Machine Learning Engineer Nanodegree

Distracted driver detection

Chiluka Nikhila NagaJyothi

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Proposal

Domain Background:

As per the CDC motor vehicle division, a one out of five vehicle accident is caused by a distracted driver. Unfortunately, this means 425,000 individuals harmed and 3,000 individuals killed by distracted driving each year.

1. Distracted driving accounts for approximately **25%** of all motor vehicle crash fatalities.
2. At the time of fatal crashes, teens have been the largest age group that reported being distracted while driving.
3. Driver distraction is reported to be responsible for more than 58% of teen crashes.
4. In 2015, **391,000** injuries were caused in distracted driving related accidents.
5. In that same year, distracted driving was cited as a major factor in **3,477** traffic deaths.

State Farm plans to improve these disturbing statistics, and better insure their customers, by testing whether dashboard cameras can consequently recognize drivers engaging in distracted behavior.

Reference Link: https://www.researchgate.net/publication/260543405_Real-Time_Detection_System_of_Driver_Distraction_Using_Machine_Learning

Problem Statement:

Given a dataset of 2D dashboard camera pictures, a algorithm should be developed to classify each driver's behavior and decide whether they are driving mindfully, wearing their safety belt, or taking a selfie with their

companions in the backseat so on..? This would then be able to be utilized to automatically recognize drivers engaging in distracted behavior from dashboard cameras.

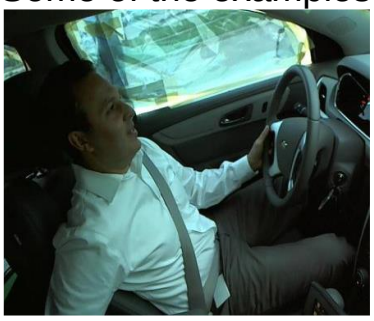
Datasets and Inputs:

The data set which I am working on consists of driver images, each taken in a car with the driver doing something in the car (texting on mobile, eating something, talking on the phone or with the people who besides her/him, makeup, reaching behind, etc) were provided.

The 10 classes to predict are:

- c0: safe driving
- c1: texting - right
- c2: talking on the phone - right
- c3: texting - left
- c4: talking on the phone - left
- c5: operating the radio
- c6: drinking
- c7: reaching behind
- c8: hair and makeup
- c9: talking to passenger

Some of the examples are given below:



There are 102150 total images. Of these 17939 are training images,4485 are validation images and 79726 are training images. All the training, validation images belong to the 10 categories shown above. The images are colored and have 640 x 480 pixels each as shown in Fig.1

Some of the layers:

- ✓ Convolution Layer
- ✓ Polling layer
- ✓ Fully Connected Layer etc.

Following are the file descriptions and URL's from which the data can be obtained:

- imgs.zip - zipped folder of all (train/test) images
- sample_submission.csv - a sample submission file in the correct format
- driver_imgs_list.csv - a list of training images, their subject (driver) id and class id

☑ https://www.kaggle.com/c/state-farm-distracted-driver-detection/download/driver_imgs_list.csv.zip

☑ https://www.kaggle.com/c/state-farm-distracted-driver-detection/download/imgs.zip

☑ https://www.kaggle.com/c/state-farm-distracted-driver-detection/download/sample_submission.csv.zip

Problem Statement:

A deep learning algorithm will be developed using Tensorflow/Keras and will be trained with training data. Specifically a CNN will be implemented in Tensorflow/Keras and will be optimized to minimize multi-class logarithmic loss as defined in the Evaluation Metrics section. Predictions will be made on the test data and will be assessed.

Benchmark Model:

The benchmark model for this project was a simple CNN model with the Public Leader board score (multi-class logarithmic loss) of 0.08690 will be used as a benchmark model. Attempt will be made so that scores (multi-class logarithmic loss) obtained will be among the top 50% of the Public Leader board submissions.

Evaluation Metrics:

Submissions are evaluated using the multi-class logarithmic loss. Each image has been labeled with one true class. For each image, you must submit a set of predicted probabilities (one for every image).

The formula is then,

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

where

- N is the number of images in the test set,
- M is the number of image class labels,
- log is the natural logarithm (yij), is 1 if observation i belongs to class j and 0 otherwise, and is the predicted probability that observation i belongs to class j.

The submitted probabilities for a given image are not required to sum to one because they are rescaled prior to being scored (each row is divided by the row sum). In order to avoid the extremes of the log function, predicted probabilities are replaced with *max*(*min*(*p*, 1 − 10−15), 10−15).

The logarithmic loss measures the performance of a classification model by taking the prediction input as a probability value between 0 and 1 rather than a simple true or false. That means the logarithmic loss takes into account the uncertainty of the model prediction based on how much it varies from the actual label, yielding a more nuanced evaluation of the model's performance.

Project Design:

From the description and problem statement it can be inferred that computer vision can be used to arrive at a solution. CNN class of deep learning algorithm can be employed for this problem.

- Initially data exploration will be carried out to understand possible labels, range of values for the image data and order of labels. This will help pre-process the data and can end up with better predictions.

Pre-processing:

Preprocessing of data is carried out before model is built and training process is executed. For the number of images per category issue, several attempts were made to balance the number of images by either removing random images or selecting drivers with excess images per category. None of these attempts yield positive results, in fact there was a noticeable dip in performance.

- After this, necessary functions will be implemented, data will be randomized and CNN will be implemented in Tensorflow/Keras.
- Finally necessary predictions on the test data will be carried out and these will be evaluated.