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Deep Learning for Monitoring Drivers Distraction From Physiological and Visual Signals

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Abstract
Drowsiness is amongst the significant causes of road accidents. In today's era, road accidents are one of India's most serious issues, resulting in human loss. This article proposes a Deep Learning For Monitoring Drivers Distraction From Physiological And Visual Signals with the help of computer vision and machine learning algorithms. The system detects the eye closure, yawning, head bending to identify the drowsiness or fatigue of the driver and make alterations accordingly. The proposed system uses simple and unimpaired methodologies for developing a low cost, accurate model for reducing road accidents and thereby saving human lives.

Keywords: Machine learning, Drowsiness detection, Face recognition, Alarm generation .

Introduction

Drowsiness is a complex phenomenon which states that the driver has less conscious levels. Several direct or indirect methods for detecting the fatigue or drowsiness of drivers are stated. Driving for long hours can be tiresome. Now a days, fatigue and laziness is taking over the daily lifestyle of people. Lack of sleep (uneven sleeping hours), mental and physical stress, addiction to electronic devices are also some of the causes of drowsiness.

The major and supreme reasons for causes of road accidents is drowsiness in India and worldwide as well. Researchers paid lot of attention on the vast increment of road accidents due to drowsiness. It has been proven by researchers that the performance of drivers kept deteriorating with increase in drowsiness. Most of the accidents occur at mid night, stated the top researchers. Keeping this in mind, increase of intelligence systems and vehicles has taken place. Apart from speed of the vehicle, steering wheel movement and continuous driving duration, various other parameters such as eye closure rate, yawning, head bending are considered to be an integral part of a Smart Vehicle System (SVS). Various other parameters including medical parameters like heart beat rate, pulse rate etc could be implemented.In this system,high vision cameras are used to detect and record the run time images of the driver and generate warning signals accordingly. With respect to this concern, various researchers have mentioned many various algorithms were implemented to detect objects such as face. Levels of eye closure was taken as a measure to detect drowsiness. Later, recognition of symptoms of drowsiness of a driver using infrared camera was done. Researchers used the concept of bright pupils and deduced an algorithm for eye detection and detection of drowsiness. On similar basis, eye localization and segmentation were taken as the main concepts.

LITERATURE REVIEW

[1] **PAPER**: Machine learning and end-to-end deep learning monitoring Distractions physiological and visual signals.

AUTHORS: M. Gjoreski , M. Z. Gams .
ANALYSIS:The proposed system the overall physiological and affective responses in relation to the external distractions were analyzed. The physiological response includes nEDA, pEDA, HR, BR and eye tracking data. The affective response includes emotions, facial expressions and the head pose.

[2]PAPER: Deep unsupervised multi-modal fusion network for detecting driver distraction.
AUTHORS: Y. Zhang, Y. Chen
ANALYSIS: The proposed system the overall physio logical and affective responses in relation to the external distractions were analyzed. The

physiological response includes nEDA, pEDA, HR, BR and eye tracking data.

[3]PAPER: Classification of driver distraction:A comprehensive analysis of feature generation, machine learning, and input measures
AUTHORS: A. D. McDonald, T. K. Ferris
ANALYSIS: This paper proposes analysis of a set of driver performance and physiological data using advanced machine

learning approaches, including feature generation, to determine the best-performing algorithms for detecting driver distraction and predicting the source of distraction.

III PROPOSED METHODOLOGY

In the proposed work, Implementation of features for facial landmark detection is done to identify the state of the driver. 68 predefined landmarks for prediction of shape and to identify the regions of the face like eye, mouth etc. Many variations in parameters of the distinguished points report various expressions of the person. The recognition of facial landmark is carried out as:

Fig 1.The facial landmarks

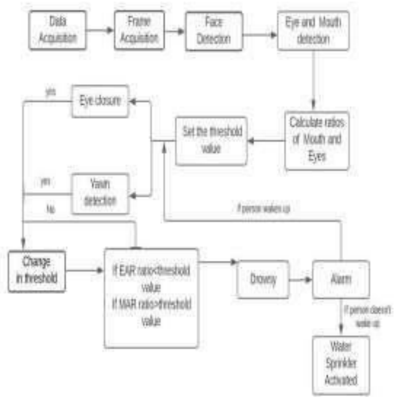

Fig 2.The block diagram of a Real time

drowsiness detection and Monitoring system for drivers

•Workflow

High vision cameras are embedded to monitor and capture to extract frames one by one and generate the alerts accordingly. Each extracted frame is analyzed to study the pattern of facial features; using Haar Cascade Classifier and determined Eye Aspect Ratio(EAR) and Mouth Aspect Ratio(MAR) for each frame [12]. When the EAR and MAR values go beyond their designated thresholds, the system identifies a blink or a yawn, respectively. The alarm is activated to grab the driver's attention and it keeps on ringing until driver wakes up.The monitor is embedded with high capacity computer vision based cameras to extract frames one after the other and

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to generate alarms based on the information accessed. Each frame is analyzed after extraction and the pattern for facial features are studied using classifier like Haar Cascade. The Eye Aspect Ratio(EAR), Mouth Aspect Ratio(MAR) for each frame is analyzed. The system compares the EAR and MAR values of each frame with their respective threshold values, and triggers an alarm if it detects consecutive frames indicating eye closure or yawning. In few cases, the driver doesn't come into active state even after the generation of alarm. In such cases, a water sprinkler system is activated which sprays water on the face of the driver to get him back to consciousness or active state.

•Facial Features and Gesture Detection

•Data Acquisition: In this data acquisition video is recorded by using the web cam and frames are extracted in laptop. After thiswe use image processing techniques like open CV are applied to extract the image. As soon as the driver sit in front of the web cam video is recorded. Then we detect features like eye closure, eye blinking and yawning.

•Frame Acquisition: A high resolution digital camera is set up in the car in such a way that it captures the complete view of the driver. A video is captured and consequently frames are extracted,analyzed to detect the current state of the driver.

•Face Detection: To locate the frontal face of the driver, algorithms like Histogram of Oriented Gradients(HOG) and Linear Support Vector Machine (SVM) are implemented. This is so done to get accurate results with very few false positive values.

•Eye Detection and Mouth Detection: 68 pixels in (x,y) coordinates of the facial landmarks of the face are acquired by the pre-trained shape predictor in dlib library. The probability of distance between pairs of •pixels is used to detect the eyes and mouth in the facial region and Euclidean distance is implemented to assess the distance between the coordinates on the eyes and mouth, thereby finding out the current state of the driver.

•Eye Closure

Here we consider Eye Aspect ratio(EAR).This EAR ratio is calculated as the ratio of height and width of the eye given by the formula

EAR = ||P2− P6||+||P3− P5| | /2||P1-P4||

The notation P1 denotes the facial landmark corresponding to point I, while (Pi – Pj) refers to the Euclidean distance between landmarks I and j.

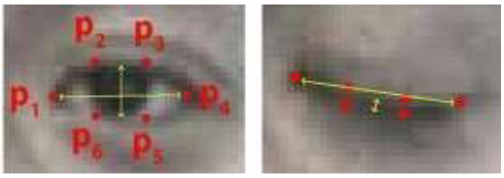

Fig 3.Represents EAR ratio

•Yawn Counts

Using the dlib landmarks predictor function, 8 coordinates are marked on the mouth starting from the left corner of the mouth in clockwise direction. As shown in Figure-4. The relation between the horizontal and vertical co-ordinates is considered. To determine MAR, the ratio of vertical distance between lower and upper lips to the horizontal distance between the lip corners is calculated.

MAR=||P1− P5||+||P2− P4||2||P6− P3||]

While yawning, the distance between lower and upper lips increases. As soon as MAR value exceeds a certain threshold, the yawn count is incremented .

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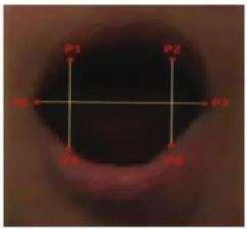

Fig 4.Represents MAR ratio

•Alarm Activation
When the Eye Closure and Yawn Counts exceed certain specified threshold values for a certain number of frames, the system will take the state of the driver into account as drowsy and will generate an alarm. This would help the driver get back to his original active state.

•Hardware
●In this project we consider user-friendly hardware components such as Arduino
●Relay Module
●Battery (9V)
●Motor(3-6V)

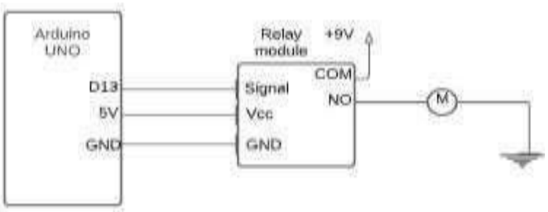

Fig 5.Block diagram of Water Sprinkler

As per the EAR and MAR ratios if the driver doesn't wake up even after the generation of alarm, then these ratios are sent to the Arduino. After receiving these ratios , the Relay Module gets triggered and then it sends 5V of supply to the battery and the water sprinkler gets activated after comparing the thresholds.

•Water Sprinkler Activation
After the generation of the alarm for certain specified number of times, if the driver doesn't If the alarm is left ringing

and unattended, a water alarm may serve as a backup solution.sprinkler is activated which helps in the splashing of water on the driver's face can serve as a means of arousing or alerting them.

Results
Our project involves utilizing the Tkinter module to create a user interface for a GUI application.In this user interface two buttons are located START CAMERA and STOP CAMERA.As soon as we click start camera button the input video is starts recording and EAR and MAR ratios are calculated as mentioned above .This process get terminated after clicking the stop button.
The output results of this deep learning for monitoring drivers distraction from physiological and visual signals are as follows:

Fig 6. Represents EAR ratio is detected when the person is drowsy(Alarm generate)

Fig 7. Represents MAR ratio is detected when person is drowsy(Alarm generate)

Fig 8. Water Sprinkler is activated after the alarm Generation

Conclusion

In the proposed work, a low cost, Deep Learning For Monitoring Drivers Distraction from Physiological And Visual Signals has been proposed, based on visual behavior and machine learning. The work is entirely based on Visual behavioral features like Eye Aspect Ratio, Mouth Aspect Ratio are computed from the streaming video and captured through a webcam. An adaptive threshold technique has been developed to detect the drowsiness of driver in real time. The developed system works accurately with the generated synthetic data. Machine learning algorithms have been used for classification and subsequently the feature values are stored. In future, wearable devices such as smart watches or other devices can be used to identify parameters like pulse rate, heart rate, BP etc to detect drowsiness more accurately and efficiently.

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