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Stay Awake Alert: A Driver Drowsiness Detection System with Location Tracking and Alarm

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Abstract - ***Drowsiness is a condition when a person feels the need to fall asleep. There are many reasons that can cause drowsiness which include lack of sleep, depression, working overtime, etc. which turns out to be dangerous in the form ofroad accidents if the drowsy person is a driver driving a vehicle. Studies reveal that a person is most likely to die from drowsy driving as compared to driving while consuming alcohol or being distracted while driving. This paper focuses on a real-time low-cost system that detects drowsiness using a machine-learning approach. the driver will be monitored continuously by using a webcam. openCV is used with the haar cascade algorithm for face detection, dlib is used to detect facial landmarks, and compute EAR eye aspect ratio to detect driver drowsiness based on the threshold value. Here CNN Convolutional neural network is used for determining the state of the driver whether the driver is drowsy or not.***

Key Words: ***Dlib, Eye Aspect Ratio, opencv, Haar cascade algorithm, convolutional neural network, Machine learning.***

1. INTRODUCTION

As per reports from the Centers for Disease Control and Prevention[1].1 out of 25 adult drivers fall asleep while driving. According to the national sleep foundation around 6,400 people die yearly involving accidents caused by drowsiness. These accidents are not only dangerous for the driver but also for the passengers and the people who are using the road it can cause mental, physical, and financial damage. NHTSA National Highway Traffic Safety Administration reported that accidents related to drowsiness causing injury or death cost $109 billion yearly. Thus there is a need occur to develop a system that will keep the driver awake while driving.

There are many techniques used for developing driver drowsiness detection system. [2] Vehicle-based drowsiness detection system in this technique drowsiness is detected by in-vehicle sensors collect data for detecting the drowsiness level of the driver through his behaviour the detection aspects are the steering wheel movement , vehicle deviation and position, and vehicle speed. This type of system requires costly infrastructure and complex programming. Physiological drowsiness detection systems use physiological signals from the human body such as the brain, eyes, and heart.This system uses signals such as EEG electroencephalography signals for the brain or EMG electromyography signals for muscle tone. This system has to be implemented with wearable devices which might make the driver uncomfortable because of wearability issues. Because of these issues in physical and physiological techniques in this system behavioural measures have been used for detecting driver drowsiness in the proposed research. It does not require any complex programming or costly components and due to its non-contact behaviour, the driver does not worry about wearability issues

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Firstly a webcam is used for recording real-time video of the driver. the webcam is placed in front of the driver to continuously capture the image of the driver. The frames are extracted from the video using OpenCV.it is a real-time computer vision library. haar cascade algorithm used to detect faces from the frames. After face detection, facial landmarks have been extracted by using lib library. the facial landmarks are then used to compute the EAR eye aspect ratio. .after this convolutional neural network is used for classifying the state of the driver. the EAR value is compared with the threshold value that is taken as 0.2 in the proposed system if EAR value becomes less than the threshold value It is found that the drowsiness is detected as eyes are found to be closed. Then an alarm will be sent to alert the driver. After that the location of the driver will be shown to the driver.

Yann Lecun is the director of the Facebook AI research group [3] who built the first model of a Convolutional neural network in the year 1988. As the domain of computer vision is increasing day by day it is enabling machines to view the world as humans do. The amazing advancement in computer vision is because of machine learning, particularly with the convolutional neural network algorithm. Machine learning gives the machine the ability to learn and use this learning to perform various tasks.a convolutional neural network is used for detecting and classifying objects. Therefore to build our proposed system we have used machine learning with the convolutional neural network.
Figure 1 shows the overall engineering of the system.

1.1 OVERVIEW

The rest of this paper is divided as follows. In the next section 2. Related work, This section represents previous work done for implementing a driver drowsiness detection system. In section 3 proposed methodologies is included which shows the proposed algorithm based on machine learning and facial landmark detection along with the accuracy, efficiency study of the given model with the experimental and analysis in 4. 5 and 6 shows conclusion and references.

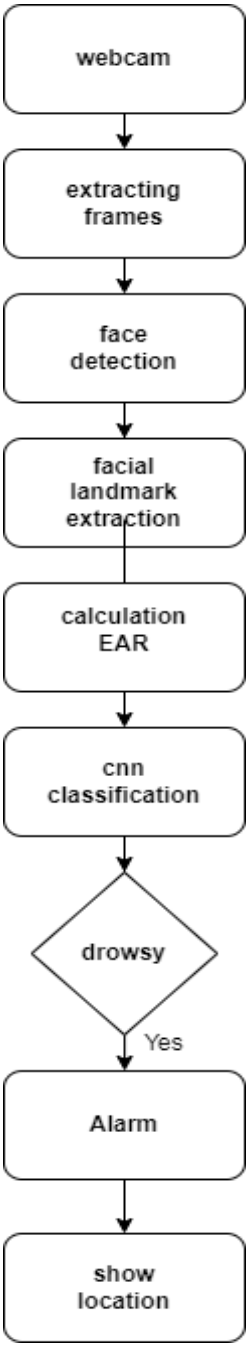

Fig-1: General architecture of proposed drowsiness detection system

2. RELATED WORK

U.Shrinivasulu Reddy.et al [4] proposed a deep neural network a machine learning method used to detect driver drowsiness by detecting the state of the eye. in his system he used a stacked deep convolutional neural network to examine facial features.

Mohammed .S Majdi., et al [5] developed a drive-net for detecting driver drowsiness his team compared this system with RNN recurrent neural network and multiple systems for analysing how his system achieves better results.

Jin ming gua., et al [6] proposed a driver drowsiness detection system using hybrid cnn and long-short-term memory LSTM is used in this system as a time skipper to improve the processof catching frames .it ignores the frame that does not show any slight change thus improve processing time.

Sonekar, Shrikant V., et al [7] proposed a computational algorithm that helps to decide the termination of a proposed head algorithm using the finite state machine concept, the behavior of the attackers is identified and the finite state machine clearly gives the idea about the identification of intrusion.

research based on Enhanced route optimization technique for malicious node detection technique Sonekar, Shrikant V., et al [8] proposed research in which it shows that out of thousands of paths from source to destination, only one is optimal and also gives the information About several nodes involved in the creation of optimal Path using Cluster and cluster head formation algorithm

Kyong hee lee., et al [9] proposed a study on different methods used for feature extraction. in this paper different methods are defined and compared for facial feature extraction .it shows how to monitor eyes, head position, and mouth from the face to detect drowsiness.

Mohesen Babaein., et al [10] proposed logistic regression techniques using a machine-learning algorithm for detecting drowsiness. Here ECG Signal is used to monitor heart rate when a driver is driving a vehicle. The logistic regression method is used to improve the detection time and accuracy of the system. this paper shows that by adding more layers to a neural network the accuracy of the system can be increased.

Lemkaddem., et al [11] proposed a study on a multi-modal driver drowsiness detection system. in this paper multiple methods are used same time to detect drowsiness. A hybridsystem was developed by combing both physiological behavioural methods. A camera used with wearable watch. That records the PPG photo plethysmography signal.

3. PROPOSED MEHODOLOGY

3.1 Image Capture : Real-time image is captured by using a web camera with the help of OpenCV. The inbuilt laptop's

webcam front camera will be used for this purpose. By using webcam, images from the video are extracted continuously.

3.2 Face detection: For detecting the entire face from the image Viola-Jones object detecting calculation [12] with Haar overflow classifierhas been used with OPEN CV and python. Haar cascade classifier computes Haar highlights for identifying the face from pictures.**Fig-2:** Face Region Image

Fig -2: Captured Face Region Image

3.3 Eye Localization: To locate eyes from the face, facial landmarks are used. Open source dlib library has been used to produce 68 (x, y) coordinates that match specific facial structures. dlib libraryfunctions are used to detect the eyes in real-time. These landmarks are obtained from training the shape_predictor. Points 37-42 represent the right eye and 43-48 represent the left eye from facial landmarks. These points are used tocreate a rectangular cropped image of the two eyes**.**

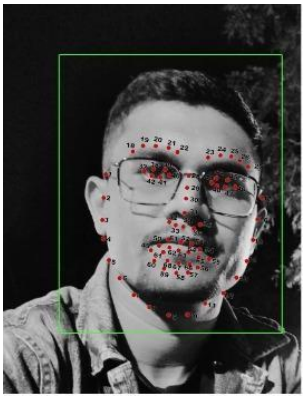

Fig -3: Face Landmark Co-ordinates

3.4 Calculating Eye aspect Ratio: The eye blink is detected on the basis of eye aspect ratio.To find the EAR following formula is used.

$$EAR= (p2 - p6) + (p3 - p5)/ 2(p1 - p4)$$

The EAR is fed into the convolutional neural network and after that according to the cnn prediction it will compared to a threshold value which we have taken 0.2 in the proposed system.The value of EAR is constantly monitored. when the EAR value becomes less than the threshold value a blink is considered and the program will move for further processing..

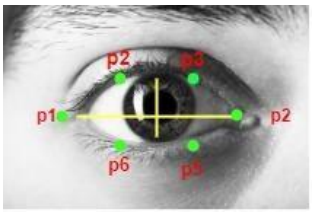

Fig -4: Captured Face Region Image

3.5 Convolutional neural network: A convolutional neural network is used in the proposed paper for driver drowsiness detection. It will continuously examine the real-time images extracted from video through a webcam.it will predict probabilities to calculate the state of the driver if the set threshold value found to be less than the prediction according to the EAR value the eyes are found to be closed. the alarm will be start

3.5.1 Layers of proposed cnn model

Figure 4 shows the planned CNN model utilized in this work.

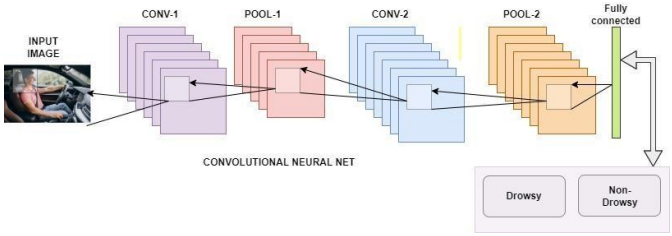

Fig-5: Proposed deep CNN model

CNN consists of layers like the convolutional layer, max pooling, layer, Relu layer and fully connected layer. In the proposed system 3 convolutional layers has been used .The number of channels in the first and second layer is 32, and in the third channel is 64. All these convolutional layers have a filter size of 3*3. This layer produces a feature map as a result of calculating the scalar product between the kernel and the local region of images. for speed calculation cnn uses a max pooling layer of size 1*1..in this layer input image is divided into different regions then on each region operations are performed. the best feature has been selected

In this layer which is trailed by dropout with 0.25% which has been used to avoid overfitting .after this a flatten layeris used to flatten the output after all these layers a fully

connected layer has been used in which activations from all the layers output are combined with a softmax function to get probability. the model is trained under acceptable accuracy

3.6 Determining the location of the driver : After the alarm will start to alert the driver. the proposed system will show the location of the driver with nearby hospitals and hotels. so that the driver can pull over to takea break or stay alert. For providing this function in the system web browser module is used along with the desired address

4. EXPERIMENTS AND ANALYSIS

Here we have performed two types of experiments .In the first type of experiment collected dataset has been used. To perform the first type of experiment we have useda dataset containing 3843 images label with EAR value. From the dataset, we have used 2000 images for training theproposed model out of which 500 images were closed eyes Figure 7 and 8 shows the accuracy and loss variation for 50 epochs

Fig-6: Images from dataset

And the remaining were open eyes. for testing the proposed model we have used 1000 images from the dataset out of which 600 were drowsy images and 400 were non-drowsy images. For validation purposes, we have used 843 images from the dataset out of which 500 images were of open eyes and the remaining

In the Second type of experiment, live video is captured with the help of a webcam associated with a laptop. an audio file is being played in the form of an alarm to wake up the driver when drowsiness is detected. This method is user-friendly and only needs a webcam no need for any hardware. Figure 9shows the result of the second type of experiment

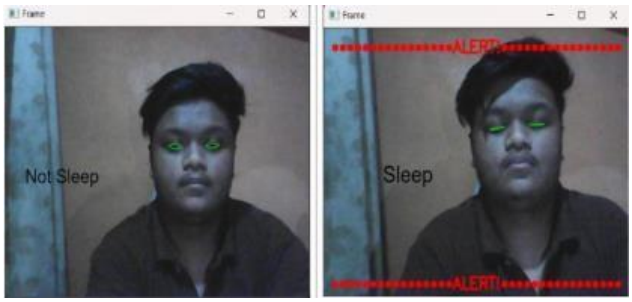

Fig-9 Result of the proposed system

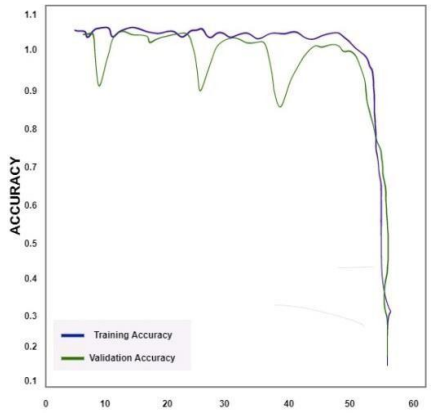

Fig-7: The training and validation accuracy

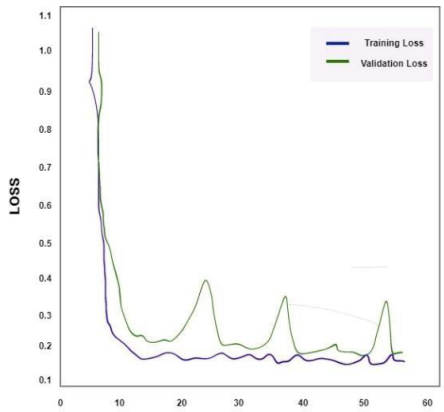

Fig-8: The training and validation loss

Table-1: Accuracy of the proposed system

Training images	**2000**
Testing images	**1000**
Validation images	**843**
Training accuracy	**90.2%**
Testing accuracy	**92.2%**
Validation accuracy	**95%**

5. CONCLUSIONS

This system plays a very important role in preventing accidents caused by the drowsiness of the driver. The main focus and concentration while developing this system were to develop a prototype of a driver drowsiness detection system that will accurately monitor the drowsy state of the driver. the proposed system was able to detect the facial landmarks of the driver by using a webcam and further processed by convolutional neural network for classification. A warning is given to the driver when the driver is detected to be drowsy. the proposed system achieved an average of 95% accuracy. The proposed system can be extended further for different users such as bike riders or different domains like airlines or railways.

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