Driver Drowsiness Detection

Neural Networks and Deep Learning

Group Members

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Problem Identified

overview of project

Sleep disorders increase the risk of road accidents by 300%, finds a World Bank study.

Many of these truck drivers or bus drivers who drive vehicles on highways suffer from Obstructive Sleep Apnea (OSA), a disorder that majorly goes undetected because of lack of testing.

0% of all road accident victims are found suffering from sleep disorders and OSA and more than 23% of truck drivers have sleep deprivation. Clearly, these drowsy drivers can cause fatal accidents on roads.

Literature Review

Research Paper 1 - **A Realistic Dataset and Baseline Temporal Model for Early Drowsiness Detection (15th April 2019)**

In this paper, we presented a new and publicly available real-life drowsiness dataset (RLDD), which, to the best of our knowledge, is significantly larger than existing datasets, with almost 30 hours of video. We have also proposed an end-to-end baseline method using the temporal relationship between blinks for multistage drowsiness detection. The proposed method has low computational and storage demands. Our results demonstrated that our method outperforms human judgment in two designed metrics on the RLDD dataset

Research paper 2 - **Drowsiness Detection with Machine Learning (14th December 2019)**

First, simpler models can be just as efficient at completing tasks as more complex models. In our case, the K-Nearest Neighbor model gave an accuracy similar to the LSTM model. However, because we do not want to misclassify people who are drowsy as alert, ultimately it is better to use the more complex model with a lower false-negative rate than a simpler model that may be cheaper to deploy. Second, normalization was crucial to our performance. We recognized that everybody has a different baseline for eye and mouth aspect ratios and normalizing for each participant was necessary. Outside of runtime for our models, data pre-processing and feature extraction/normalization took up a bulk of our time. It will be interesting to update our project and look into how we can decrease the false-negative rate for kNN and other simpler models.

Literature Review

Research Paper 3 - **Vision-based drowsiness detector for a Realistic Driving Simulator (20th September,2010)**

This paper presents a non intrusive approach for monitoring driver drowsiness, based on computer vision techniques, installed in a realistic driving simulator. The proposed drowsiness detection method has demonstrated to be valid, showing an 85% of awake state recall rate considering only PERCLOS. The computer vision and the Gaussian model method does not need fixed threshold to determine the eye opening. However the PERCLOS signal assessment needs a nominal or fixed eye opening threshold value. This nominal value is dependent on the constraints of the driver's eye and it is calculated in an initial automatic process

Research Paper 4 - **Driver Fatigue Detection Based on Convolutional Neural Networks Using EM-CNN (18th November 2020)**

With a focus on fatigue driving detection research, a fully automated driver fatigue status detection algorithm using driving images is proposed. In the proposed algorithm, the multitask cascaded convolutional network (MTCNN) architecture is employed in face detection and feature point location, and the region of interest (ROI) is extracted using feature points. A convolutional neural network, named EM-CNN, is proposed to detect the states of the eyes and mouth from the ROI images. The percentage of eyelid closure over the pupil over time (PERCLOS) and mouth opening degree (POM) are two parameters used for fatigue detection. Experimental results demonstrate that the proposed EM-CNN can efficiently detect driver fatigue status using driving images. The proposed algorithm EM-CNN outperforms other CNN-based methods, i.e., AlexNet, VGG-16, GoogLeNet, and ResNet50, showing accuracy and sensitivity rates of 93.623% and 93.643%, respectively.

Literature Review

Research Paper 5 - **A Machine-Learning Approach for Driver-Drowsiness Detection based on Eye-State (13th April, 2021)**

The drowsiness detection based on eye state has been done accurately based on the varying features and factors, and also with the help of experts knowledge. Predicting the facial landmarks and detecting the eye-state and displaying the driver status on the screen and in the App is the most necessity ingredient for drowsiness detection.
Generally, the driving person feels drowsy due to continues driving for long hours or Physical illness or might be drunken and this leads to major road accidents. Our aim is to detect the drowsiness, make them alert to prevent accidents and generate a notification in the app and an alarm sound.

Research Paper 6 - **Driver drowsiness detection using ANN image processing (October, 2017)**

Analyzing the results of applying these networks on the acquisitioned images it can be concluded that both networks had very good results, with 100% positive classification results, which were presented in chapter 3. The small number of neurons used in the hidden layers to successfully classify the images (10 for the 1 hidden layer network and 15 for the autoencoder network) allows the implementation of these networks on compact computing devices, using a very small portion of their memory. Also the processing time is in the order of milliseconds on a Windows based computer, which on a compact device can be more reduced. The training of the network can be done specifically for each driver, thus enhancing the classification success rate

Literature Review

Research Paper 6 - **Real-time Driver Drowsiness Detection for Android Application Using Deep Neural Networks Techniques (2018)**

This paper proposes a drowsiness detection system based on multilayers perceptron classifiers. It is specifically designed for embedded systems such as Android mobile. The role of the system is to detect facial landmark from images and deliver the obtained data to the trained model to identify the driver's state. The purpose of the method is to reduce the model's size considering that current applications cannot be used in embedded systems due to their limited calculation and storage capacity. According to the experimental results, the size of the used model is small while having the accuracy rate of 81%. Hence, it can be integrated into advanced driver-assistance systems, the Driver drowsiness detection system, and mobile applications. However, there is still space for the performance improvement. The further work will focus on detecting the distraction and yawning of the driver.

Research Paper 7 - **Robust Drowsiness Detection for Vehicle Driver using Deep Convolutional Neural Network (3rd June, 2020)**

. During facial features extractions proposed method used aggregation strategy and integral image construction to process rectangle features in case face region cannot be extracted due to some issues, i.e. light reflection, shadow in input frames. In face alignment phase, proposed method used cascade of regressors cutting edge method in order to improve identification of facial landmarks under highly varying lighting conditions for video frames. Later, in pupil detection step, proposed research used deep convolutional neural network (DCNN) for accurate pupil detection for nonlinear data pattern where proposed method used facial landmarks as the center of segmentation to be used through DCNN network.

Literature Review

Research paper 8 - **Detecting Human Driver Inattentive and Aggressive Driving Behavior Using Deep Learning: Recent Advances, Requirements and Open Challenges (3rd June, 2020)**

In this study, we classified and discussed the human driver's Inattentive driving behavior (HIDB) into two major categories; Distraction and Fatigue/Drowsiness. The detection of driver distraction and driver fatigue/drowsiness was classified according to the features selected for the detection of human driving behavior in the literature. Aggressive driving behavior being another more risky human driving behavior was also explained and discussed, high-lighting the causes and effects of different aggressive driving styles on human safe driving

Research paper 9 - **Detecting Drowsy Drivers Using Machine Learning Algorithms (Decemeber, 2020)**

In this work, we tried to detect drowsy drivers using supervised machine learning algorithms. Because of the time-series nature of the data, we had to do aggregation over the time-series to generate features. We tried to generate aggregate features in the granularity of per-run and per-event in each run. We found that the per-event aggregate features result to better classifiers with respect to area under ROC curve. The per-event aggregate features are also more informative and intuitive when analyzing the selected attributes from the dataset. Also, function-based classifiers such as Logistic Regression and SMO performed better than Bayes and Trees for this classification task.

Literature Review

Research paper 10 - **AN EFFICIENT DETECTION APPROACH OF DRIVER- DROWSINESS USING MULTIPLE CONVOLUTIONAL HAAR CASCADE KERNELIZED CNN (MCHCKCNN) ALGORITHM (March, 2021)**

In this field, we are analyzed different experimentation for Real-Time DDD System. In a practical simulation setting, we took careful care to carry out our test testing. For a practical mode of vehicular mobility. With python as a simulation tool, we analyzed our model. While certain traditional models can detect the positions of several facials, the eyes and mouth areas of the driver cannot be established. However, the driver will practically have diverse and complex facial expressions that distort their detection.

Proposed Solution (Novelty)

In this Python project, we will be using OpenCV for gathering the images from the webcam and feed them into a Deep Learning model which will classify whether the person's eyes are 'Open' or 'Closed'. The approach we will be using for this Python project is as follows :
Step 1 – Take the image as input from a camera.
Step 2 – Detect the face in the image and create a Region of Interest (ROI).
Step 3 – Detect the eyes from ROI and feed them to the classifier.
Step 4 – The classifier will categorize whether eyes are open or closed.
Step 5 – Calculate score to check whether the person is drowsy

The model we used is built with Keras using Convolutional Neural Networks (CNN). A convolutional neural network is a special type of deep neural network which performs extremely well for image classification purposes. A CNN basically consists of an input layer, an output layer, and a hidden layer that can have multiple layers. A convolution operation is performed on these layers using a filter that performs 2D matrix multiplication on the layer and filter

Societal Impact

(Beneficiaries of the proposed Solution)

with this Python project, we will be making a drowsiness detection system. A countless number of people drive on the highway day and night. Taxi drivers, bus drivers, truck drivers, and people traveling long-distance suffer from lack of sleep. Due to this, it becomes very dangerous to drive when feeling sleepy.

The majority of accidents happen due to the drowsiness of the driver. So, to prevent these accidents we will build a system using Python, OpenCV, and Keras which will alert the driver when he feels sleepy.

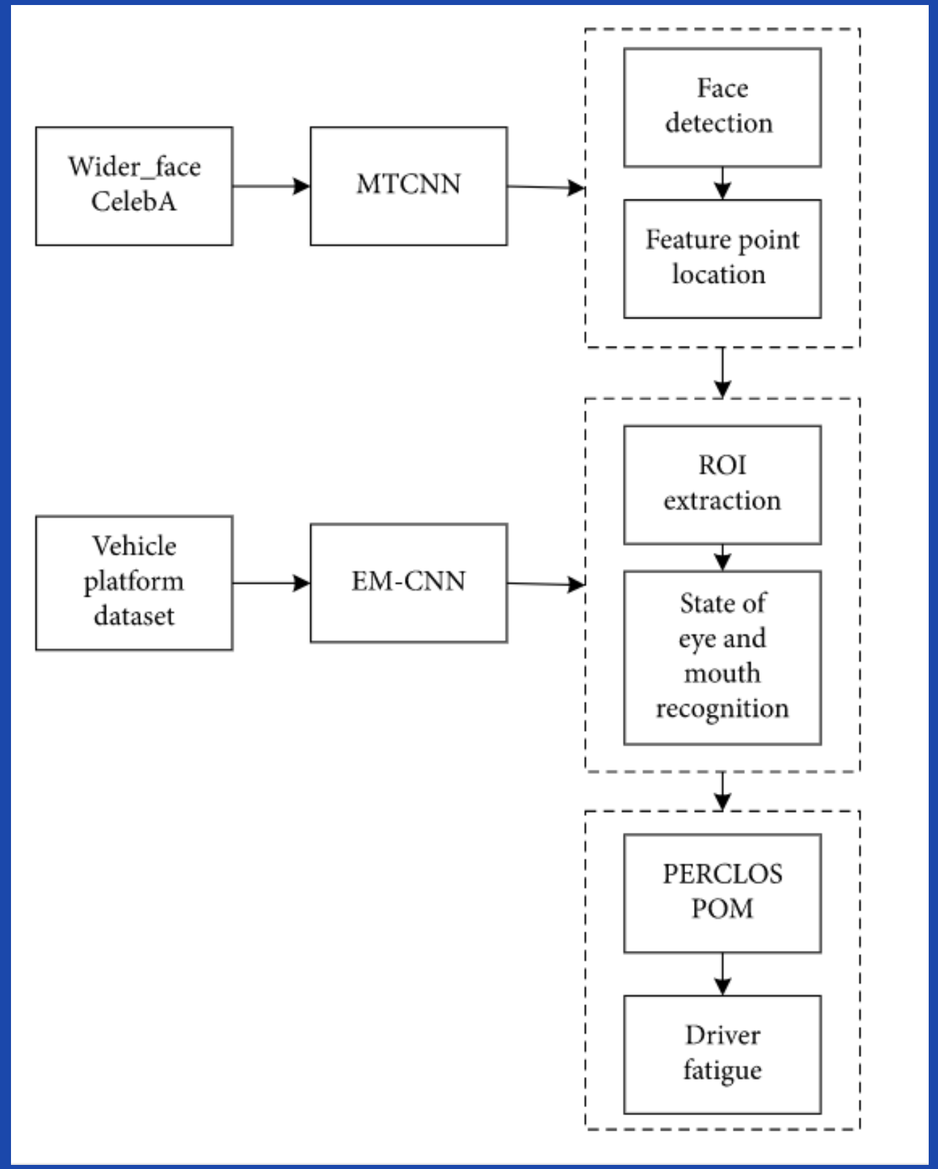
Objective of the Project

Safety

- Drowsiness detection is a safety technology that can prevent accidents that are caused by drivers who fell asleep while driving.

- The objective of this intermediate Python project is to build a drowsiness detection system that will detect that a person’s eyes are closed for a few seconds. This system will alert the driver when drowsiness is detected.

Block Diagram



Hardware and Software Details

Used in the project

WebCam

a webcam through which we will capture images

OpenCV

opencv-python (face and eye detection)

TensorFlow

tensorflow (keras uses TensorFlow as backend).

Keras

palette thkeras (to build our classification model).

Pygame

game (to play alarm sound).

Driver Drowsiness dataset

To build and train our model