AI-Powered Vigilance Monitoring for Safer Driving

Project Authors: Varun Simha Reddy Thippireddy, Rinoj Gautam, and Connor Neff

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Objective

The objective of this project is to develop an optimized solution through the manipulation of parameters and hyperparameters. Bayesian optimization will be employed to identify the most effective configurations. The focus will be on constructing a neural network designed to differentiate between two states: eyes being open or closed, and the presence or absence of a yawn. Additionally, new data will be acquired and processed through a specialized preprocessor to ensure compatibility with the existing training data format. This approach is aimed at enhancing the model's performance by fine-tuning its parameters and hyperparameters. Further information and resources related to Bayesian optimization can be accessed at Bayesian Optimization on GitHub [1].

Dataset

The yawn_eye_dataset_new is a dataset used for driver drowsiness detection systems. The dataset is divided into train and test sets, with each set consisting of four target classes: "Closed," "no_yawn," "yawn," and "Open". [2] The dataset contains image data of drivers on the highway in a state of yawning, not yawning, eyes open, and eyes closed. Eye movements and mouth conditions are used as indicators of driver conditions. The dataset has been used to train convolutional neural networks (CNNs) to detect driver drowsiness based on eye and mouth movements. The CNN model achieved an accuracy of 98.7% [4] with a learning rate of 0.001 and an epoch of 20. Other studies have also used the dataset to train CNN models for driver drowsiness detection, achieving accuracies ranging from 83.3% to 96.42%.[3] The yawn_eye_dataset_new is a valuable resource for developing and testing driver drowsiness detection systems.

Motivation

The yawn_eye_dataset_new is driven by the need to enhance road safety. One of the causes of car accidents is driver drowsiness, which affects a persons focus while driving. This dataset is a resource, for training learning models to detect drowsiness based on eye and mouth movements. Building systems to detect drowsiness is crucial in preventing accidents caused by drivers ultimately improving overall road safety. Moreover researchers have also utilized this dataset to propose techniques that enhance the training of learning models for detecting driver drowsiness in real world

situations. This highlights the goal of utilizing technologies, like computer vision and deep learning to tackle real life challenges and promote road safety by preventing accidents caused by driver fatigue.

Description

The project begins with the acquisition of the "yawn_eye_dataset_new" from Kaggle. This dataset is integral to our research, as it contains diverse images of drivers exhibiting various states like yawning, not yawning, and with eyes either open or closed. It's strategically divided into training and testing sets, each comprising four target classes: "Closed," "no_yawn," "yawn," and "Open."

The initial phase of model training involves deploying a Convolutional Neural Network (CNN) using this dataset. Historical models have shown promise, achieving accuracies ranging from 83.3% to 98.7%. Building upon these foundations, we plan to implement Bayesian Optimization to refine the model's parameters and hyperparameters meticulously. This step is crucial in striving to exceed the previously attained accuracy of 98.7%. Paramount among the hyperparameters are the learning rate, previously set at 0.001, and the number of epochs, formerly fixed at 20.

To bolster the model's training process, we intend to integrate new, relevant data. This addition is not merely about expanding the dataset but is aimed at enhancing the model's robustness and generalizability across varied scenarios. A critical step here involves developing or adapting a preprocessor that will standardize the new data, ensuring its compatibility with the established training format. Preprocessing will likely encompass image resizing, normalization, and augmentation to enrich the dataset.

Once the expanded dataset is in place, the next phase involves re-training the neural network with the optimized parameters and hyperparameters, followed by a thorough evaluation. The performance metrics of interest will include accuracy, recall, and precision, benchmarked against previously established standards.

A continuous improvement approach will guide the subsequent steps. Based on the evaluation outcomes, further adjustments to the model's parameters and hyperparameters will be made. This iterative process of training and evaluation will continue until the desired level of accuracy and reliability is achieved.

Finally, as part of the academic and research community ethos, we will meticulously document the entire process. This documentation will encompass the Bayesian Optimization techniques employed, the model architecture, the training methodology, and the evaluation metrics. The culmination of this project will see us sharing our findings, code, and trained models on platforms such as GitHub or Kaggle, inviting community feedback and furthering research in this vital field.

In summary, this project is not just about improving upon existing CNN models used for driver drowsiness detection; it's a journey towards a significant contribution in the realm of machine learning and driver safety, harnessing the power of Bayesian Optimization and data integration.

Expected Outcome

The expected outcomes for this project in machine learning and driver drowsiness detection are multifaceted. Firstly, we aim for enhanced model accuracy. By employing Bayesian Optimization to fine-tune parameters and hyperparameters, we anticipate surpassing the previous accuracy benchmark of 98.7%. This increase in accuracy is crucial for

the reliability of the drowsiness detection system. Secondly, robust model performance is a key target. The integration of new data and its rigorous preprocessing will help build a model that performs well across various real-world scenarios. It will be particularly adept at identifying drowsiness indicators such as eye state and yawning, reflecting its robustness.

Another significant outcome is the improved generalization of the model. With an expanded and diversified dataset, we expect the neural network to generalize better, effectively reducing the likelihood of overfitting and ensuring consistent performance on new, unseen data. This aspect is vital for the model's applicability in diverse driving conditions and scenarios.

Finally, the practical application in driver safety is an overarching goal. The development of an effective driver drowsiness detection system can be a critical tool in reducing accidents caused by fatigue. This has real-world implications and benefits, aligning with our objective to contribute significantly to driver safety through technological innovation.

In essence, the project is geared towards achieving technical advancements in machine learning models for driver drowsiness detection, ensuring high accuracy, robustness, and generalizability, all of which are crucial for practical, real-world applications in enhancing driver safety.

References

1. https://github.com/bayesian-optimization/BayesianOptimization
2. https://github.com/SayamAlt/Driver-Drowsiness-Detection
3. https://www.researchgate.net/publication/367658202_Data_Augmentation_for_Deep_Learning_Algorithms_that_Perform_Driver_Drowsiness_Detection
4. https://www.kaggle.com/code/amir1314334/driver-drowsiness