SEMINAR PAPER

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REAL IMAGE BASED DRIVER'S DROWSINESS DETECTION (Machine Learning)

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Contents

Abstract

Driver's drowsiness in one of the common reasons of road accidents while driving on a highway or motorway where the drive is more comfortable and less interruptive for longer period of time. The proposed work is a step towards the solution of this common real-life issue. This is an artificially intelligent real-time monitoring system in which a digital camera is installed in front of driver. The camera is connected to a computing board which read the frames at real time from it and use the image processing techniques on them to detect drowsiness. In a real-time frame, first of all we detect the driver face using Viola-Jones fast object detection algorithm and select a region where driver is most likely to be exist. Next, we use the same method for eye detection and finally we apply a specially designed sobel like filter to detect the upper eyelash of eye. Once the upper eyelash is detected successfully, we use a special orientation approximation approach to specify that whether the eyelash curve is oriented upward or downward. Based on the result of eyelash orientation, our system classifies the close eye frames and open eye frames as drowsy and non-drowsy respectively. The algorithm counts the drowsy classified frames and generate an alarm if these frames come continuously for a specific amount of time (for eight frames). The system runs on its own totally without the interference of driver and give specific signals if the driver is not siting properly on seat.

Key Words: Drowsiness Detection, Raspberry pi, Python, Computer Vision and Image processing, Face detection, Eye detection and Curve orientation approximation.

INTRODUCTION

In recent years the machine learning algorithms play a vital role in finding solutions to various daily life problems. Some of the well-known applications are medical diagnosis, credit risk analysis, customer profiling, market segmentation, and fraud detection (*Tzanis, et al. 2006*). Mainly the machine learning algorithms can be classified into two categories i.e. supervised learning and unsupervised leaning algorithms (Mohammed, et al. 2017).

In supervised machine learning algorithms, the machines are trained using data that are well labeled, which means the correct answers are already known. The dataset is split into parts, where the training part is used to build the model and testing part is used to test the accuracy of the model. Figure 1 below describe the working pattern of supervised learning algorithms. Some of the well-known supervised learning algorithms are Regression, classification etc.

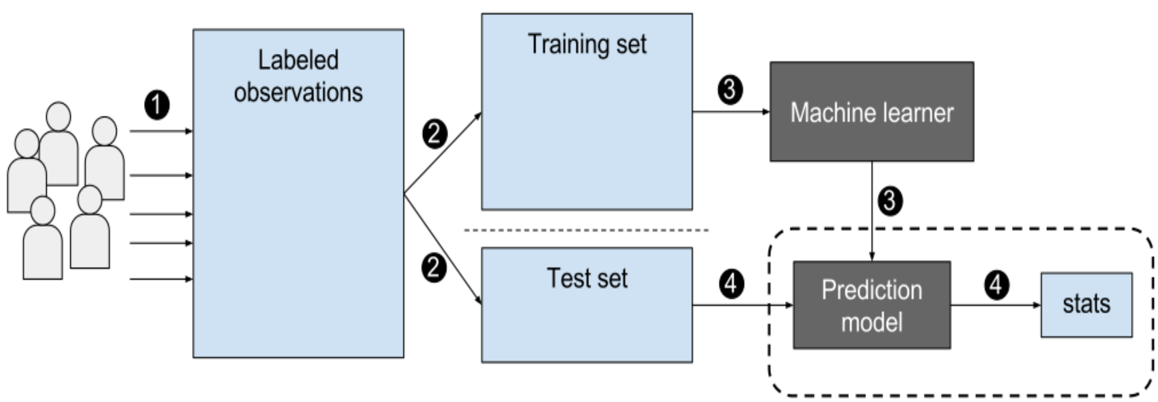
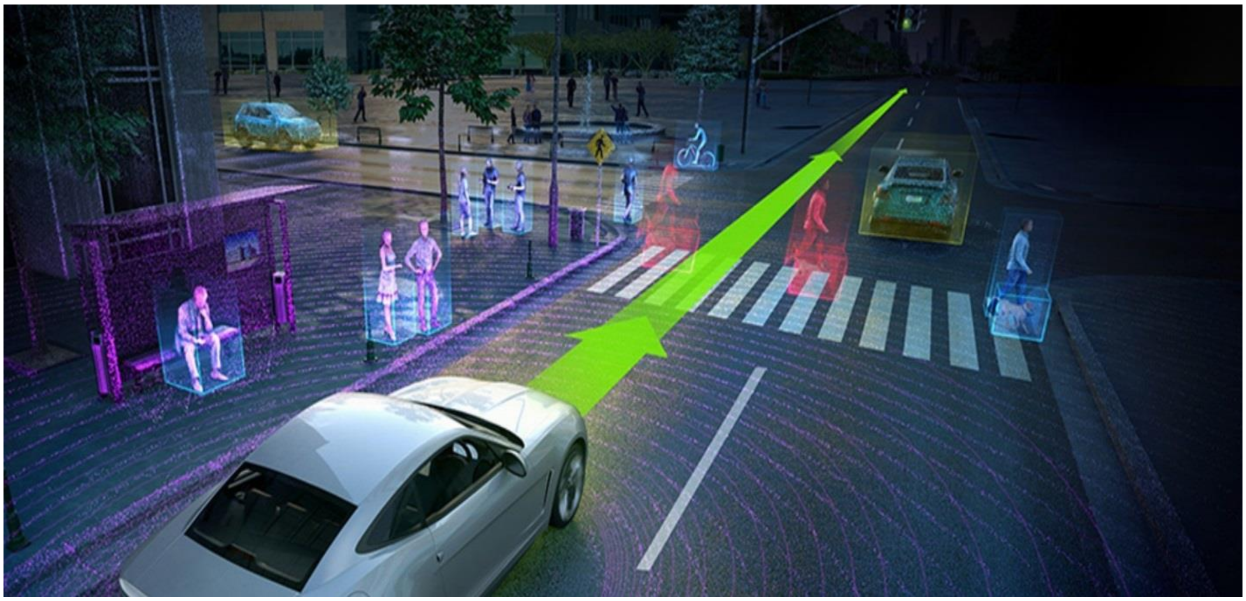


Figure 1: Supervised learning algorithms

On the other hand, unsupervised learning algorithms helps in exploratory analysis as it identifies the previously unknown patterns in the datasets without any labels (Hinton, et al. 1999). The most commonly used unsupervised learning algorithm is clustering analysis, which is used for data segmentations based on similarities (Breytenbach, 2000). Nowadays these algorithms are widely used in solving numerous challenges that researchers face in designing self-driving cars (Grigorescu, et al. 2019). The potential applications of machine learning algorithms in autonomous driving cars are examination of driver conditions or driving scenario classification (Fridman, et al. 2019). In autonomous car driving, one of the foremost jobs of a machine learning algorithm is nonstop interpretation of neighboring environment and predicting the changes that are probable to these backgrounds (Fridman, et al. 2016).



Source: How Self-Driving Cars Work – A Simple Overview. Retrieved from https://emerj.com/ai-sector-overviews/how-self-driving-cars-work/.

Figure 2: Car reading the surrounding environment

Motivation

Road accident is one of the serious life risk issue of human being. In this modern era of twenty first century where the quality of traffic has been enhanced and the time of traveling decreases, the issue of road accidents has increased. Road accident can be caused due to several reasons that include over speeding, violation of traffic rules, physical or mental disorder of driver and drowsiness of driver are some to mention. Among all these reasons, the drowsiness of driver is one of the main reason. In our work, we propose a driver assistance system that detect the drowsiness and alarm the driver if the drowsiness level exceeds a certain level. The sensors and machine learning algorithms can be developed, which alarm the driver and reduce the chances of accidents.

Drowsiness

Drowsiness or sleepiness is a state of strong desire for permanent sleep. It can be referred to a usual state proceeding falling asleep. It can be accomplished by lethargy, weakness and lack of mental agility. Sleepiness can be dangerous when performing tasks that require constant concentration, such as driving a vehicle. This website wrote more on drowsiness (Blake, 2019, July 31).

Methods

Methods of Drowsiness Detection

The drowsiness can be detected by various methods in different disciplines like signal-based detection (EEG and ECG), machine learning or neural network-based detection, Image based detection etc. The image-based drowsiness detection can be classified into template matching, yawing behavior or eye blink behavior based etc. The image-based classification of drowsy and non-drowsy driver can be used. The blink behavior-based technique is used to classify that whether the driver is feeling drowsy or not (Fuletra & Dulari, 2013). We take frames from camera installed in front of the driver and classify them as drowsy or non-drowsy. Evaluate the percentage accuracy of algorithm in open and close eyes trail on the test datasets after training the model on a large number of images.

Single Obstacles and their Solutions

Localization of driver's face among all other passengers with him while traveling was the first obstacle after the face detection by Viola-Jones (2001). This problem can be solved by taking the face with highest area among all the faces keeping in mind the fact that the camera should install closest to the driver.

Localization of eye and the redundancy of eye detection in Viola-Jones raise the question of which eye should we take and how to ignore wrongly detected eyes. Ignore those regions of the face, where there is more expectation of wrong eye detection and concise our detector to detect eyes with in the range of certain expected size.

The major issue with This technique could be the noise of eye-brows with the eyelash. Hence the eye brows act as a noise with them. To overcome this, take only the region where only the eye part exists exactly and reduce the noise up to a reasonable extent. Do this by taking the combine region of both the eyes which start from lowest positioned eye and end at the end of rightmost eye.

Applied Technique and its Usefulness

The classification of open and close eye is done by filtering out the upper eyelash curves with the specially designed sable like filter. The detected upper eyelashes are then classified as oriented upward or downward by a series of methods. The end result is able to classify the eye-lash curves of more than half closed eye as the drowsy eye and more than half opened eye as open eye. So, the dowsing driver can be alerted before he goes to a complete sleep state. The system generates an alarm signal to a buzzer if the eye state is close continuously for a specific amount of time.

Nontriviality of the solution

Among all other features, the upper eye lash is a best feature responsible for closing and opening of the eye. Once we extract it from the rest noisy curves in the eye, we can surely get a way to detect the drowsiness. This is because of the fact that it is a very compact and much more accurate than the other features of eye for this specific problem. The classification of oriented upward (or, we may say ‘Concave Up’) and downward oriented curves (or, we may say ‘Concave Down’) is done by a self-accessed experimental based systematic approach with a series of different methods.

Results

Expected Results

- Efficient localization of the driver's face has been done among the all faces of passengers with him/her.
- Combination of the region of both the eyes in a systematic way which reduction of the noise due to eyebrows with eye-lash up to some extent.
- Design of a special filter for curve detection with more response to the upper eye-lash in the selected eye region.
- Extraction of the eyelash curve from all other detected curves in the region.
- Classification of the open eye and close eye on the basis of eye-lash orientation with percent accuracy.
- Execution of the code on raspberry pi with a continues run over it and a time check for close eye to generate a alarming signal if it exceed the condition defined.

Conclusion and future work

Future planes and space in the work

The shortcomings of our results can be minimized if a latest eye detection algorithm is used which improves the eye localization as accurate for close eye as it does for open eye and completely ignore eye brows. Intense illumination conditions also affect the results of detector where the eye is not illuminated enough to detect and specify the eye lash. These problems can be solved by making the detector independent of the lightning conditions.

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