DS 3000 Final Project: Drowsy Driver Detection through Machine Learning

Aadya Chaturvedi and Arhat Shah

Northeastern University: Khoury College of Computer Sciences

Abstract

This research project aims to develop a drowsy driving detection system using machine learning algorithms. The proposed system utilizes various sensors such as eye tracking, steering wheel movement, and head position to gather data from drivers. The data is derived from a Kaggle **Drowsiness Detection Dataset (DDD**) [1].

Introduction

While researching what topics to cover in this project, we were intrigued by the statistics surrounding drowsy driving. Drowsy driving is a significant problem that can lead to accidents, injuries, and fatalities on the road. Drowsy driving references the act of operating a vehicle while feeling excessively sleepy or fatigued. It is a problem that affects many drivers and can result in serious injuries and accidents. According to the National Highway Traffic Safety Administration (NHTSA), drowsy driving is responsible for an estimated 90,000 crashes, 50,000 injuries, and 800 deaths each year in the United States alone [2].

In recent years, computer vision techniques have been used to detect drowsy drivers by monitoring their facial features and eye movements. In this project, we aim to develop an improved drowsy driver detection system using computer vision techniques.

The development of a drowsy driver detection system can provide significant benefits to society. It can help prevent accidents and save lives by detecting drowsy drivers in real-time. Furthermore, this project can equip us with valuable skills to work on similar problems in other industries. By using a **Convolutional Neural Network (CNN)** for image classification and a **Random Forest Regression** algorithm to generate a model accuracy score for our trained model.

Related Works

The most relevant work to our project was a research paper regarding the **Detection and Prediction of Driver Drowsiness for the Prevention of Road Accidents** [3]. This work goes over the negative effects of Drowsy Driving and strategies to predict it using Convolutional Neural Networks (CNN). This technique allows the model to be trained to predict drowsy driving based on facial recognition.

Another relevant work to our project was a published Medium article titled **Drowsiness Detection with Machine Learning** [4]. This article highlighted the process to develop a machine-learning tool to detect drowsy driving using Python. This model utilizes **Convolutional Neural Networks (CNN)** to analyze image data.

Methodology

To start this project, we utilized a dataset from the Kaggle **Drowsiness Detection Dataset (DDD)** [1]**.** which included various images of faces in different positions. The final model takes images as input from a camera or a linked image dataset. The trained model categorizes whether the user's eyes are "yawn" or "no_yawn". Based on this, the model classifies the person's eyes as "open" or "closed" and assigns them a drowsy detection score from 0-7.

The model uses **Convolutional Neural Networks (CNN)** for image classification and organization. The classifier allows the model to tell the user whether or not the person driving is driving safely based on their score which is determined based on how long the individual's eyes are closed.

Additionally, the model utilizes a **Random Forest Regression** algorithm to determine the accuracy of the trained model. For our model, we used a value of 500 estimators and a random_state value of 42 to determine an accuracy score for the trained model which comes out to be 1.00 because the model has a 100% testing accuracy. Additionally, users can upload their own image that utilizes the trained random forest model to determine a drowsiness score from 0-7 which makes the interface usable and interactive.

Model Accuracy Score

```
Model score: 1.00
```

Values for Random Forest Regression Model

```
# Create a Random Forest Regression model with 100 trees
rf = RandomForestRegressor(n_estimators=500, random_state=42)
```

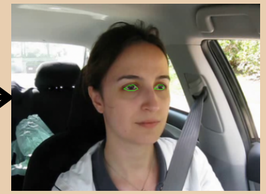
Results and Evaluation

Based on our experiment, we were able to draw certain conclusions regarding our model. For example, we were able to obtain a classification matrix that included various factors including a precision category, recall category, f1-score, and support category that measured the accuracy of the machine learning model. These results are demonstrated below. Based on these, we can see that the precision rating for no_yawn, Closed, and Open data was relatively high whereas, for yawn data, they were much lower. On the other hand, for recall data, scores were much lower for the no_yawn category as compared to the other three demonstrating that the model behaved differently on different metrics.

In terms of the future scope of this project, it should be trained on videos as opposed to static images because videos are a more realistic scenario than snapshots and images that may not capture the full story resulting in lower accuracy of drowsy driving detection.

because that is a more realistic form of data input for this type of experiment. Additionally, more data should be collected to ensure that this model continues to perform well based on different metrics including race, gender, and other physical attributes of the test subjects used. This will ensure that the model isn't biased. By training the model on more data, we can also increase its accuracy and effectiveness so that it's more applicable in testing scenarios.

Our model highlights and analyzes the user's eyes to assign them a drowsiness score



The Impacts

The impact of a project such as this is extremely widespread because drowsy driving affects the lives of millions of Americans every day.

Combatting this widespread issue will reduce the number of serious injuries and accidents caused by car crashes annually. By offering American drivers a method to detect unsafe driving scenarios prior to them occurring, predictive models such as this one can prevent the 1 in 4 vehicle crashes that occur as a result of drowsy driving.

Conclusion

Through this project, we were able to generate a model that assigns values to facial frames based on the likelihood that the subject is drowsy. This model was successful due to our implementation of the Convolutional Neural Networks technique which allowed us to train our model based on image data.

Although this is a good starting point, the model should be trained on a wider variety of data as well as being trained to work with video data as opposed to static images. These improvements will make the model more effective in providing drowsy driving detection.

References

[**1**]https://www.kaggle.com/datasets/dheerajperumandla/drowsiness-dataset

[**2**] National Highway Traffic Safety Administration. (n.d.). Drowsy driving. Retrieved from https://www.nhtsa.gov/risky-driving/drowsy-driving

[3] Nasri, I., Karrouchi, M., Snoussi, H., Kassmi, K., Messaoudi, A. (2022). Detection and Prediction of Driver Drowsiness for the Prevention of Road Accidents Using Deep Neural Networks Techniques. In: Bennani, S., Lakhrissi, Y., Khaissidi, G., Mansouri, A., Khamlichi, Y. (eds) WITS 2020. Lecture Notes in Electrical Engineering, vol 745. Springer, Singapore. https://doi.org/10.1007/978-981-33-6893-4_6

[4] Zhong, G. (2021, June 10). Drowsiness detection with machine learning. Medium. Retrieved April 16, 2023, from https://towardsdatascience.com/drowsiness-detection-with-machine-learning-765a16ca208a