiness detection, [2] and Haar cascades for face detection will be explored.

5. Data

We want to leverage publically accessible datasets, such as the MRL Eye dataset for blink detection and the Closed Eyes in the Wild (CEW) dataset for open and closed eye recognition. Labeled photos of eyes in different states (open, closed, and blinking) are included in these datasets. We will use data augmentation methods like rotation, scaling, and brightness correction to enhance these datasets as appropriate. In order to effectively train the CNN model using computational resources, We will use a GPU-enabled environment, maybe making use of Google Colab. As the dataset is small, Colab should suffice.

CEW

MRL

6. Approach

We plan to develop a Convolutional Neural Network (CNN) for face and eye detection. First, a pre-trained model such as VGG16 or ResNet will be employed to extract facial features. For eye state classification (open, closed, or blinking), we will either fine-tune the pre-trained model or develop a custom CNN architecture. Additionally, there might be integration of a time-series analysis method to track blinking patterns and closed-eye duration to detect fatigue if time permits. We plan to improve upon existing implementations by optimizing the model for real-time performance and ensuring robustness across various conditions, such as different lighting or face angles.

7. Evaluation Metric

We plan to evaluate the model using standard metrics such as accuracy, precision, recall, and F1-score, specifically for the classification of eye states (open, closed, or blinking). We also plan to produce visual outputs such as confusion matrices and plots of loss/accuracy over training epochs. Qualitatively, the model's predictions will be analyzed on test images and validate its real-time performance. Quantitatively, the model's performance will be compared against baseline methods for fatigue detection, using metrics such as Area Under the Curve (AUC) for ROC analysis to measure the model's ability to distinguish between different eye states accurately.

References

[1] Mohammed Ghazal, Yasmine Abu Haeyeh, Abdelrahman Abed, and Sara Ghazal. 2018. Embedded Fatigue Detection Using Convolutional Neural Networks with Mobile Integration. In *6th International Conference on Future Internet of Things and Cloud Workshops, FiCloud Workshops 2018, Barcelona, Spain, August 6-8, 2018*, Irfan Awan, Muhammad Younas, and Filipe Portela (Eds.). IEEE Computer Society, 129–133. https://doi.org/10.1109/W-FICLOUD.2018.00026 1

[2] Fengyi Song, Xiaoyang Tan, Xue Liu, and Songcan Chen. 2014. Eyes closeness detection from still images with multi-scale histograms of principal oriented gradients. *Pattern Recognit.* 47, 9 (2014), 2825–2838. https://doi.org/10.1016/J.PATCOG.2014.03.024 1