CSE472: Machine Learning Sessional

Project Proposal

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Project Name

Distracted Driver Action Classification using Deep Learning

Project Scope

- Our target is to classify the distracted activity of the drivers.
  - We envision this type of product being embedded in cars to prevent accidents due to distracted driving.
- Dataset: State Farm Distracted Driver Detection
  - A dataset of 2D dashboard camera images
  - The training set has **~22.4 K** labeled samples with equal distribution among the classes and **79.7 K** unlabeled test samples.
  - There are **10 classes** of images.

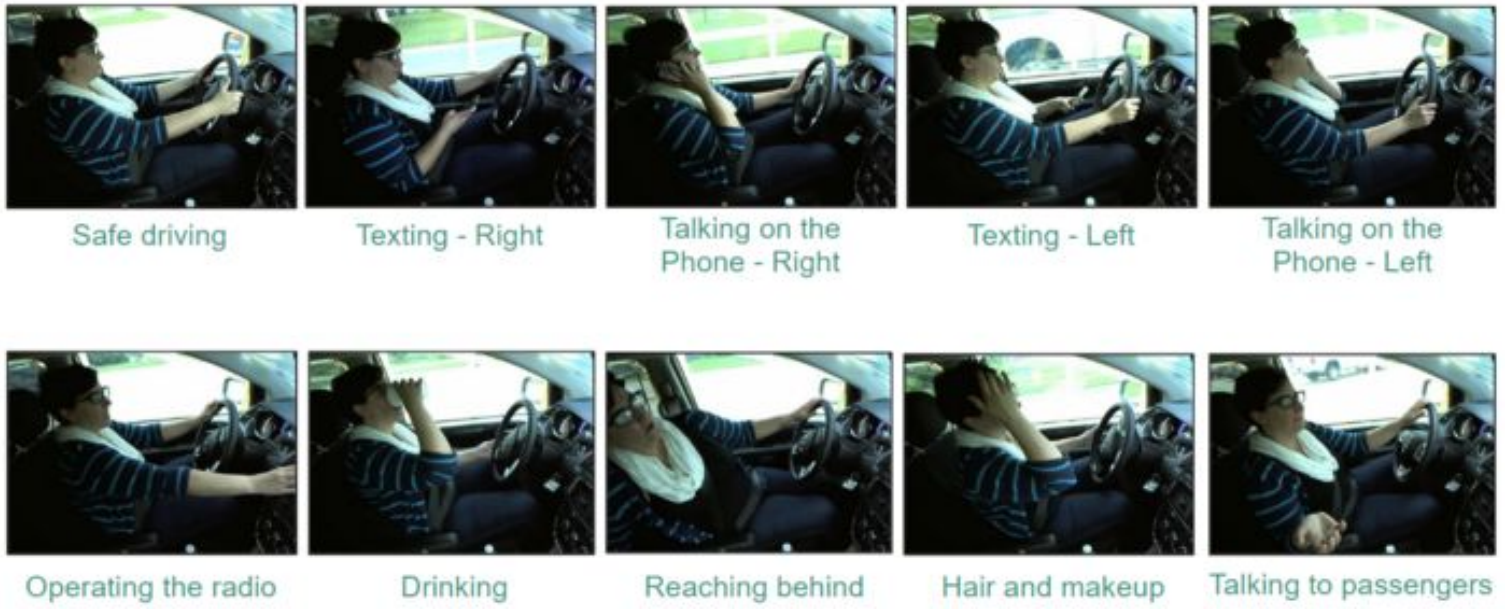


Figure: Sample images from training data

Unlabeled Test Data

We have labeled ~250 unlabeled data points manually.

Architecture

1. CNN model
2. Transfer Learning
    a. VGG16
    b. ResNet
    c. Xception
    d. MobileNet

Data Leakage

We proceeded to build the CNN models from scratch.

```
Accuracy: 0.994203
Precision: 0.994217
Recall: 0.994203
F1 score: 0.994199
```

Our training data has **multiple images of the same person within a class** with slight changes of angle and/or shifts in height or width. This was causing a **data leakage problem** as **the similar images were in validation as well**, i.e. the model was trained much of the same information that it was trying to predict.

Solution to Data Leakage

- We splitted the train dataset into train and validation sets based on unique subject id (**images from same subject do not exist on both sets**).
  - 20 subjects (17391 images) in train, 6 subjects (5033 images) in validation
- Now, we see more **realistic results** when we fit our model with the modified training and validation sets.

Validation Data

Accuracy: 0.665408
Precision: 0.705954
Recall: 0.665408
F1 score: 0.664654

Test Data

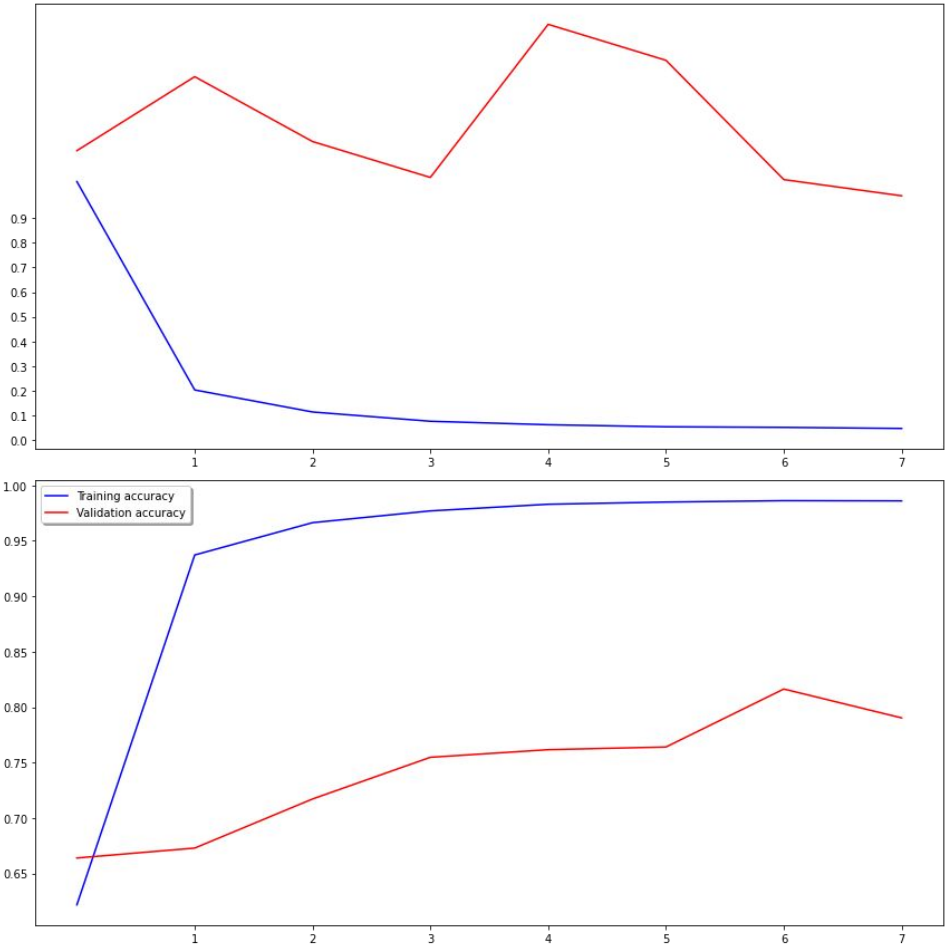
Accuracy: 0.592334
Precision: 0.644497
Recall: 0.592334
F1 score: 0.593688

CNN Architecture

After tuning hyperparameters in our existing CNN model,

Validation
Accuracy: 0.790326
Precision: 0.799796
Recall: 0.790326
F1 score: 0.789709

Test
Accuracy: 0.759718
Precision: 0.763664
Recall: 0.759718
F1 score: 0.748692



Data Augmentation

Original Image

We have tested using augmented features for Resnet, Xception and Mobilenet architecture.

After applying height_shift, width_shift, zoom, rotation

Transfer Learning

Architecture	Extra Layer Added?	Train Accuracy	Validation Accuracy	Test Accuracy
VGG16	No	0.964661	0.402509	0.125436
RESNET 50	Yes	0.7565	0.7037	0.5554
Xception	No	0.6678	0.7484	0.5578
Mobilenet	**No**	**0.8378**	**0.7531**	**0.7393**

Transfer Learning (cont.)

Architecture	Extra Layer Added?	Train Loss	Validation Loss	Test Loss
VGG16	No	0.131356	4.6378	14.544
RESNET 50	Yes	0.7052	0.8937	1.2986
Xception	No	0.9791	0.7449	1.3064
Mobilenet	**No**	**0.6030**	**0.7299**	**0.7606**

Challenges

1. We resized our input image into (64, 64, 3). In some sources, they recommended to use the input of shape (224, 224, 3). We could not explore that because of our limited RAM capacity.
2. Our basic CNN model took around 3 hours to run. Normally pretrained model took moderate time to train, but when we wanted to add few extra layers and data augmentation, it took huge time.
3. Cropping out parts from the images which provide more information such as hands, eyes, etc. could be explored to improve accuracy.

Literature

1. Paper 01 (2020): https://www.ijedr.org/papers/IJEDR2004016.pdf
    a. Test acc: 81.56%
    b. Validation acc: 93.24%
2. Paper 02 (24-04-2018):

    https://www.researchgate.net/profile/Pramila-Chawan/publication/337275106_Distracted_Driver_Detection_and_Classification/links/5dce5afc299bf1b74b426c58/Distracted-Driver-Detection-and-Classification.pdf

    a. Validation acc: 75-77%

Notebooks

1. CNN (8 epoch): https://colab.research.google.com/drive/1gq3i0PfB0MTGcjppBBLWBXhT1C83SD79?authuser=2
2. MobileNet: https://colab.research.google.com/drive/1eKmaNzPNF10coo1fmPPsZXOksJbTz_od?authuser=2
3. VGG16: https://colab.research.google.com/drive/1XiTved6XCNz1lhJV_5TXs2jonsVI6KeD?authuser=2#scrollTo=W--0ofjTgkVg

Thank you