Driver Drowsiness and Distraction Detecting System

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ABSTRACT

Drowsiness can be depicted as a characteristic state where the body is encountering significant change from an attentive state to a napping state. At this stage, a driver can lose attention and will not be able to do activities, for instance, avoiding head-on accidents or slowing down fortunately. There are obvious signs that can suggest whether a driver is tired or not, like, frequent yawning, and inability to keep eyes open etc. Face composition also changes because of the blood circulation system. This research work aims to create a nonintrusive framework that can separate the facial landmarks spots of the driver using the Region of Interest and learn the eye perspective extent and sort the eyes as closed or open.

Keyword : - *Drowsiness detection prediction, CNN classifier, deep learning*

1. INTRODUCTION

The growth in the population of automobiles is at a faster pace than the economic and community growth. The role of drivers in transporting commodities through road means from long distance tirelessly is really appreciable and hence their security is also a major concern. Hence, a system is highly required where the drowsiness of the driver is determined and an alert is provided to him at the first instance. Upon prolonged drowsiness, automatic speed reduction can be enabled thus reducing the intensity of the accident to occur. With an increasing number of vehicles, the complexity in driving as well as the cognitive sense drives up [1]. Accurate eye status detection method is very important for drowsiness detection [2]

There is extensive genuine confirmation that focuses on driver sleepiness as a fundamental factor of accidents all over the world. Driving for continuous intervals of time can result in mishaps if rest isn't taken.

A highly recommended approach is to design a deep cascaded convolutional neural network (DCCNN) to detect the face region from live video [4]. Then the convolutional neural network is used to determine the drowsiness of the driver and thereby providing an alert to the user detecting signs of fatigue or a state close to sleep and loss of driver care [7].

Subsequently, this approach that relies upon a Deep Learning can be completed on Android applications with high accuracy and henceforth can be facilitated into driver assistance frameworks. Several structures are open on the market yet the assembling is exorbitant and thus normal individuals can't afford it.

2. LITERATURE SURVEY

Zhuang et al [2] focused on the fatigue detection using pupil and iris segmentation by the percentage of eyelid closure. The technique used was bidirectional convolutional neural network and Fatigue has been determined using the eyelid closure ratio. Upon using Fully Connected Network (FCN) accuracy of 91% has been obtained. FCN has been used to determine the drowsiness accurately. One advantage of this methodology is that the Training dataset has variety of eye images which helps to determine accurately.

The authors in [8] proposed Drowsiness detection system, named Drowsiver, that was developed for a mobile electroencephalograph (EEG) and a mobile phone. The signal is transmitted to the Android mobile application via Bluetooth and will give an alarm notification if the drowsiness is detected. The brainwave from the mobile EEG is processed using Fast Fourier Transform (FFT) to extract its features. These features are classified using K-Nearest Neighbor (KNN) classifier. The system produces the best performance with the highest accuracy of 95.24% using the value of k=3.

A deep learning approach to detect drowsy drivers in real time suggested VGG- 16 CNN algorithm that tracks the driver’s eyes and feeds it into a pre-trained that predicts the state of the eye. Once the prediction is obtained, it would be able to detect if the driver is drowsy or not. This paper deals with providing a model with VGG – 16 CNN and EAR. The accuracy obtained was 94.17% which is ideal for real time analysis [9].

Nikolskaia, Kseniia ,Bessonov et al[7] used Histogram of Oriented Gradients in order to Monitor the eyes of the driver and to release an alarm when he/she is drowsy. As a result of this analysis, the system will determine if the subjected user is able to drive or not. The system draws the data from the data source and detects the drowsiness although the results and analysis of Yawning is not being monitored in this paper.

The authors in [4] proposed methods in Detecting the drowsiness of driver in two modules namely online and offline by making use of Support Vector Machine and Convolutional Neural Networks. The results were quite promising that around 94.8% accuracy has been obtained. Authors in [6] suggested a method in which Driver sleepiness is detected and the information is passed in the telegram group along with the co-ordinates. The proposed system is split into two different modules. The first one is used to detect the drowsiness and the second is used to add the data to the server and provide notification regarding the same. This paper provides notifications post accidents and the data needs to be obtained from the server through telegram channel. The SVM model built gave a good percentage of accuracy score.

In [5] detection system for drivers in real-time, studied on the usage of face detector API and Kstar where Drowsiness is detected using Heart Rate Viability (HRV) using heart beat sensors and Bluetooth module. Google API has been employed and the application is deployed in android based smartphone. Accuracy of about 95.59% has been obtained. Even though Comparative study of various algorithms and implementation of Google API were studied, the paper lacks the detection of the face in absence of illumination.

The authors in [3] dealt with a system in which Drowsiness and Alcohol in air is detected. Drowsiness is detected using EAR & MAR ratio and Alcohol in air is detected using microcontroller .On the other hand Face Detection is mainly used for the identification and EAR, MAR ratio and Alcohol sensor is used to detect the alcohol content in air .SVM and ANN were the main techniques used in the paper and Accuracy of 92% has been achieved. Detecting the alcohol in air is an extra advantage to determine the drowsiness of the driver. Unfortunately, there was no common database for comparing the results.

Another study in [12] proposed Image Smoothening techniques through which the Driver’s fatigue is determined using different modules like eye closing modules, head lowering modules and complexity modules. The system described in this paper covers two aspects of drowsiness of a driver - eye closing and head lowering. Both of these aspects are monitored by the camera and are detected using two different modules on the FPGA and are processed parallelly. If the system detects either one of the two aspects it will alert the driver using an alarm and vibration. The paper also deals with the study of Prototype of model using Arduino and MATLAB.

The study mentioned in [13] proposed a system in which Drowsiness is determined using various measurement scales like vehicle-based measures, steering wheel movement etc. They used the concepts of Epworth sleepiness scale and Karolinska Sleepiness Scale thereby taking into account of the Behavioral characteristics of the driver as well which is an extra advantage.

3. PROPOSED SYSTEM AND ITS BENEFITS

The aim of this research is to analyze the driver's drowsiness in real time and providing initial alert system. Upon consistent drowsiness, enabling automatic speed reduction and halting the vehicle by the side of the road. To be able to detect the eyes from the image and accurately classify the state of eyes either closed or open and to provide a warning to the driver if drowsiness is detected is the ultimate aim.

The objective of this system is to build a drowsiness detection system that will detect a person's eyes are closed for few seconds. Then the system will alert the driver by using sound alert when drowsiness is detected. Major benefits of the proposed model are that after the first sound alert, if the driver continuously closes his eyes then the system gradually slows down the speed of the engine and this helps to reduce the intensity of the damage at the worst case.

4. SYSTEM REQUIREMENTS

Camera is used to continuously capture the face image and feed it into the model to determine whether the user is feeling drowsy or not. It is used as the input to the system.

Detection is carried out by using OpenCV. The major functions are converting the color image into gray scale, detection of face from the entire image and detection of eyes from the face. [8]

CNN classifier is used to detect whether the driver is drowsy or not. CNN classifier gets the image of the eye and it classifies it as open or closed. Based on the assigned threshold value, the system decides whether the driver is drowsy or not. ReLU activation function is used entirely and SoftMax is implemented only for the output layer.

An alert system plays a crucial role here. Once the score crosses the threshold value, the alert begins from the system. There exist two types of alert, first one is just an alert by using sound and second one, providing continuous sound and engine speed reduction. The system diagram for the experimentation with the processes involved are mentioned in Fig-1.

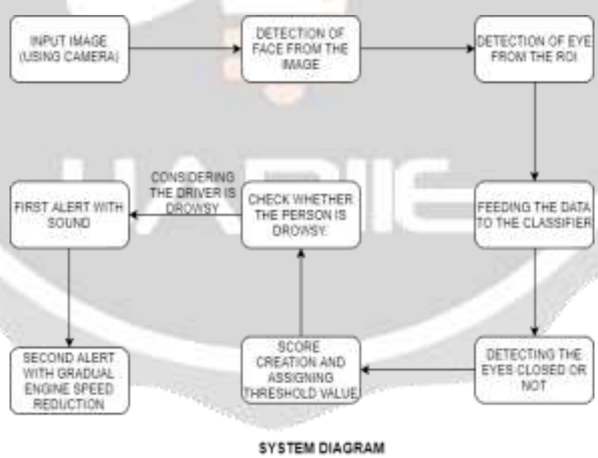

Fig- 1: System diagram

5. ALGORITHMS AND RELATED DATA STRUCTURES

The landmark points extricated from images will go about as the input to the calculation, as shown in Algorithm 1, in view of CNN. During this progression, the training process will result where there will be different predictions from which a model will be framed; revisions are made to the model if the predictions turn out badly. The training will be executed till the required degree of precision is reached. At last, the algorithm can choose if the driver is sleepy or not. The algorithm for the Driver Drowsiness system is provided below.

Input: Image from the camera
1. Loading the image into the model

2. Recognizing Region of Interest (ROI) (detecting the face) from the input using OpenCV algorithm
3. Recognizing eyes from ROI using OpenCV algorithm and feeding it into the classifier
4. Defining neural networks

· Convolution Layer: 32 nodes, kernel size: 3
· Convolution Layer: 32 nodes, kernel size: 3
· Convolution Layer: 64 nodes, kernel size: 3
· Fully Connected Layer: 128 nodes
· All the layers use ReLU as the activation function except the last output layer in which SoftMax is used.

5. Training the model on the loaded data

Output:

1. When the score value exceeds say (score >15), alert is given in the form of sound
2. When the score value exceeds say (score>20), alert and gradual speed reduction occurs

6. WORKING OF EACH MODULE

- **DETECT THE EYES FROM ROI AND FEED IT TO THE CLASSIFIER**

The same procedure which we followed before to detect the face is only used to detect the eyes. At first, we set the cascade classifier for eyes in leye (left eye) and reye (right eye). Then we detect the eye using left_eye= “leye.detectMultiScale(gray)”. We need to get the grayscale image as the OpenCV takes only grayscale as input. Here we need to get the image of the eyes alone from the entire face. In order to perform the task, we extract the boundary box of the eye and then we pull out the eye image from the frame. We use the code “l_eye = frame [y: y+h, x: x+w]”l_eye contains only the image data of the eye. This data will be fed into our CNN classifier which predicts whether the eyes are closed or open. The same extraction process will be carried out for r_eye.

- **CATEGORIZING WHETHER THE EYES ARE CLOSED OR NOT USING THE CLASSIFIER**

At first, we convert the color image into grayscale using the inbuilt function which is available in the OpenCV [10]. After the color conversion process is completed, we need to resize the image to specific value of the pixels (say 24*24 pixels or 18*18 pixels).

Once these steps are done, we need to normalize our data for better convergence. In order to normalize, we use the simple code “r_eye = r_eye / 255”. Upon executing this code, all the values will be coming in between 0-1. Once all these processes are completed, we need to predict the status of each eye using the model we built. If the predicted values come as 1, it means that the eyes are open. If the predicted value come as 0. It means that the eyes are closed [11].

- **CALCULATING THE SCORE TO CHECK WHETHER PERSON IS DROWSY OR NOT**

The score is the value which we used to determine where the person is drowsy or not. Consider his both eyes are closed, the score keeps on increasing. When he opens his eyes, the score starts to decrease. The score value will be fed directly in our output screen using the function “cv2.putText()”. This code helps to show up the score directly on our output window. A threshold value is set at first, for example consider the threshold value 10 which means that the person eyes are closed for a long time. At this point a small alert will be provided by the system. If the threshold value crosses 15 then the alert will be will be provided once again and the engine begins to slow down. The Fig 2,3 and 4 explains the same.

Fig -2 :Eyes open (Score : 0)

Fig -3: Eyes Closed (Score: 12) First level of alertness

Fig -4: Eyes Closed (Score: 16) Gradual Speed Reduction enabled.

- **AUTOMATIC SPEED REDUCTION MODULE**

This module works as the second level of alertness where the cruise control / autonomous driving comes into the picture. When the threshold value reaches the second level, speed reduction is enabled and thus it helps in reducing the intensity if any accident occurs and parking the vehicle to the left side of the road using lane splitter function available in automobiles.

7. CONCLUSION

In this research, using convolutional neural network, it was able to achieve an accuracy of 98.32%. Fig:5 shows the training and validation accuracy. This system detects the drowsiness in real time and in case of fatigue or other medical issues where the person loses his conciseness, the vehicle automatically reaches the left side of the road.

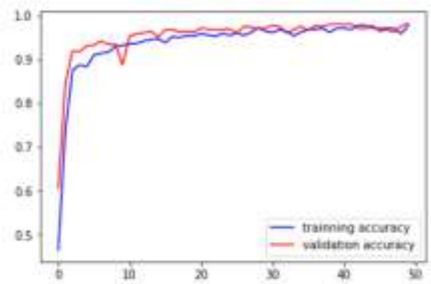

Fig- 5: Training and validation accuracy

In future, we could embed available API through which a notification can be passed to the driver's friend relatives indicating that driver is drowsy and the vehicle has been halted in the particular latitude and longitude.

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