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IJIEMR Transactions, online available on 28th Feb 2023. Link :http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue 02

DOI: 10.48047/IJIEMR/V12/ISSUE 02/84

Title **Drowsiness Detection**

Volume 12, ISSUE 02, Pages: 550-557

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Drowsiness Detection

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Abstract
One of the main causes of traffic accidents all around the world is driver inattentiveness. Anyone can experience drowsiness when operating a motor vehicle, whether it's from physical exhaustion, inadequate sleep, or lengthy travel. Major effects of inactivity or sleepiness include slower reaction times, lack of coordination, and delayed responses from drivers, all of which increase the risk of accidents, serious injuries, and even fatalities. Drowsy driving is a factor in over 1,000,000 crashes that the authorities are made aware of each year. As the population has grown, so has the frequency of traffic accidents. Due to this, numerous studies have been conducted on the development of systems that can detect drowsiness, inactivity, or driver tiredness and alert the motorist in advance, preventing them from dozing off and causing an accident. The suggested approach is to create a model using computer vision and convolutional neural networks to identify driver intoxication. The system can locate the eye by using the trained model's detection of facial areas. The suggested framework determines that a motorist is feeling sleepy if their eyelids are closed for a predetermined amount of time and sounds an alarm. The study also uses the HAAR cascade technique, which works with OpenCv and CNN, to classify images after face identification in order to discover the region of interest (RoI) specifically designed using Keras. The categories are right eye opened, right eye closed, and left eye opened, respectively. The trained model anticipates the driver's state and warns them, keeping them from dozing off and encouraging them to concentrate on driving.

Keywords: Drowsiness, Computer Vision, Keras

Introduction

On an average 1200 road accidents record daily in India out of which 400 leads to direct death and rest gets effected badly. Car accident is the major cause of death in which around 1.3 million people die every year. Majority of these accidents are caused because of distraction or the drowsiness of driver. The countless number of people drives for long distance every day and night on the highway.

Drowsiness appears in situations of stress and fatigue in an unexpected and inopportune way, and it may be produced by sleep disorders, certain type of medications, and even, boredom situations, for example, driving for a long time. In this way, drowsiness produces danger situations and increases the probability that an accident occurs. In this context, it is important to use new technologies to design and to build systems that will monitor drivers, and measure their level of attention throughout the whole driving process. In the proposed system, a camera is used to record user's visual characteristics. We use face detection and CNN

techniques and try to detect the drowsiness of driver, if he/she is drowsy then alarm will be generated. So that the driver will get cautious and take preventive measures. Driver drowsiness detection contributes to the decrease in the number of deaths occurring in traffic accident.

A computer's vision-based thoughts concept has been used for creating this Drowsy Driver Detection System. The camera being the initial point of the system by providing the live feed of the driver to the framework that concentrates it straight towards the face of driver and checks the driver's eyes with a particular objective to catch drowsiness of the driver. On analysing the live video an alert is issued to the driver in circumstances where drowsiness is outcome of the analysis. The proposed method is to develop a model using Convolutional Neural Networks, Computer Vision to detect drowsiness of drivers. The trained model finds the facial spots, which helps the system to identify where the eye's location. If the eyes of driver are closed for a specific amount of time, the proposed framework draws a conclusion that the driver is feeling drowsy and an alarm is alerted.

The work also implements a categorization of right_eye and left_eye as right_eye_opened, right_eye_closed and left_eye_opened, left_eye_closed by using the Haar cascade algorithm which works with OpenCV and CNN is used for image classification after face detection to find the region of Interest (RoI) purpose built with keras. The trained model predicts the driver's condition and alerts him/her thus preventing them from falling asleep and pushing them to focus on driving.

Problem statement & Objectives

Traffic accidents due to human errors cause many deaths and injuries around the world. The major cause of these accidents is drowsiness of the driver due to sleeplessness or long driving hours. There is need for a system developed with the technologies that are available today which can overcome this situation. The aim of this system is to reduce the number of accidents by developing a model which can generate an alert if the driver is feeling drowsy so that the driver can become aware and take necessary actions.

Objectives

Driver drowsiness detection is a car safety technology which helps to save the life of the driver by avoiding mishaps when the driver is feeling tired.

- The primary goal is to initially plan a framework to distinguish driver's sluggishness by persistently checking retina of the eye.
- The framework works disregarding driver wearing displays and in different lighting conditions.
- To caution the driver on the identification of laziness by utilizing ringer or alert.
- Speed of the vehicle can be reduced.
- Traffic management can be maintained byreducing the accidents.

Literature Survey

Title: Drowsiness Detection System Utilizing
Physiological Signals. Author:
Trupti K. Dange, T. S. Yengatiwar.
Summary: The Physiological parameters-based techniques detect drowsiness based on drivers' physical conditions such as heart rate, pulse rate, breathing rate, respiratory rate and body temperature, etc. These biological parameters are more reliable and accurate in drowsiness detection as they are concerned with what is happening with driver physically. Fatigue or drowsiness, change the physiological parameters such as a decrease in blood pressure, heart rate and body temperature, etc. Physiological parameters-based drowsiness detection systems detect these changes and alert the driver when he is in the state, near to sleep.

Title: Drowsiness Detection with OpenCV (Using Eye Aspect Ratio)
Author: Adrian Rosebrock.
Summary: A real-time algorithm to detect eye blinks in a video sequence from a standard camera is proposed. Recent landmark detectors, trained on in-the wild datasets exhibit excellent robustness against a head orientation with respect to a camera, varying illumination and facial expressions. We show that the landmarks are detected precisely enough to reliably estimate the level of the eye opening. The proposed algorithm therefore estimates the landmark positions, extracts a single scalar quantity – eye aspect ratio (EAR) – characterizing the eye opening in each frame.

Title: Real Time Driver Fatigue Detection Based on SVM Algorithm.
Authors: Burcu Kir Savas, Yasar Becerkli.
Summary: In this study, SVM based driver fatigue prediction system is proposed to increase driver safety. The proposed system has five stages: PERCLOS, count of yawn, internal zone of the mouth opening, count of eye blinking and head detection to extract attributes from video recordings. The classification stage is done with Support Vector Machine (SVM). While the YawDD dataset is used during the training phase of the classification, real-time video recordings are used during the test phase.

Title: Driver drowsiness detection using ANN image processing.
Authors: T. Vesselenyi1 , S. Moca1 , A. Rus1 , T. Mitran1 , B. Tătaru1.
Summary: The study regarding the possibility to develop a drowsiness detection system for car drivers based on three types of methods: EEG and EOG signal processing and driver image analysis EEG (Electroencephalography) and EOG (Electrooculography) signals measurement and on the eye state (closed or opened) image classification. The EEG method monitors the brain activity through a sensor placed on a specific part of the scalp, The EOG method tracks the eye movements by measuring the signals from the muscles which are acting on the eye The eye image analysis can monitor the opened or the closed state of the eye.

Paper 5 Title: Live drowsiness detection using image processing and deep learning
Authors: Mukesh Prasad, E.Raju, P. Malavika, K. David Raju
Summary: Driver fatigue and drowsiness are some of the prime reasons for road accidents around the globe. Anyone can become a victim of drowsiness while driving after tiring physical conditions, short periods of sleep, or during long journeys. Drowsiness or inactivity causes effects driving in these couple of major areas. It increases reaction time, loss of coordination which makes drivers respond late which may result in an occurrence of accidents, several injuries, may loss of people. Every year more than 1,000,000 police-reported crashes involve drowsy driving. The occurrence of road accidents has been increasing, with the rise in population. Due to this, various studies were done in designing systems that can examine inactivity and drowsiness or driver fatigue and alert him/her beforehand thus preventing them from falling asleep and causing an accident. Our proposed method is to develop a deep learning algorithm using Convolutional Neural Networks, Computer Vision to detect drowsiness of drivers. The trained model predicts the driver's condition and alerts him/her thus preventing them from falling asleep and pushing them to focus on driving.

System Design

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.

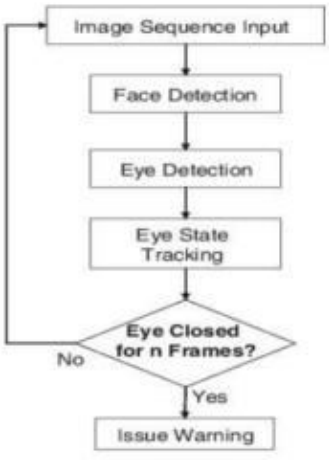

Fig: 4.1 System Design

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Proposed Methodology

The existing system used Support Vector Machine (SVM) for classifying the face (if the eyes ae closed or not) as drowsy or not drowsy. To separate the two classes of data points, there are many possible hyperplanes that could be chosen. The objective of SVM is to find a plane that has the maximum margin, i.e., the maximum distance between data points of both classes. In this system, instead of Support Vector Machine (SVM) we use a Classification Model based on Convolutional Neural Networks (CNN). Deep Learning is concerned with algorithms inspired by the structure and function of the brain called artificial neural networks. Convolutional Neural Networks are a type of Artificial Neural Networks which are widely used for image classification. Convolution layers in a CNN consist of a set of learnable filters. The driver's face is continuously captured using a camera. The image frames are extracted and by face detection, the face of the driver is detected. A classification model is built based on CNN to classify the face as drowsy / not drowsy. The trained model finds the facial spots, which helps the system to identify where the eye's location. If the eyes of driver are closed for a specific amount of time, the proposed framework draws a conclusion that the driver is feeling drowsy and an alarm is alerted.

Modules

Face and Eyes Detection Module:

The 'haar cascade files' which works with OpenCV to classify the face, left_eye and right_eye is been used. The model folder contains my model file "cnnCat2.h5" which was trained on convolutional neural networks, so the best weights are already obtained for the model. Working of Haar algorithm: This algorithm uses Haar features to extract objects.

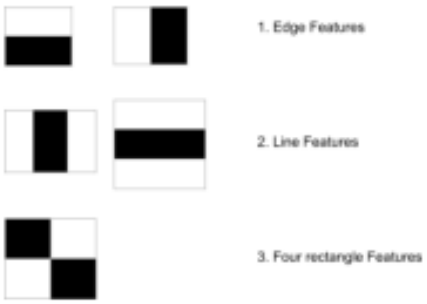

Fig: 4.2 Haar Features

A Haar-like feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums. This difference is then used to categorize subsections of an image.

The Classification Module:

In this module, we build a Deep Learning Binary Classification model to classify the images as alert / drowsy. We used sequential model. In machine learning, classification refers to a predictive problem where a class label is predicted for a given example of input data. A model will use the training dataset and will calculate how to best map examples of input data to specific class labels. Convolutional Neural Networks, or CNNs, were designed to map image data to an output variable. The benefit of using CNNs is their ability to develop an internal representation of a two-dimensional image. A convolution is essentially sliding a filter over the input. Each convolutional layer contains a series of filters known as convolutional kernels. The filter is a matrix of integers that are used on a subset of the input pixel values. Each pixel is multiplied by the corresponding value in the kernel, then the result is summed up for a single value for simplicity representing a grid cell, like a pixel, in the output channel/feature map.

"Model.py" file contains the program through which the classification model is built by training on dataset. The implementation of convolutional neural network can be seen in this file. The model used is built with Keras using Convolutional Neural Networks (CNN). A

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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 which can have multiple numbers of layers. A convolution operation is performed on these layers using a filter that performs 2D matrix multiplication on the layer and filter.

Predicting the images captured from the camera:

After the model is trained with the given dataset, we can use the model to predict the class of the images which are captured from the camera. We use OpenCV to capture the images from the camera. We continuously capture image frames from the camera. The same pre-processing steps which are applied on the dataset are applied on each frame captured i.e., detecting the face from the image frame, extract the Region of Interest and then resizing the Region of Interest to a fixed size (100x100). Then we convert the images into array format to give as input to the model. Then, we can give a set of images to the trained CNN Classification model to predict the labels for the images. If the driver is feeling drowsy, a voice alert is generated. An audio file is played using the playsound module in python. An audio clip "alarm.wav" which is played when the person is feeling drowsy.

System Architecture

OpenCV is been used for gathering the images from webcam and feed them into a Deep Learning model which will classify whether the person's eyes are 'Open' or 'Closed'. The steps involved are as follows:

Step 1: Take image as input from a camera and read it using OpenCV.

Step 2: Detect the face in the image and create a Region of Interest (ROI) using Haar algorithm.

Step 3: Detect the eyes from ROI and feed it to the CNN classifier.

Step 4: The CNN classifier will categorize whether eyes are open or closed.

Step 5: Calculate score to check whether the person is drowsy (If the eyes are close for above 20 seconds the alarm will ring).

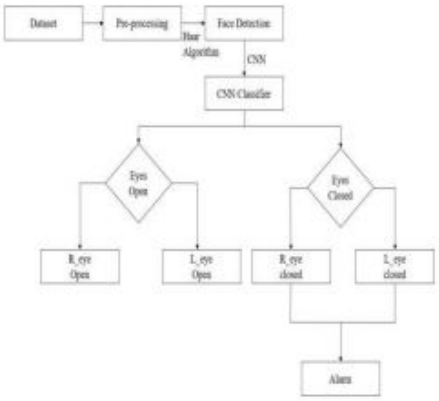

Fig:4.3 System Architecture

Implementation

Artificial Intelligence

A branch of computer science dealing with the simulation of intelligent behavior. Artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Artificial Intelligence (AI) is the study and creation of computer systems that can perceive, reason and act. The primary aim of Al is to produce intelligent machines. The intelligence should be exhibited by thinking, making decisions, solving problems, more importantly by learning. Al is an interdisciplinary field that requires knowledge in computer science, linguistics, psychology, biology, philosophy and so on for serious research.

Machine Learning

A subset of AI that uses computer algorithms to analyse data and make intelligent decisions based on what it haslearned, without being explicitly programmed. Machine Learning is defined as the study of computer programs that leverage algorithms and statistical models to learn through inference and patterns without being explicitly programmed. Machine Learning field has undergone significant developments in the last

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decade. Machine learning focuses on the development of computer programs that can access data and use it to learn for themselves.

Deep Learning

A specialized subset of machine learning that uses layered neural networks to simulate human decision making. Deep learning is an AI function that mimics the workings of the human brain in processing data for use in detecting objects, recognizing speech, translating languages, and making decisions. Deep learning AI is able to learn without human supervision, drawing from data that is both unstructured and unlabelled. It is a form of machine learning, can be used to help detect fraud or money laundering, among other functions

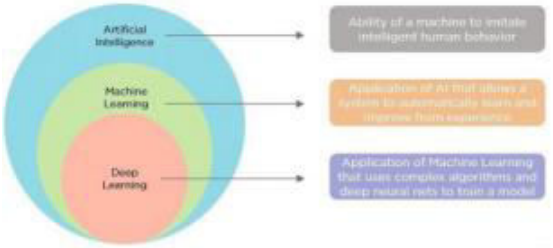

Fig: 5.1 AI,ML,DL

Neural Networks

Neural networks are a computational model that shares some properties with the animal brain in which many simple units are working in parallel with no centralized control unit. The weights between the units are the primary means of long-term information storage in neural networks. Updating the weights is the primary way the neural network learns new information. Components of a typical neural network involve neurons, connections, weights, biases, propagation function, and a learning rule. Neurons will receive an input from predecessor neurons that have an activation, threshold, an activation function f, and an output function. Connections consist of connections, weights and biases which rules how neuron i transfers output to neuron j. Propagation computes the input and outputs the output and sums the predecessor neurons function with the weight. The learning rule modifies the weights and thresholds of the variables in the network.

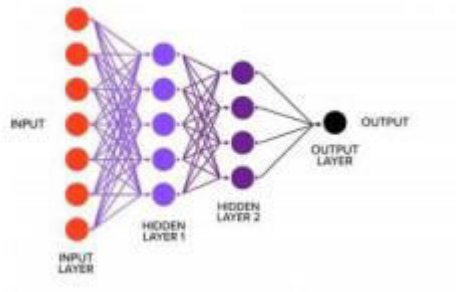

Fig: 5.2 Neural Networks

Convolutional Neural Networks (CNNs)

The goal of a CNN is to learn higher-order features in the data via convolutions. They are well suited to object recognition with images and consistently top image classification competitions. They can identify faces, individuals, street signs, platypuses, and many other aspects of visual data.

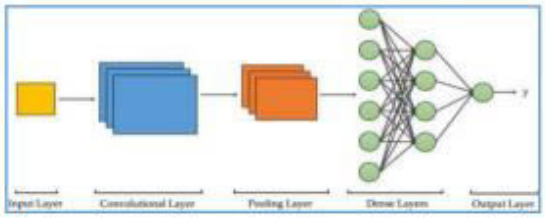

Fig: 5.3 Convolutional Neural Networks

Libraries used

Tensorflow - It is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks. TensorFlow's popularity is due to many things, but primarily because of the computational graph concept, automatic differentiation, and the adaptability of the Tensorflow python API structure.

Keras - It is an open-source software library that provides a Python interface for artificial neural networks. Keras acts as an interface for the TensorFlow library. Keras is the best platform out there to work on neural network models. The API that Keras has a user-friendly where a beginner can easily understand. Keras has the advantage that it can choose any

libraries which support it for its backend support. Keras provides various pretrained models which help the user in further improving the models the user is designing.

NumPy - NumPy stands for Numerical Python. It is a library for the Python programming language, adding support for large, multi-dimensional arrays and various derived objects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation and matrices, along with a large collection of high-level mathematical functions to operate on these arrays.

OpenCV - It is a Python library that allows you to perform image processing and computer vision tasks. It provides a wide range of features, including object detection, face recognition, and tracking. OpenCV is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.

Experimental Analysis and Results
Result with eyes open

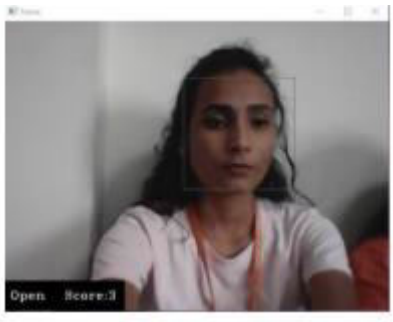

Fig: 6.1 Prediction - Eyes Open, No alarm

Eyes closed

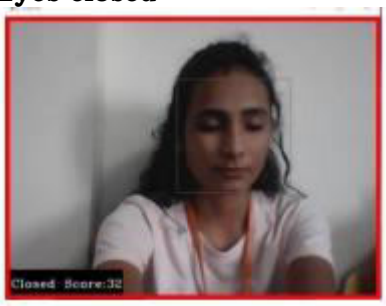

Fig: 6.2 : Prediction - Eyes Closed, if the score is greater than 10. Rings an alarm

Left eye closed Right Eye Opened

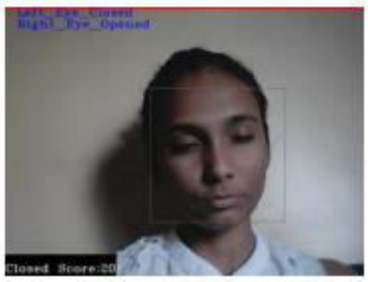

Fig: 6.3 : Eyes Open or closed classification

Conclusion

Drowsiness or inactivity causes effects in major areas as it increases reaction time, loss of coordination which makes drivers respond late which may result in an occurrence of accidents, several injuries, may loss of people. The trained model finds the facial spots, which helps the system to identify where the eye's location. If the eyes of driver are closed for a specific amount of time, the proposed framework draws a conclusion that the driver is feeling drowsy and an alarm is alerted. There are limitations to this technology, such as obstructing the view of facial features by wearing sunglasses and bad lighting conditions. However, given the current state, there is still room for performance improvement and better facial feature detection even in bad lighting conditions. Thus, we have successfully designed a prototype drowsiness detection system using OpenCV software and Haar Classifiers. The system so developed was successfully tested, its limitations identified and a future plan of action developed.

The work can be extended in special situations like when a driver wears spectacle along with mask by utilizing the physiological reading of the driver. The drowsiness detection of the driver can be viewed more accurately with these readings. In future, planned to find out the accuracy, precision, recall of the proposed work along with comparison to other artificial intelligence algorithms. Other than that, a generalized model for the same work can be implemented.

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