Journal of Harbin Engineering University Vol 44 No. 8
ISSN: 1006-7043 August 2023

Driver Drowsiness Detection Using Machine Learning

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Abstract
Drowsiness of drivers is one of the significant causes of road accidents. Every year, there is an increase in the amount of deaths and fatal injuries globally. Driving safely depends on ignoring distractions and keeping your eyes on the road. You should take the following actions in order to maintain concentration while driving: Never multitask while driving; pay full attention at all times. Use no electronic devices, including phones, while driving. By detecting the driver's drowsiness, road accidents can be reduced. This paper describes a machine learning approach for drowsiness detection .Future research will advance the science of machine learning. The challenge of assessing and interpreting the volume of data that is growing so quickly is what has led to this development. The foundation of machine learning is the idea that, with the help of this growing data, the best model for the new data may be found among the old data. Therefore, research into machine learning will continue in tandem with the growth of data. The history of machine learning, the techniques employed, the areas in which it is applied, and the research in this area are all covered in this study. The purpose of this study is to educate academics on machine learning, which has recently gained a lot of popularity, and its applications. Face detection is employed to locate the regions of the driver's eyes, which are used as the templates for eye tracking. Finally, the tracked eye's images are used for drowsiness detection in order to generate warning alarms. This proposed approach has three stages: Detecting Face, Detecting Eyes and Detecting Drowsiness .It works by taking images as input from a webcam using the method provided by OpenCV. Then, detect faces in the image and create a Region Of Interest (ROI). Classifier will categorise whether Eyes are open or closed and Calculate Score to check whether Person is Drowsy by comparing it with the threshold value. The model is built with Keras using Convolutional Neural Networks (CNN), Python, HAAR and OpenCV which will alert the driver when he feels sleepy. The average correct rate for eye location and tracking could achieve 95.0% based on some test videos. Thus, the proposed approach for a real-time of driver drowsiness detection is a low cost and effective solution method.

Index Terms

Classifier:
A classifier is the algorithm itself – the rules used by machines to classify data.

Object class identification:
Object class recognition (categorization) is the problem of identifying the class membership (e.g.,a car, a dog, a toy) of an object contained in a photograph.Categorization is to be distinguished from the recognition of particular object instances(e.g., my Toyota Prius, my dog Fluffy, my teddybear).

OpenCV:
OpenCV is a library of programming functions mainly for real-time computer vision.

Enhanced Haar cascade algorithm:
The Enhanced Haar cascade algorithm is a method for detecting objects in photos and classifying them in accordance with their shape and position in the image.

Deep Learning Based Technique:
Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans.

PERCLOS:
PERCLOS is the percentage of eyelid closure over the pupil over time and reflects slow eyelid closures ("droops") rather than blinks. A PERCLOS drowsiness metric was established in a 1994 driving simulator study as the proportion of time in a minute that the eyes are at least 80 percent closed.

Artificial Neural Networks:

ANN is based on a collection of connected units or nodes called artificial neurons,which loosely model the neurons in a biological brain.

Convolutional Neural Network(CNN):

A type of artificial neural network used most frequently to analyse visual imagery in deep learning is called a convolutional neural network.

Introduction

In the world of higher travelling and shipping of goods, there are increasing chances for the drivers to feel sleepy. The risky combination of driving, sleepiness, and exhaustion is known as drowsy driving. This typically occurs when a driver has not had enough sleep, but it may also occur as a result of untreated sleep problems, drugs, alcohol use, or shift work. No one can pinpoint the precise moment when sleep overtakes their body. Although falling asleep at the wheel is risky, being sleepy has an impact on your ability to drive safely even though you are not asleep. To avoid accidents caused by sleepiness, we'll use Python, OpenCV, and Keras to create a framework that will alarm the driver when he feels sleepy. Face recognition is the process of recognising and interpreting people's faces. Automatic face detection and recognition have exploded in popularity in the military and other top-secret organisations in recent years. When there are few examples and it is difficult to collect photos for the dataset, training becomes extremely difficult. There are a variety of methods for extracting features from a face today .This proposed approach has three stages: Detecting Face, Detecting Eyes and Detecting Drowsiness .The use of multilayer convolutional neural networks to generate features responsible for decision-making provides a new perspective on individual drowsiness recognition. After good eye detection and tracking using computer vision and deep learning techniques, the mentioned model alerts drowsy drivers with an alarm .

Historical Analysis:

The previous method primarily used two cameras, one to track head movement and the other to track facial expressions. It may take a while to combine and analyse all the data. As these sensors are attached to the driver's body, they may have an adverse effect on the driver, which is another drawback of using sensors to record body motions. A significant drawback of the haar cascade technique is the potential for false face detection in an image. It will take a lot of time adjusting the cv2 to recognize faces/humans/objects in OpenCV (and eliminate the false positives). In order to get around these issues, we suggest using this improved Haar cascade technique. Facial features including the lips, nose, and eyes were extracted by the first facial recognition system. These region type features were chosen in order to achieve identification. As a result of this procedure, classifiers were trained on the face and classifier datasets using predefined functions. Due to the small amount of data used, despite being effective, this technique did not produce meaningful outcomes. It overlooks the environment when recognizing faces and concentrates primarily on facial traits. Alshaqaqi et al,proposed a detection strategy that focused on edge detection and took advantage of the symmetry of facial features in order to extract the eyes. The state of the eyes is determined as open or closed by applying the Hough transform to circles and comparing the intersection of the Hough transform and the edge picture with a threshold. The drowsiness level is then assessed using the Percentage of Eyelid Closure (PERCLOS), a scientifically associated indicator of drowsiness associated with infrared light of various wavelengths. Two pictures of the driver's face are taken at fixed wavelengths. The difference between these images is used to figure out how many eyes are closed. A neural network is used in the second approach, which is still in its infancy, to identify the best driver output variable combinations for PERCLOS prediction. The system captures the video using a remote camera that has near-infrared lighting. The eye area of interest is located using an anthropometric parameter, and a face is located using the Haar object detection technique. Eye closure is determined by comparing the closed portion of the eye to the average height of the open portion. A tool for real-time driver blinking tracking was developed using motion picture analysis. There

are several methods for figuring out how drowsy the driver is. They are divided into three categories: artificial neural networks, image processing, and electroencephalography. Additionally, there are options for processing images based on templates, yawning patterns, and eye blink measurements.

In addition, a method based on the blink time has been developed for predicting consciousness loss. The blinking waveforms of distinct individuals and of the same person over time vary.With ten subjects, the flicker extraction rate has expanded from 16% to 70 percent, and we could possibly anticipate the level of cognizance. In contrast to conventional methods that rely solely on eye states, face expressions are used to detect sleepiness. There are a number of issues with detection systems. Changes in power due to lighting conditions, the presence of glasses, and the presence of facial hair growth on the individual's face are huge elements. A new study is trying to figure out if the drivers' red eyes are from not getting enough sleep. The stable blood vessel structure of the sclera, the white outer layer of the eye, can be used to identify individuals. This study focuses on the eye's external shape and the iris region.Three levels of eye recognition were used in another method for identifying the iris-sclera pattern.In the initial phase of the face detection procedure,techniques such as template matching and elliptical approximation were utilised. In the third level, the driver's fatigue was evaluated using the percentage of eye closure (PERCLOS) test.

Methodology :

In this approach, OpenCV is used to gather images from a webcam and feed them into a Deep Learning model that will classify if the person's eyes are open or closed in this Python project. For this Python project, we'll take the following approach:

Step 1

Image Acquisition: For demonstration purposes, a webcam will be used to capture images in an infinite loop.

Step 2

Region of Interest (ROI) Detection Eye: The face will be detected first, followed by the face, and finally our region of interest, the eyes. Since a colour image isn't required for this, the image will be converted to grayscale. To detect faces, OpenCV's Haar cascade classifier will be used.

Step 3

Observation of the eye: We'll be looking at a series of pictures to see if they're blinking quickly, concentrating their eyes to one side, or if they've closed their eyes.

Step 4

Warning the driver: If any drowsiness is detected in this step, an alarm sound will be produced to alert the driver.

The model consists of Keras and Convolutional Neural Networks (CNN). A convolutional neural network is a type of deep neural network that performs exceptionally well when it comes to image classification. A CNN is made up of three layers: an input layer, an output layer, and a hidden layer of several layers. These layers are convolution using a filter that performs 2D matrix multiplication on both the layer and the filter.

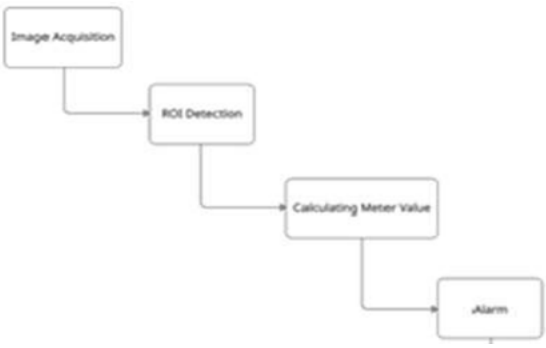


Fig. Architecture Diagram

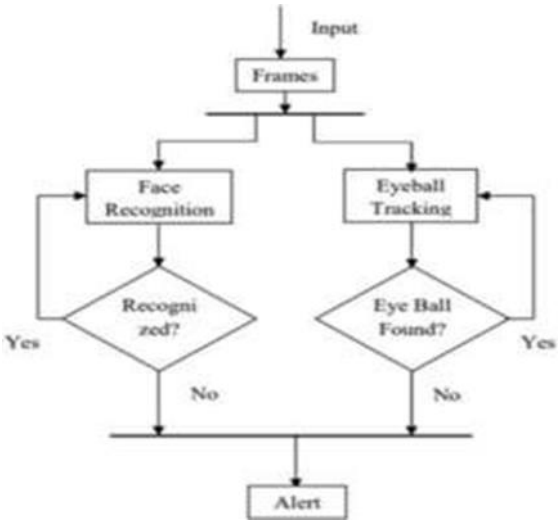


Fig. 2: Data Flow Diagram

Fig.3: System Diagram

Testing:

The table below shows the three test cases that will be faced when working on this project that are related to the driver's sleepiness.

TestCases	EyesDetected	EyesClosed	RESULT
CASE1	NO	NO	NoResult
CASE2	YES	NO	NoAlarm
CASE3	YES	YES	Alarm

When the driver's eyes are closed for longer than a predetermined number of edges, we can assume that they are weary. These cases are now identified, and a warning is issued.

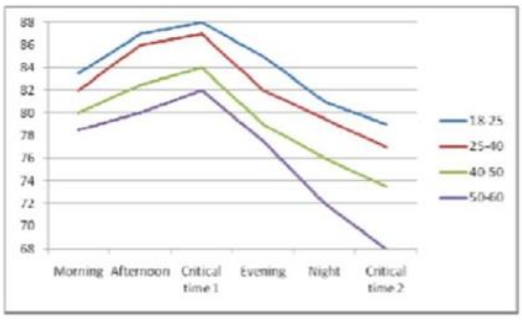
Results And Discussions:

We applied the concepts of enhanced haar cascade algorithm and CNN for using the laptop's built-in webcam for this project. When driver drowsiness is detected, the system's built-in speaker is used to deliver sound output to awaken the driver. The framework was tested on a variety of people in both daylight and nighttime illumination scenarios.

Serial No.	Eye Detection accuracy	Drowsiness Accuracy
Sample 1	80%	62.5%
Sample 2	75%	83.34%
TOTAL	75.5%	81.5%

Table. Result Table

Throughout the test method, every volunteer for the experiment will be asked to act lethargic and squint repeatedly.This detection device enables early identification of a reduction in driver alertness while driving and offers a non contact technique for evaluating various levels of driver attentiveness. When this happens when weariness is found, a warning signal is sent to the driver to let them know.



We come to the conclusion that one could accurately assess a driver's level of tiredness by developing a hybrid drowsiness detection system that combines non-intrusive physiological monitoring with other measurements. If a driver who is considered to be drowsy receives an alarm, many accidents on the road may be prevented.

Conclusion And Future Work:

Using the concepts of enhanced haar algorithm and convolutional neural networks technology for developing a representation learning-based method for identifying drivers dizziness is the focus of this project. A fresh perspective on driver dizziness detection is provided by the generation of decision- making features by means of multi-layer convolutional neural networks. The described model gives drowsy drivers an alarm after successfully detecting and tracking their eyes using computer vision and deep learning techniques (CNN and Keras and enhanced haar algorithms) with an accuracy of 88.5%. Using a carefully selected dataset, a model was developed to identify facial features. The focus of our investigation was then the removal of the eyes from the face.

When determining whether a driver's eyes were open, this was used. If they were closed for more than 15 seconds, an alarm would go off. A message is sent to the driver's emergency contact if the alarm is not turned off within twenty seconds. Sleep deprivation and exhaustion-related road accidents will decrease as a result of this. Additionally, we may offer a function that notifies the emergency contact of the driver's location. The contacts may be able to send an ambulance or other form of assistance if necessary.

Using the enhanced haar cascade algorithm helps to overcome the disadvantages of the prior algorithm and helps to achieve accuracy.

Acknowledgement:

Our work on the "Driver Drowsiness Detection System" project provided us with a wealth of information and invaluable expertise. We appreciate the strong moral support and encouragement from our honourable professor Mr.S.Jegadeesan.

References:

1. Vinay Kalisetti,Vamsi Sai Chandra Vasarla; Sujeeth Babu Kolli; Rakesh Varaparla ``Analysis of Driver Drowsiness Detection Methods" 2023 Second International Conference on Electronics and Renewable Systems (ICEARS) on 05 April 2023.

2. Jagannath E. Nalavade; Rutuja Sanjay Patil "Driver Drowsiness Detection System Using Deep Neural Network"2022 3rd International Conference on Computing, Analytics and Networks (ICAN) on 18-19 November,2022.

3. A. Raorane, H. Rami and P. Kanani, "Driver Alertness System using Deep Learning, MQ3 and Computer Vision," 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2020.

4. H.Joseph and B. K. Rajan, "Real Time Drowsiness Detection using Viola Jones & KLT," 2020 International Conference on Smart Electronics and Communication (ICOSEC), Trichy, India.

5. K. S. Sankaran, N. Vasudevan and V. Nagarajan, "Driver Drowsiness Detection using Percentage Eye Closure Method," 2020 International Conference on Communication and Signal Processing (ICCSP),Chennai, India, 2020.

6. S. Kailasam, M. Karthiga, R. M. Priyadarshini, K. Kartheeban and K. Anithadevi, "Accident Alert System for Driver Using Face Recognition," 2019 IEEE International Conference on Intelligent Techniques in Control, Optimization and Signal Processing.

7. A. Walavalkar, S. Singh, R. Salian and V. Shrivastava, "Driver Distraction Monitoring and Alerting System," 2019 1st International Conference on Advances in Information Technology(ICAIT), Chikmagalur, India, 2019.

8. S. Mohanty, S. V. Hegde, S. Prasad and J. Manikandan, "Design of Real-time Drowsiness Detection System using Dlib," *2019 IEEE International WIE Conference on Electrical and Computer Engineering (WIECON-ECE)*, Bangalore, India, 2019.

9. Ahmed, Javed et al. “Eye behaviour based drowsiness Detection System.” *2015 12th International Computer Conference on Wavelet Active Media Technology and Information Processing (ICCWAMTIP)* (2015): 268-272.

10. “A Survey on Driver Cognitive Distraction Detection” done by P.Suresh Babu, R.Dhivya,VCET-International Journal of Research (IJR) April 2015, Using Sensor, Bluetooth, NFC, wearable, PERCLOS was developed.