Smart Anti-Distraction and Drowsiness Alert System for Drivers using Facial Image Processing

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Abstract

This research study developed a smart-alert system specifically on drowsiness and anti-distraction for drivers with the use of facial image processing. Drowsiness and Distraction were detected by the alert system then let the subject keep alerted along their driving session. The system prevented the driver to fall in a state of drowsiness and distraction while they are driving on a daily basis because the image processor or Raspberry Pi detected facial recognition from the live feed of web-camera that considered or based on datasets. Raspberry Pi also implemented feedback to have immediate output in a form of an alarm sound to avert the driver from accidents through the data being collected from the previous process. The system embodies various components that made the whole project worked as one that offered safe travel having an extra-layer of safety feature along the driving session of the drivers. The prediction model was able to achieve a prediction accuracy of around 97% when tested on a video stream. With the help of image processing, the detected subject being drowsy having parameters of eye and mouth aspect ratio consisted specific alert of playing the alarm tone, the system was also able to record detection and log it in the real time database.

Introduction

Safe use of various types of vehicles such as motors, automobile, buses, trucks and construction machinery equipped with a requirement of appropriate operation in mechanical works, physiological and psychological conditions. In establishing and enforcing a vehicular safety onto the next level, an added safety feature is a must implemented while driving. For this reason, the extra-layer in driving acknowledges a safety package and worry-free in travelling that can possibly lead to open new-technology-based opportunities in preventing such unwanted accidents on roadways. According to statistics, over 1.2 million people die on road accidents every single year and there is 20-50 million people all over the world suffering from non-fatal injuries as a result of these road accidents. 25% of all accidents are due to driver fatigue and drowsiness. Data shows that driver inattention is a major issue for road accidents all over the globe. Driver inattention may be due to his/her lack of concentration on secondary tasks, such as using the cell-

General Objectives

The main objective of this project is to create a prototype of a system that prevent possible vehicular accidents by detecting sign of distraction and drowsiness on the driver using machine learning and image processing. This project aim to provide a microcomputer-based alert system to notify the driver whenever it detects signs of distraction and drowsiness. In addition, the system monitored and log the driver's activity when a certain event is detected.

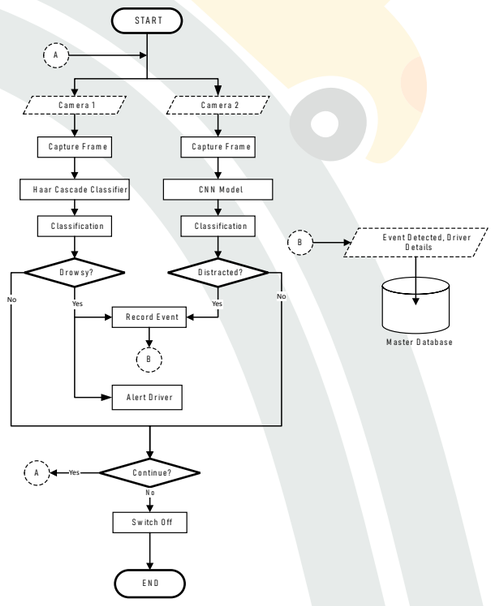
Specific Objectives

1. To develop a program that will alert the subject when it detects signs of drowsiness using image processing.
2. To create a prediction model that will identify distracted behavior using Convolutional Neural Network (CNN).
3. To create a secure database application using C# programming to view the recorded data of detected events from the real-time database.

Significance

The researchers created a system to help individual drivers by providing an extra layer of safety while driving for both anti-distraction and drowsiness detection. The system can be also helpful for businesses on field of trucking and delivery services as well as public transport in ensuring that the driver is in good condition during driving by being aware on their driving behaviors. In addition, this project may be significant for certain car manufacturers by implementing similar idea on the future design of cars and vehicles to further innovate and improve the safety of the drivers.

Methodology and Design



The project consists of different approach or methods to made the Smart-Anti distraction and Drowsiness alert system working and reliable. The setup was composed of various components such as hardware and software needed by the system to be able to train, test, and ensure the consistency of the system.

The subject is the driver, and the facial features and the driver behavior will be the data used for the study. The setup for the system consists of an input device (camera), the alarm system (Speaker) and the database application. The Raspberry pi will serve as the brain of the system since it handles the image processing and decision making. The camera will act as an input device and provide a live video feed of the subject to the system which will then be processed by the Raspberry Pi. The database application will serve as a user interface to monitor and view records from the system.

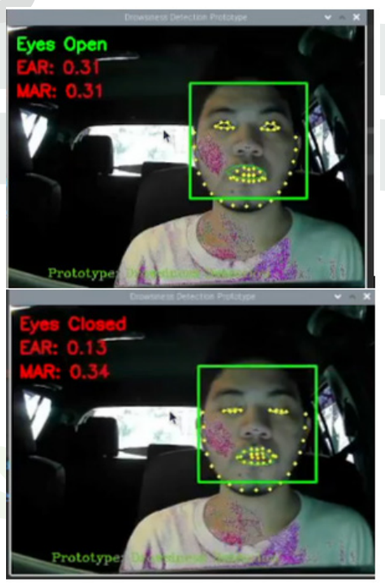
The system for both drowsiness and distraction were setup in a way that the camera will not obstructs the driver's perspective or point-of-view while having an optimal outlook for the system. The camera was connected to a programmed raspberry pi that can be powered by a 12V USB port on a car or a portable battery pack. The raspberry pi can use an external speaker or the sound system of the vehicle itself for

Results and Discussion

Drowsiness Detection

The drowsiness detection of the system works by using image processing and detecting the facial feature and computing both Eye and Mouth Aspect Ratio (EMAR) of the subject. Metronome is a helpful tool or device that produced steady pulse that measured beats per minute to maintain stabilized period of time. Beats per minute (BPM) is a unit used for music in measuring a tempo or typically monitored one's heart rate. In order to test how well the program can detect eye movement, the researchers used Metronome and conducted unique testing counting the duration or the eye closing/opening state of the subject's (driver's) eyes and testing included the combination of eyes state that has partially opened mouth for drowsiness detection to obtain the Eye and Mouth Aspect Ratio (EMAR).

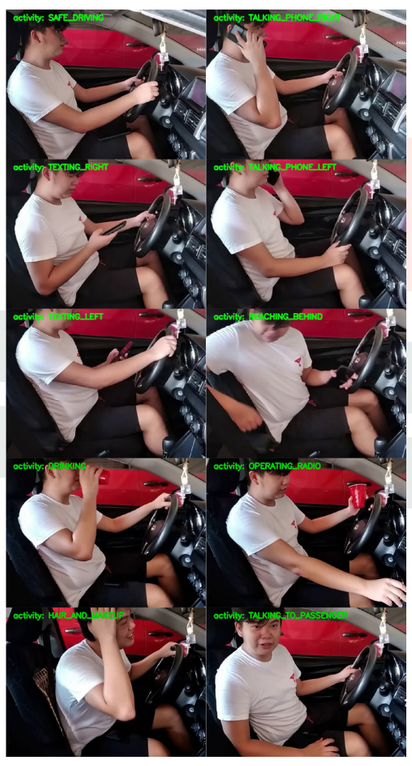
Getting the mean for % difference for 20 trials results to 7.50% difference in terms of the real eye movement count and the blink detected by the system. Also, the researchers also recorded when the alarm would trigger based on the duration of the eye closure of the subject as prior to the previous process. The result shows that, it triggers when the closure of subject's eyes was around 2.86 and triggers earlier than the previous test at around 2.73 seconds when the mouth of the subject was partially opened.



Drowsiness Detection

The researchers have trained the model from scratch using Convolutional Neural Network before using the prediction model. The model was trained using the State Farm Distracted Driver Detection Dataset. The training uses the 17939 samples from the training images for 25 epochs where the sample was divided into 40 batches and was validated using the remaining 4485 samples. By the end of the last epoch, the program output shows the data or values of accuracy and loss of training the created prediction model. Furthermore, the model reached around 99.71% validation accuracy and 2.45% validation loss and the confusion matrix shows that the model can properly predict the label of a training sample and match it with its true label with high enough accuracy The retraining was done for 25 epochs and a batch size of 12 using the same CNN architecture. After retraining the best saved weights, the model manages to achieve a validation accuracy of 99.40% with validation loss of 3.01% that can be seen in the program output.

After successfully retraining the model, the researchers used their own 20 random images compiled in to a video and feed into the prediction model to assess how accurate can it predict a label. The program output was the video rendered with the label on the upper left corner. Having the ratio of 18 out of 20 frames with a correct label, the model at least reached 90% accuracy on the still image test. The prediction model was also tested on a video stream input with continuous motion. The output video then was then exported as an image sequence



Conclusion

The system was developed to alert the subject when it detects signs of drowsiness using image processing and created a prediction model that identify the subject's distracted behavior using Convolutional Neural Network (CNN). For distraction detection, datasets were used to train then eventually test the prediction model. In addition, the created database application logs the records or session through the captured event by the system. It was concluded that the drowsiness detection has a percent difference of 7.50% for detecting eye movement. In addition, based on the gathered data for drowsiness detection having closed mouth, 2.86 seconds or more was the threshold to trigger the alarm. While the mouth of the subject was partially opened, 2.73 seconds or more was the threshold to also trigger the alarm. For distraction detection, Convolutional Neural Network was used to train the model and implemented a dataset called State Farm Distracted Driver Detection to be able to match and align the correctness of the test subject along with the provided dataset. After retraining the model provided by the researchers to the new dataset, all 10 behaviors were accurately predicted by the model and able to detect the tested images.