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Driver Drowsiness Classification Based on Eye Blink and Head Movement Using KNN Algorithm

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Abstract:

The advancement in computer vision has assisted drivers in the form of automatic self-driving cars etc. The misadventure are caused by driver's fatigue and drowsiness about 20%. It poses a serious problem for which several approaches were proposed. However, they are not suitable for real-time processing. The major challenges faced by these methods are robustness to handle variation in human face and lightning conditions. We aim to implement an intelligent processing system that can reduce road accidents drastically. This approach enables us to identify driver's face characteristics like eye closure percentage, eye-mouth aspect ratios, blink rate, yawning, head movement, etc. In this system, the driver is continuously monitored by using a webcam. The driver's face and the eye are detected using haar cascade classifiers. Eye images are extracted and fed to Custom designed Convolutional Neural Network for classifying whether both left and right eye are closed. Based on the classification, the eye closure score is calculated. If the driver is found to be drowsy, an alarm will be triggered.

INTRODUCTION:

Humans have always invented machines and devised techniques to ease and protect their lives, for mundane activities like traveling to work, or for more interesting purposes like aircraft travel. With the advancement in technology, modes of transportation kept on advancing and our dependency on it started increasing exponentially. It has greatly affected our lives as we know it. Now, we can travel to places at a pace that even our grandparents wouldn’t have thought possible. In modern times, almost everyone in this world uses some sort of transportation every day. Some people are rich enough to have their own vehicles while others use public transportation. However, there are some rules and codes of conduct for those who drive irrespective of their social status.One of them is staying alert and active while driving. Neglecting our duties towards safer travel has enabled hundreds of thousands of tragedies to get associated with this wonderful invention every year. It may seem like a trivial thing to most folks but following rules and regulations on the road is of utmost importance. While on road, an automobile wields the most power and in irresponsible hands, it can be destructive and sometimes, that carelessness can harm lives even of the people on the road. One kind of carelessness is not admitting when we are too tired to drive. In order to monitor and prevent a destructive outcome from such negligence, many researchers have written research papers on driver drowsiness detection systems. But at times, some of the points and observations made by the system are not accurate enough. Hence, to provide data and another perspective on the problem at hand, in order to improve their implementations and to further optimize the solution, this project has been done.

Problem Statement

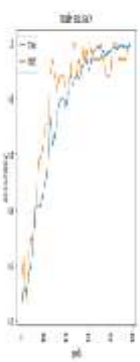
Current drowsiness detection systems monitoring the driver's condition requires complex computation and expensive equipment, not comfortable to wear during driving and is not suitable for driving conditions; for example, Electroencephalography (EEG) and Electrocardiography (ECG), i. e. detecting the brain frequency and measuring the rhythm of heart, respectively.A drowsiness detection system which use a camera placed in front of the driver is more suitable to be use but the physical signs that will indicate drowsiness need to be located first in order to come up with a drowsiness detection algorithm that is reliable and accurate. Lighting intensity and while the driver tilt their face left or right are the problems occur during detection of eyes and mouth region.Therefore, this project aims to analyze all the previous research and method, hence propose a method to detect drowsiness by using video or webcam. It analyzes the video images that have been recorded and come up with a system that can analyze each frame of the video.

OBJECTIVE:

- To suggest ways to detect drowsiness while driving.
- To observe eyes and mouth from the video images of participants in the experiment of driving simulation conducted that can be used as an indicator of drowsiness.
- To investigate the physical changes that take place during drowsiness.
- To develop a system that use eyes closure and yawning as a way to detect drowsiness.

IMPLEMENTATION:

The proposed method is tested on Yaleface database which consists of black and white images of 15 samples, each having 11 images in different expressions making a total of 165 images. A sample is shown in figure 7. Images for one subject in different facial expression or configuration: center-light, with glasses, happy, left-light, without glasses, normal, right-light, sad, sleepy, surprised, and wink. The categories are defined as subjects along with labels, so total classes are 15. The complete dataset is splitted in two parts: 148 images for training, and 17 for testing. Final average accuracy is calculated at softmax layer by checking the number of test samples which identified correctly. The idea is implemented on Python 3.5.3 (64 bit) system. Opencv package is used for pre-processing using frontal face feature of haar cascade. Creation and training of neural network is done using keras, theano, and tensorflow (packages available in python). Final average accuracy achieved in proposed system is 97.05%, which is close to human face recognition accuracy of nearly 97.5%. The comparative analysis from some of the previous FR systems is provided in tables.



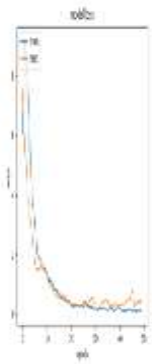


Fig:-1 Fig 2:- Losses

Fig:-3 Yalefaces Dataset

PROPOSED SYSTEM:

Our proposed system will provide a solution for monitoring driver's drowsiness. The cons of the existing system in extracting only selected hand-crafted features is overcome by using custom-designed CNN by giving an input driver image. Now the driver will be continuously monitored by a webcam. The video captured is converted into a sequence of frames. For each frame, the face and eye are detected using predefined classifiers available in opencv called haar cascade classifiers. Eye images are extracted and sent to a series of 2D CNN layers (5x5, 3x3 kernel valid padding), max-pooling layers(2x2) and finally, the fully connected dense layer classifies whether eyes are closed or not. A score is calculated based on eye closure. If both eyes are closed consecutively in 15 frames then the system predicts as drowsy and an alarm sound is triggered to alert the car operator. The categorization of driver drowsiness is done correctly and the normalization issues in the existing model are eliminated by using customdesigned CNN.

Advantages Of Proposed System:

- If the eyes are both closed, we increase the score and when eyes are open, we decrease the score. We are drafting the outcome to display the actual time condition of the driver.
- approach enables us to identify driver's face characteristics like eye closure percentage, eye-mouth aspect ratios, blink rate, yawning, head movement.

Algorithms Used For Proposed Model:

K Nearest Neighbour Algorithm

- K-Nearest Neighbour is one of the simplest Machine Learning algorithms based on Supervised Learning technique.
- K-NN algorithm assumes the similarity between the new case/data and available cases and put the new case into the category that is most similar to the available categories.
- K-NN algorithm stores all the available data and classifies a new data point based on the similarity. This means when new data appears then it can be easily classified into a well suite category by using K- NN algorithm.
- K-NN algorithm can be used for Regression as well as for Classification but mostly it is used for the Classification problems.

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- K-NN is a **non-parametric algorithm**, which means it does not make any assumption on underlying data.
- It is also called a **lazy learner algorithm** because it does not learn from the training set immediately instead it stores the dataset and at the time of classification, it performs an action on the dataset.
- KNN algorithm at the training phase just stores the dataset and when it gets new data, then it classifies that data into a category that is much similar to the new data.

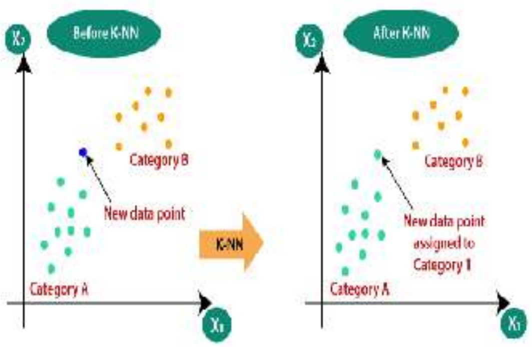


Fig:-4Before KNN and After KNN Graphs

RESULTS AND DISCUSSION:

Comparison of Existing Solutions

The comparison of various machine learning techniques for drowsiness detection mentioned above will help to find the well-suited approach for given business context. The following table provide comparative analysis of machine learning techniques for drowsiness detection. The first table specifies metrics and classifiers used for every method along with its accuracy. The second table specifies pros and cons of every method used in the drowsiness detection systems. driving supporter schemes decreased the danger of four-wheeler accidents, and investigations depicted weariness to be a major reason of four wheeler accidents. A car organization announced an idea that whole deadly accidents (17%) would be attributed to weary drivers. Many revisions showed by Volkswagen AG specify that 5-25% of all accidents are produced by the sleeping of driver. The lack of concentration damage steering actions and decrease response period, and revisions illustrated that sleepiness raises threat of crashes demand for a dependable intelligent driver sleepiness sensing system. The existing systems uses the orientation of facial characteristics for drowsy detection.based on three factors such as physiological, behavioral, and vehicle-based measurements. But these approaches pose some disadvantages in certain real time scenarios.

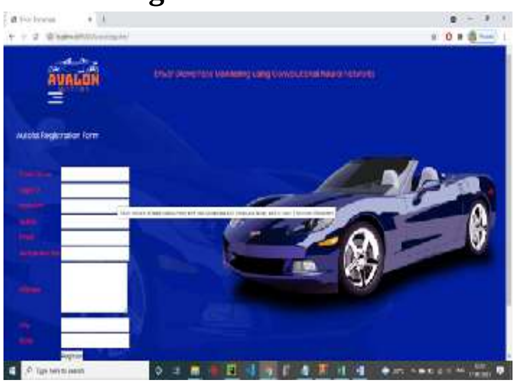
Method	Metric	Classifier	Accuracy
Vehicle-based features	Steering wheel movement (SWM) Standard deviation of lane position (SDLP)	Multi-level back propagation neural network	88.02%
Facial landmarks	Eye aspect ratio (EAR) Mouth opening ratio (MOR) Nose length ratio (NLR)	Support Vector Mechanism (SVM)	95.8%
Method	**Metric**	**Classifier**	**Accuracy**
Eye features	Eye closure analysis, Eye blink rate	Convolutional Neural Network (CNN)	95.18%
Physiological and behavioral features	ECG, EEG, Pulse rate	Support Vector Mechanism (SVM), Karolinska sleepiness scale (KSS)	80%

Table:-1COMPARATIVE ANALYSIS OF DROWSINESS DETECTION TECHNIQUES

Screen Shots

Home Page

Autoist Register



Drowsiness Detections

Fast History Results

CONCLUSION:

A model for drowsiness sensing depends on effective CNN architecture, planned to observe drowsiness based on eye closure. The implementation started preparing image datasets for both open and closed eyes. 75% of the data set is used for the custom-designed CNN training and the balance 25% of the dataset is utilized for test purposes. First, the information video is transformed into frames and in each frame, the face and eyes are detected. The enhanced CNN supplied an automated and effective learned characteristics that aid us to categorize the opening or closing of eyes. If the closing of eyes occur in 15 successive frames, an alarm is triggered to alert the driver. The proposed CNN gives a training accuracy of 97% and a testing accuracy of 67%. For future works, extra face characteristics can be added to give more accuracy in detection. We can also combine vehicle driving pattern information obtained using On-Board Diagnostics sensors with the facial features extracted.

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