# Drowsiness Detection

Shawn Seo
DSI 725

# Introduction

National Highway Traffic Safety Administration (NHTSA) estimates:

- about 91,000 police-reported crashes involve drowsy drivers

- 50,000 people injured and 800 deaths in 2017

# Most Common Factors of Drowsy Driving

1. Occur most frequently between midnight and 6 am or in late afternoon
2. Often involves a single driver running off the road at high speed with no evidence of braking
3. Frequently occur on rural roads/highways

The NHTSA estimates that going over 20 hours of sleep may be equivalent of having a BAC of 0.08, the US legal limit.

# Problem Statement

How could I reduce the number of collisions caused by driving while drowsy?

Can we accurately be able to assess the drowsiness of the driver?

# Data Collection

- University of Texas at Arlington
- 60 participants
  - 51 men, 9 women
  - Different Ethnicities
  - Varying age groups
- Self-recorded in 3 drowsiness states
  - Alert
  - Low-vigilant (dropped)
  - Drowsy
- 10 minutes long

# Recommended Set up

# Data Preparation

- Save 1 frame per second for each video
  - Reduced the total frames from ~20,000 to ~600
  - Keeps context of whole video
- Data was split into 5 folds
  - 4 folds used to train,
  - 5th fold used for testing
- Of the three states of drowsiness, low-vigilant was dropped for binary classification
  - States were self-reported
  - Very ambiguous

# First Sequential Model

- Conv2D layer
  - 16 filters (3x3)
- MaxPool2D
  - (2x2)
- Flatten
- Dense

# First Sequential Model

Train Loss: 0.0147

Train Accuracy: 99.88%

Validation Loss: 4.4248

Validation Accuracy: 62%

# Second Sequential Model

- 3 Conv2D layers
  - 32 filters each (3x3)
- MaxPooling2D
  - (2x2)
- 2 additional Conv2D layers
  - 32 filters (3x3)
- Flatten
- Dense
  - Dropout to avoid overfitting

# Second Sequential Model

Train Loss: 0.0096

Train Accuracy: 99.79%

Validation Loss: 7.9892

Validation Accuracy: 60.01%

# Transfer Learning (EfficientNet)

Train Loss: 0.0281

Train Accuracy: 99.83%

Validation loss: 1.03

Validation Accuracy: 57%

# Conclusion

The first sequential model performed the best with an accuracy rate of 62%.

Overall trend of overfitting - may be due to needless noise

# Recommendations

Due to nature of project, no recommendations can  be drawn from the models

The NHTSA offers these tips to help drive alert:

1. Get adequate sleep on a daily basis
2. Avoid alcohol
3. Check prescription medication labels for potential drowsiness side-effects
4. Avoid driving during peak sleepiness periods
    a. Midnight - 6am

# Limitations

1. Number of Frames
   a. Dropped 29/30 frames per second - huge data loss
2. Lack of Computing Power
   a. Each model took quite a long time to run, limiting the number of runs possible
3. Unimportant elements in each frame
   a. Background, shirt color, etc.

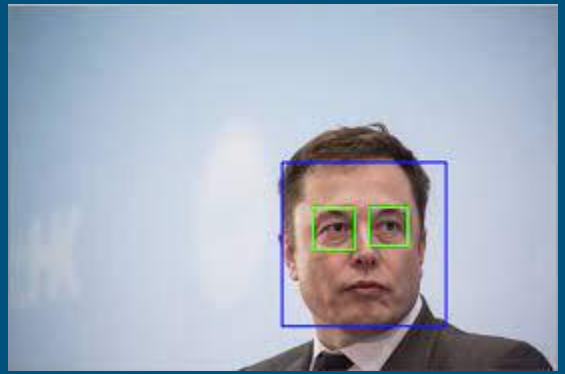
# Problem Statement

How could I reduce the number of collisions caused by driving while drowsy?

Can we accurately be able to assess the drowsiness of the driver?

# What’s next?

- Face, eye capturing for better accuracy
  - Re-train models using eye tracker to reduce noise
- Live evaluation of subject
  - Determination of drowsiness/sleeping



# Live Evaluation