Machine Learning Engineering Nanodegree

Capstone Proposal

Domain Background

According to the CDC motor vehicle safety division, one in five car accidents is caused by a distracted driver. Sadly, this translates to 425,000 people injured and 3,000 people killed by distracted driving every year. In 2015, 391,000 people were injured and 3477 were killed in motor vehicle crashes involving a distracted driver (Source: https://crashstats.nhtsa.dot.gov).

	2010	2011	2012	2013	2014	2015
Distracted Driving Deaths	3,092	3,331	3,328	3,154	3,179	3,477
All Motor Vehicle Deaths	32,999	32,479	33,782	32,894	32,744	35,092
Distracted Driving Injuries	416,000	387,000	421,000	424,000	431,000	391,000
All Motor Vehicle Injuries	2,239,000	2,217,000	2,362,000	2,313,000	2,338,000	2,443,000

A potential solution of crash due to the issue of distraction occurring within the vehicle is the use of machine learning computer vision models to determine and classify distracted driver behavior that could potentially avoid crashes caused by distraction. Murtadha et al applied the machine learning approach to detect such behavior as mentioned in the problem[2].

State Farm hopes to improve these alarming statistics, and better insure their customers, by testing whether dashboard cameras can automatically detect drivers engaging in distracted behaviors. State Farm released a public dataset for a Kaggle Competition to detect and classify distracted driver. For the Capstone Project, this State Farm public dataset will be used.

Problem Statement

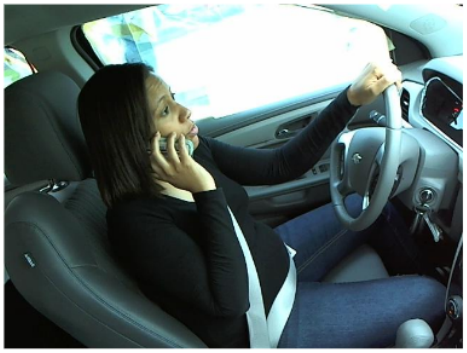
From a set of 2D images captured from dashboard camera (source: Kaggle), the aim of this project is to classify and predict driver behavior if they are driving attentively or engaged in distracted behavior.

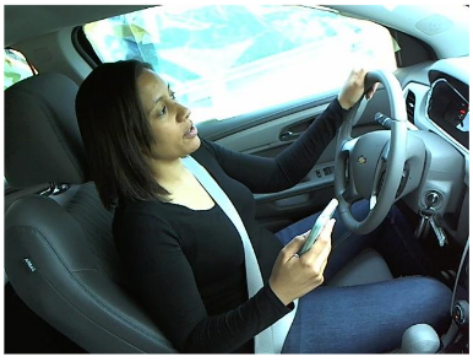
Datasets and Inputs

The dataset used here in this Capstone Project is obtained from State Farm Distracted Driver Detection competition (https://www.kaggle.com/c/state-farm-distracted-driver-detection). The images were taken using a camera mounted in vehicle's dashboard. To avoid accident, this data was captured in controlled environment where instead of driving the vehicle, a truck was used to drag the vehicle around the street. The dataset consists of 22400 training and 79727 testing images. All images are 640 x 480 pixel size. Each image classify as:

c0: Safe Driving (2489)
c1: Texting – right (2267)
c2: talking on the phone – right (2317)
c3: texting – left (2346)
c4: talking on the phone – left (2326)
c5: operating the radio (2312)
c6: drinking (2325)
c7: reaching behind (2002)
c8: hair and makeup (1911)
c9: talking to passenger (2129)

To maintain the balance among the classes, number of images in each class is maintained as similar. Training data will be split and 70% will correspond to training data and rest 30% will be used for validation. Here are some example images of normal driving (c0) and distracted driving (c1 to c9) such as texting, talking to phone, doing makeup, talking to passenger etc.










Solution statement

To solve the problem stated in this project, a convolutional neural network will be developed using Tensorflow/Keras to classify each network as CNN provides high accuracy in classifying images. Network will be trained using training data. CNN will be implemented to minimize multi class logarithmic loss. Prediction will be made on test data set and compared with benchmark model.

Benchmark Model

The data will be trained and tested using VGG16 model. The model with the public leaderboard score will be used as well for benchmarking model (https://www.kaggle.com/c/state-farm-distracted-driver-detection/leaderboard).
The aim is to be in top 50% of the public leaderboard submission.

Evaluation Metrics

Solution and benchmark models will be evaluated using the multi-class logarithmic loss. Each image has been labeled with one true class. For each image, a set of predicted probabilities is computed. The formula here is:

$$\text{logloss} = -\frac{1}{N}\sum_{i=1}^{N}\sum_{j=1}^{M} y_{ij} \log\left(p_{ij}\right)$$

where N is the number of images in test set, M is the number of image class labels, log is the natural algorithm, y_{ij} is 1 if observation belongs to class j or 0 if otherwise and p_{ij} is the predicted probability that observation I belongs to class j.

Project Design

The project is aimed to classify the distracted driving behavior. To do so, first step will be reading the train and test data. Images will be rescaled to keep in a manageable size. Then a Convolutional Neural Network will be created in Keras and trained with training data set. Then, it will be tested using subset of test data. Final step will be predicting the test data and performance evaluation. Here, my plan is to use VGG16 model for transfer learning. I will keep repeating the process by adjusting model and parameters until the desired result comes.

REFERENCES

1. National Center for Statistics and Analysis. *Distracted Driving: 2015*, in *Traffic Safety Research Notes. DOT HS 812 381*. March 2017, National Highway Traffic Safety Administration: Washington, D.C.
2. Murtadha D Hssayeni, Sagar Saxena, Raymond Ptucha, Andreas Savakis. Distracted Driver Detection: Deep Learning vs Handcrafted Features.
3. Vegega, M., Jones, B., and Monk, C. (2013, December). *Understanding the effects of distracted driving and developing strategies to reduce resulting deaths and injuries: A report to congress*. (Report No. DOT HS 812 053. Washington, DC: National Highway Traffic Safety Administration.