Driver Fatigue Detection for Autonomous Vehicle Paradigm

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Abstract

Driver fatigue is one of the leading causes of motor vehicular accidents. This project is aimed at building a prototype for drowsiness detection using convolutional neural networks with an online accessible data set.

Objectives

- Develop a deep learning model to detect the fatigue with high accuracy
- Develop an end-to-end prototype that can detect the fatigue of a user with a laptop camera

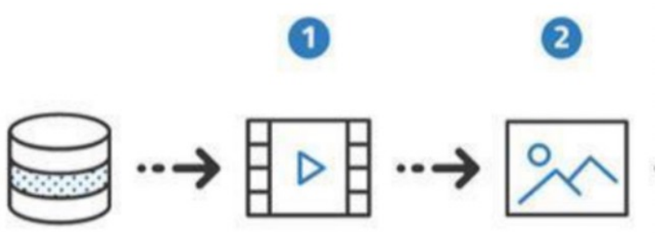
Dataset

YawDD (5GB) contains two video datasets of drivers with various facial characters. In the first dataset a camera is installed under the front mirror of the car. Each patient has three videos and each video contains three conditions such as normal, talking and yawning. The videos are in 640x480 (RGB) 30 fps with AVI format

Implementation

Data Preprocessing

- Extracting videos from the first dataset in YawDD
- Extracting one PNG image per 10 frames in the AVI videos and save the images in the corresponding folders

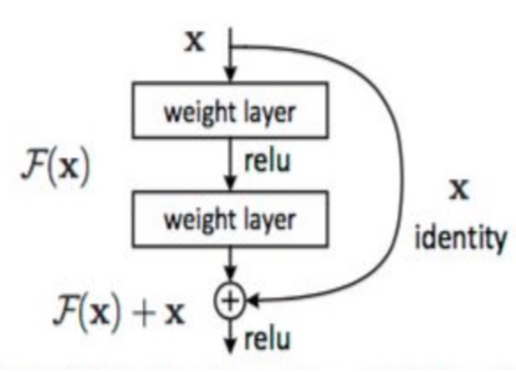


- As to the yawning folders, deleting redundant images and only keep those that record the yawning process.
- Reorganizing the images, ignoring all unnecessary tags such as genders, glasses, sunglasses
- Divide three varieties of images by the ratio of 80%-20% as training and testing samples

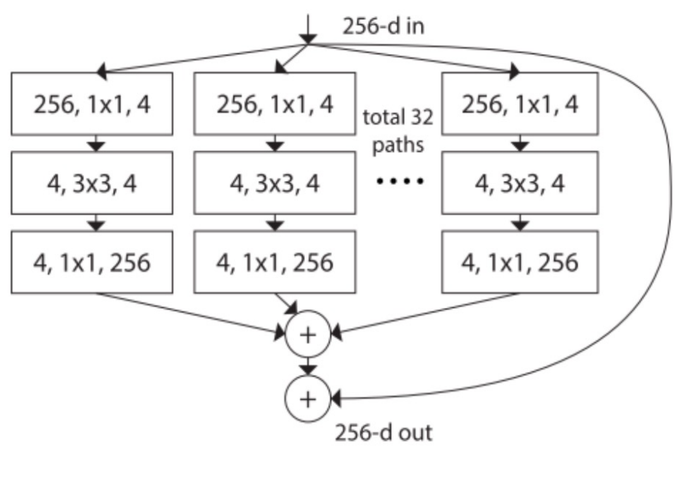
- Using Dlib and OpenCV2 to recognize faces in the images and resize them as 200x200 PNG files

ResNet

- Convert images of PNG format to RGB data by using Torchvision
- VGG19 is efficient for the training. However, compared to VGG19, ResNet has smaller computation and higher accuracy.



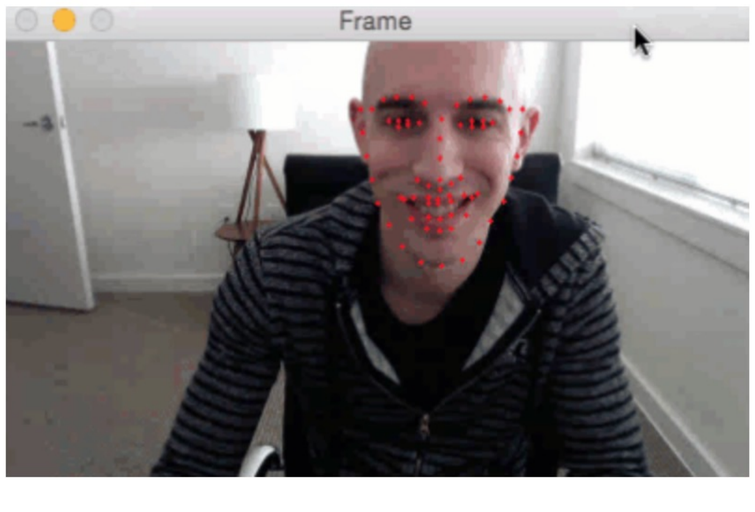
- After increasing the network depth, the gradient of the earlier layers will be small. To avoid the problem of vanishing gradients, use ResNet as the network



- Based on YawDD data set, the model reached the fatigue accuracy of 83% after training

Detection by Vision Sensor

- According to the trained model, it is possible to realize real-time fatigue detection
- Using dlib, OpenCV to capture few facial images from real-time stream every 30 frames
- Determine whether each image is detected as drowsy or not by using the current neural network



- Set a threshold and calculate the percentage of the images that are detected as fatigue
- If the percentage exceeds the threshold, the program will alert the user to concentrate their attention

Discussion

- Realizing instant fatigue detection by setting a threshold could be tricky as the model is trained for detecting the image instead of coherent videos.
- Instant detection is restricted for the model to respond with small delay if the user is speaking or yawning

Future Work

- Improve the detection further by using an advanced method for capturing drivers' faces
- Increase the accuracy under extreme conditions such as driving at night or on a cloudy day
- Enable the prototype to run on a mobile device which has a vision sensor
- Improve the algorithm to emphasize a progress with a series of images instead of training the model by analyzing the independent image one by one so that we can find a better threshold for real-time fatigue detection

References

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