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Driver Drowsiness Detection Using Deep Learning

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ABSTRACT

Driver Drowsiness is one of the major reasons of Road accidents now a days. In many cases the carelessness of drivers leads to these accidents, as for many drivers it becomes very tough to concentrate on the road while driving for a very long duration, they feels asleep or drowsy . With the advancement of technology in the field of computer vision smart/intelligence cameras are developed to monitor drowsiness in drivers. Also alerting driver with a alarm whenever they feel drowsy .As using this technology reduces the risk of accidents. In this project a new framework is being proposed using deep learning to detect the status of human eye while driving the vehicle. With the help of Inbuilt Deep learning models like Transfer learning we can train our model and classify them based on the results. Also we will use CNN as our Algorithm to get the best accuracy for our model.

Key Words: Computer Vision, Deep learning models, Classification model, python libraries, CNN, Transfer Learning

I. INTRODUCTION

In car safety Technology driver drowsiness detection is one of the best way to prevent accidents . Now a days peoples are using automobiles for their daily work , communication , comfortability .Also due to this high volume of traffic is seen in urban areas and it may also result in accidents. Driver drowsiness could be the one reason for road accidents.. According to the National Highway Traffic Safety Administration (NHTSA), every year around 1 lakh road accidents occurs because of driver drowsiness in the US and other states. NHTSA reported that 82,000 road accidents, 900 deaths and 54,000 injuries are occurred due to driver drowsiness. The average road accidents deaths in India arearound 1, 46,218 per year in last one decade. In 2016-2017, 70% of people who lost their lives in road accidents were in age group of between in 19-36.There are different signs ofdrowsiness like Yawning, nodding and many others which might not be that effective to detect the level of drowsiness as most of the peoples have different level of fatigue behavior , so the most common among all of them is the eye blinks which can be easily monitored and help in understanding the status

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of the person. There are also some other good methods which provide accurate results one of them is physiological measures ,ECG(Electrocardiography),EEG(Electroencephalography) are used to access the driver condition and based on his/her skills of driving .with this it could measure the risk factor .Here smart camera is used to detect the driver behavior instead of vehicle .It is also considered as the best way to detect driver behavior instead of vehicle .It is also considered as the best way to detect driver drowsiness .The proposed algorithm and the methodology based on Convolution Neural Network (CNN) and Facial Landmark Detection (CNN-FLD) are described .To identify faces various inbuilt open cv algorithms are used to detect different parts of faces like Eyes, mouth etc. Face detection techniques are classified into feature based and image-based .Using Transfer learning we use to detect the eye status which is trained model . Also we have different method which can be used in classification problems.

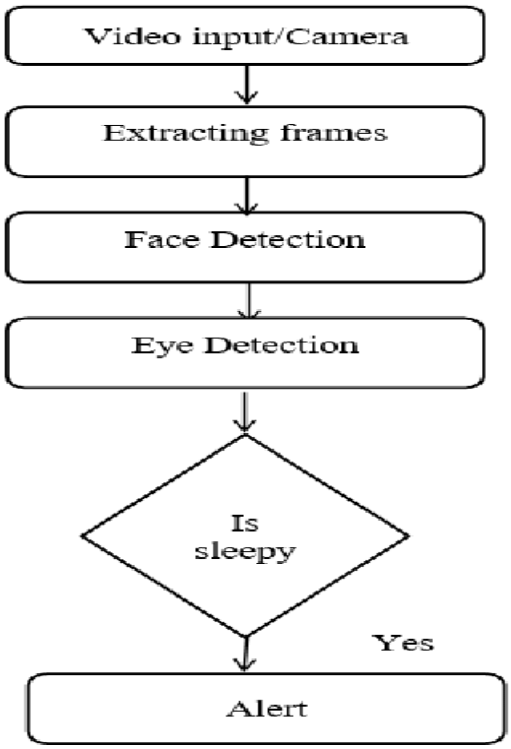

Fig 1.1 : General Flow diagram of Drowsiness detection

In the above Architecture shows the basic implementation of drowsiness detection in which each steps is carried out one by one and the results is classified in the end as drowsy and Active .Various face detection algorithms is being used to to detect the faces but for real time detection we need to use the concept of Deep Learning, Neural Network and various other statistical techniques.

II . EXISTING MODELS

For getting better accuracy many models were developed with different accuracy .[1] one approach was used to detect drowsiness was based on vehicle features like steering , vehicle speed, and accelerator pedal position. And these feature were passed into Navies Bayesian network which determines the level of drowsiness. As we discuss earlier about [2] EEG signals which takes driver inputs in the form of signals and using Artificial neural network classify them .The accuracy of the model is around 83.83%. [3] Danisman et al. developed a model which used eye blinking rate .Using viola jones to detect the faces from the images and performed some Neural network eye detector algorithm which calculates the eye blinks .As the Number of Eye blinks are more the driver is in drowsy state. [4] Abtahi et al.in his model uses yawning as a new feature to his model and combine it with his eye blink to get better results. Here the yawning is based on the mouth width , if it is more than the desired value then he classify them as drowsy drivers.[5] Also using various threshold value eye blinking is determined and is give to (SVM) Support Vector Machine for detecting the eye status. An author Tayab Khan uses angle of eyelid curvature to detect whether they are closed or open . Yawn detection are also used to detect the drowsiness status , but the real challenge was the environmental condition's which affect the accuracy .It required a proper lighting condition and less dynamic movements to easily predict the results [6]. Nowadays AI are widely used for detecting objects , and classifying images .CNN was mostly used in all [7-8]. [9]Mehta

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in is model proposed a method in which he developed an android application and was capable of detecting facial landmarks and then computing the Eye Aspect Ratio (EAR) and the Eye Closure Ratio (ECR)) to detect drowsiness in driver.[10] Using the similar technique Ellice-Healthy in his startup developed a smart glass which can detect the eye blinks and monitor each and every activity of the driver and based on those feature decides the drowsiness level with a beep sound .

Sensors/Parameters	Algorithm	Accuracy
EEG, ECG	Mean power frequency	-
Respiration Rate, Heart Rate, Heart Rate Variability	Power Spectrum	-
Cameras/Eyelid movement, gaze movement, gaze movement, head movement and facial expression	Kalman filtering tracking	Yawn–82% PERCLOS–86% AECS–95%
IR Camera	Thresholding, Mean	-
Camera/facial features of eyes, mouth and head	Fuzzy reasoning	Only focused on detection rate for facial tracking and face tracking rate
EEG	Principal Component Analysis (PCA)	Training–92.6% Testing–74.6%
ECG, EEG	dynamic Bayesian network, first-order Hidden Markov Model	Drowsy (best)–91% Active (best)–91%
Eye movement, driving performance data	Support Vector Machines (SVMs)	Distraction detection (average)–81.1%

TABLE 2.1 : Overview of Existing Drowsiness detection system

[11] Another model was based on Artificial Neural Network which uses physiological and behavioral indicator to detect drowsiness. These features are given as input to (ANN) Artificial Neural Network model in which one determines the level of drowsiness and other determines the time taken to achieve the level. Park et al [12] in his model used combination of three deep networks such as Alex Net ,(VGG)Visual Geometry Group -Face Net and Flow ImageNet for feature learning. This experiment was performed on a *National Tsing Hua University*(NTHU) video image dataset achieving around 73% of accuracy. Jabbara et al [13] in his model used deep learning with android application ,they designed a model which is based on facial landmarks point detection .Here the images were extracted from the video dataset and using Dlib facial landmarks are extracted having accuracy of 80%.

III .PROPOSED SYSTEM FOR DROWSY DETECTION SYSTEM USINF DEEP LEARNING

In this proposed system, we are using CNN based Deep Neural Network Model which gives an Accuracy of 98.5% . Here image is detected using a web cam which is further normalized and give as an input to our CNN based model.

A CONVOLUTION NEURAL NETWORK

A Convolution Neural Network is a deep learning model that includes various layers like convolution , pooling , fully connected layer. The model has its own weight vectors The neurons of convolution neural network includes various neural filters that perform convolution on Data. The Model has an Activation function called asRectified linear activation function(RELU) layer which help in increasing the accuracy of training It is given by an Equation f(x)=max(0,x). Using the various convolution layer , RELU and Pooling layer features extraction is performed .Using this process the complex features of images are extracted .The extracted features are arranged and saved in a one dimensional array The featured vector is given to a fully connected layer for classification of the model[14].Input image having A x B as dimension ,the layers are defined as l th layer .Omega(m,n) isweight matrix which connects the neurons of the lth layer with neuron of (l-1) th layer . The activation function takes the input vectors and convert them in non-linear form. Using this layer we are decreasing the dimension of the image .After completion of convolution and pooling layers , Flatten layers is used to combine the extracted features and the result is in the form of one dimension features vector. The fully connected layer uses this features to calculates the model output.After going through various convolution layer's the model output and

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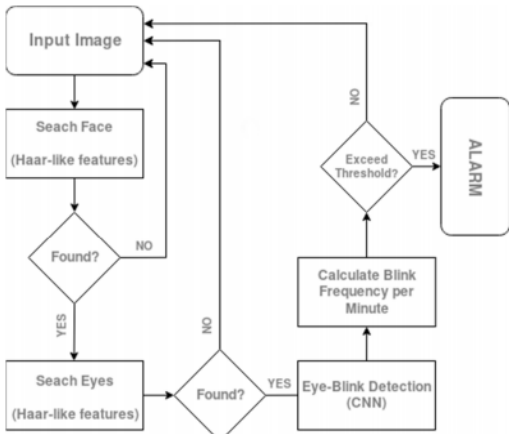
target pattern are used to find the loss function and the training is carried out using CNN. Finally the trained model is validated with the other test cases .

B STRUCTURE AND WORKING OF THE SYSTEM

The drowsiness detection vision based is developed using Convolution Neural Network. The input images is taken from the camera and is given to the CNN deep learning model which classify the drowsiness. Using a simple flowchart given in the Fig 2 we can understand more about the model.

Fig 3.1: proposed system architecture for drowsiness detection system



As shown in the diagram the proposed model takes input images from camera and searches for the desired features and sends them to the system. The system checks each frames having face or not. Usinghaar-cascade features faces are detected and using eye-cascade eye portions are extracted.The Region of interest(ROI) is determined .The extracted eye features are given as input to CNN .The CNN model uses these images and determine the eyes states. The images are in the form of 224x224x3 , which indicated the image width,height,and channel(RGB).The first layer in CNN has 64 convolution filters with 5x5 kernel and RELU activation function which have the following layer of 2x2 pooling layers . The second layers have 128 convolution filters which uses the same structure as the first. The third layer having 256 convolution layers which have 3x3 kernel using the same activation function. Finally the fully connected layers is used to convert them in the single vector and using the RELU activation function for better accuracy.

The Model uses eye blinks for the detection of drowsiness which us implemented using Haar cascade classifier and CNN. The images taken from the camera are given as an input to the model which classify the drowsiness and gives an alert to the driver with an alarm.The CNN comprise of various convolution layers as we discuss earlier. Using the four parameters height , width, depth and number of classes which is utilized to build a CNN model. The images are in the form of 224x224x3 as defined previously which is given as an input to the First layer .The model includes three layers convolution, RELUand pooling layers . The final result is determined by the fully connected layers using softmax layer . Figure below shows the overall model process of CNN.In this simulation process 2000 images are used to train the model in which few image are used for training and rest are used for test purpose.. The CNN model is trained using different number of epochs which indicate the accuracy of the model . Higher the epochs value more the accurate results. In my project I have used max 30 epochs which gave me a result of 98.5% accuracy.

IV. RESULTS AND DISCUSSIONS

The final model classifies the images based on drowsy and Active. Also giving an alert to the system whenever a driver is drowsy .

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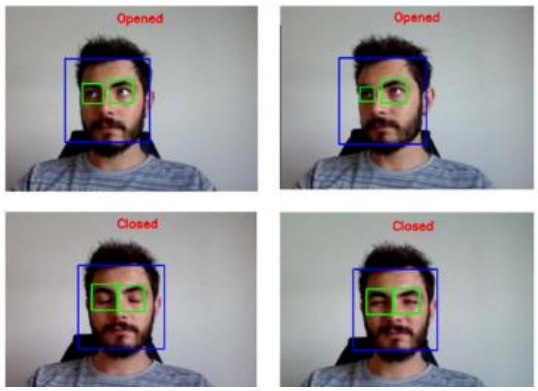

Fig 4.1 : Output of the Drowsiness Detection System

After using CNN we should get this result compare to other model in the Convolution network. The model should gives an accuracy of around 98-99% .Getting such result should not only increase the level of accuracy but also helps us in classifying other complex models with the same features .In order to get better results we going to compare our model with other CNN models having different model accuracy. In the below figure various models likeInception(Conv1d,Conv2d,Conv3d,Batch_Normalization,Max-Pooling,Dropout, Flatten, Dense), Resnet(Conv1d_46, Conv1d_47, Conv1d_45, Add_14,Activation_14, Batchnormalization_14, Dropout_**7,**Flatten_5,Dense_17**,**Batchnormalization_15 and Dense_18), WaveNet.

Table 4.2 : Model Comparison

Models	**Accuracy Train**	**Accuracy Validation**	**Accuracy Test**
Proposed CNN	**98.8%**	**93.27%**	**90.4%**
Inception	88.91%	67.70%	74.87%
Resnet	79.03%	69.86%	72.80%
Wavenet	71.54%	67.40%	75%

V.CONCLUSION AND FUTURE WORK

In this project a new method is used to detect the drowsiness based eye status. Whenever an eye is closed the drowsy status get activated which alert driver. Here Face and eye detection are done by using Viola-Jones detection algorithm .with the help of Deep Neural network model various modelling layers are being used to train the model using CNN layers and Transfer Learning. A SoftMax Layer in CNN classifier is use to detect the driver eye status. The model gives an accuracy of 98% .Here Transfer learning is used to improve the accuracy of the model.The experimental result which are used in various models are being used to gain the real time drowsiness model. Using the facial expression and applying deep neural model concept to them increase the accuracy of our classification model. In Future we can use EEG with other physiological parameters such as EOG , ECG and Near-Infrared Spectroscopy (NIRS) [15-16].

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