State Farm Distracted Driver Detection

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Abstract

Driving a car is a complex task, and it requires complete attention. Distracted driving is any activity that takes away the driver's attention from the road. Approximately 1.35 million people die each year as a result of road traffic crashes.
Road traffic crashes cost most countries 3% of their gross domestic product So, our aim/goal in this project is to detect if the car driver is driving safe or performing any activity that might result in an accident or any harm to others, by using various Machine Learning Models to classify the provided images into different categories of Distraction.
Furthermore, we can extend this work into comparing various Machine Learning Models to determine the accuracy based on respective models.

1 Importance of Project

Many states now have laws against texting, talking on a cell phone, and other distractions while driving. We believe that by applying Machine Learning algorithms, we can detect the risk of accident by classifying the driver images in one of the distracted classes and hence prevent accidents caused by distracted driving. If this information can be known at real time then a lot of accidents can be reduced with proper implementation.

2 Literature Survey

This section summarises review of some of the relevant and significant work from literature for distracted driver detection.

In paper [1], images are resized for training and testing purposes and traditional Machine Learning algorithms are applied namely Linear SVM , Softmax , Naive Bayes , Decision Tree , Two-Layer Neural Network. The paper[1] is further extended to compare the performance of traditional machine learning algorithms and advance CNN based techniques such as ResNet and VGG.

In paper[2] images are resized and feature extraction techniques are applied like Pixel , HOG , Sobel , Clustering. After this, feature extraction for dimensionality reduction PCA is applied. The classification is performed using algorithms like SVM , Decision Tree, Random Forest , 2-Layered Neural network and CNN. A comparative analysis is done for each model with different feature extraction techniques and accuracy is obtained individually using each feature extraction technique. For CNN a grid search is performed for individual parameters to obtain the best model. At the end, transfer learning algorithm VGG-19 is used. Paper[2] is further extended to obtain the results using modern Deep Learning Network Architectures and combined feature vectors are used for Image Representation.

Paper[3] preprocesses the images as skin-segmented images, face images, hands images, and "face+hands" images. These along with the raw images are trained using a weighted ensemble of CNN.

3 Dataset

The dataset used is State Farm Distracted Driver Detection taken from *https://www.kaggle.com/c/state-farm-distracted-driver-detection/data.* The dataset contains 22424 driver images in total and has 10 classes. The 10 classes are Safe driving , Texting(right hand) ,Talking on the phone (right hand),Texting (left hand) ,Talking on the phone (left hand), Operating the radio ,Drinking , Reaching behind , Hair and makeup , Talking to passenger(s).Each image belongs to one of the classes above and are taken in a car with a driver doing something in the car. The images are coloured and have 640*480 pixels

each as shown below. For the training and testing purposes the images are resized to 64*64 coloured images.
Stratified splitting is used to split the dataset into 80:10 Training-Testing ratio. The training dataset is further split into 90:10 Training-Validation set.

Figure 1: Data Visualization

4 Data Analysis

Images are resized to 64*64 coloured images for training and testing purposes.Following feature extraction techniques are applied LBP , HOG , color Histograms , KAZE , SURF.The result of feature extraction can be visualized in figure 2. Normalization is performed over the extracted features.
Dimensionality reduction techniques like PCA and LDA are used to reduce the dimensions and avoid 'Curse of Dimensionality'. For deciding the ncomponents of PCA variance-components graphs are used(Figure 3).
All the features are stacked together to get complete image representation and ML algorithms are applied to obtain the accuracy.

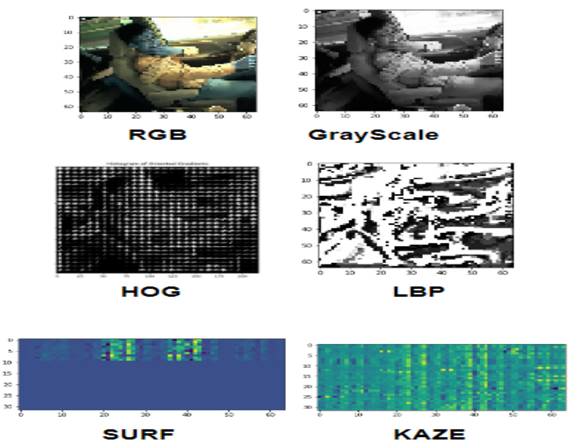

Figure 2: Feature Extraction Techniques

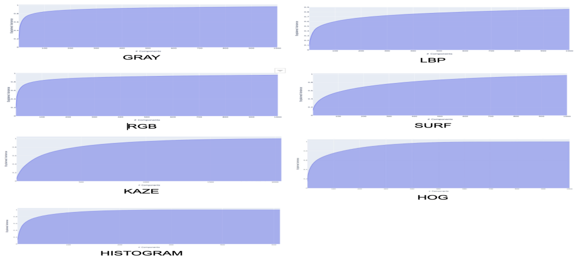

Figure 3: PCA variance and n_components graph

5 Model Evaluation

The following traditional ML algorithms are used along with feature extraction and dimensionality reduction.

- Decision Tree
- Support Vector Machine

	Precision	Recall	F1 Score	Acc
LDA	0.9088	0.9081	0.9082	0.9077
PCA	0.8955	0.8955	0.8955	0.8955
HOG	0.8511	0.8510	0.8510	0.8510
Color Hist.	0.4110	0.3805	0.3818	0.3823
KAZE	0.7927	0.7848	0.7861	0.7898

Table 1: SVM

	Precision	Recall	F1 Score	Acc
LDA	0.8754	0.8755	0.8753	0.8754
PCA	0.7869	0.7862	0.7863	0.7876
HOG	0.7415	0.7405	0.7409	0.7408
Color Hist.	0.6655	0.6629	0.6635	0.6638
KAZE	0.5639	0.5629	0.5629	0.5668

Table 2: DT

6 Inference

- As PCA was not able to capture class information so accuracy obtained with LDA is better as compared to PCA .
- As there are huge number of dimensions so Decision tree tends to overfit and performs bad over the test set.
- Combination of features from various feature extractions give better accuracy than taking individual features.

7 Planned Architecture

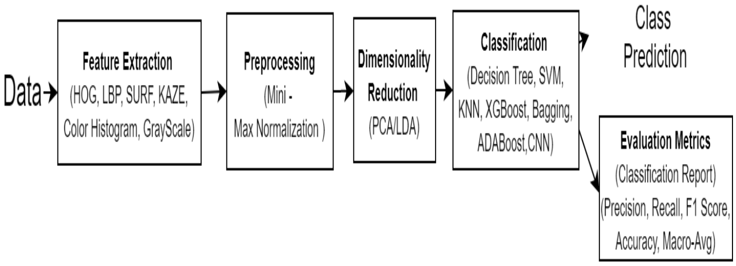

Figure 4: Project Pipeline

8 References

Paper[1]:http://cs229.stanford.edu/proj2019spr/report/24.pdf

Paper[2]:https://github.com/Raj1036/ML_Distracted_Driver_Detection/blob/master/CS539_DistractedDriverDetetion_FinalProject.pdf

PAPER[3] : H. Eraqi, Y. Abouelnaga, M. Saad, and M. Moustafa, "Driver Distraction Identification with an Ensemble of Convolutional Neural Networks", Journal of Advanced Transportation 2019, 1-12; doi: 10.1155/2019/4125865