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Driver Drowsiness and Fatigue Detection System : A Review

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Abstract:- Driver drowsiness and fatigue detection is very important in today's day. This systems reduces the road accident and ensures the vehicles as well as driver safety. In this paper, we reviewed various researches that help in drowsiness and fatigue detection. We used four categories of approach i.e researches involving machine learning, deep learning, computer vision technology and EEG. These researches have high accuracy and can be implemented in real time. The Experiments involve simulated driving environment and healthy subjects. Theyare monitored throughout the period of driving and thus drowsiness and fatigue is detected.

I. INTRODUCTION

Drowsiness is a state where a person feels abnormally sleepy or not able to keep hiseyes open, now this can happen in different ways like feeling sleepy due to excessive work, more alcohol consumption, any medication side effect or due to drugs consumption. now adays many accidents are caused due to drowsy or fatigue driving. So to reduce the numberof accidents and keep the driver awake the Driver Drowsiness Detection System has come to action. Driver drowsiness Detection measured with cameras, EEG signals.

There are many camera based drowsiness detection system that use image processing, face recognition and eye state detection methods to detect the drowsiness or fatigue of the driver. Sensor based method consists of the processing signals. EEG based drowsiness detection system are done through the EEG signals: they are the brain signals that help in drowsiness analysis. ECG based systems are done by the ECG signal: it reflects the electrical activity of the heart. Till date, many effective systems are proposed for the Driver Drowsiness Detection in different domains with different methods, components anddatasets.

Driver Drowsiness can also be detected by Fatigue Detection. Fatigue is nothing but tiredness and state of drowsy .Fatigue can be detected in same manner of drowsiness but itrequire many parameters. Fatigue detection can be done on different basis like:

Till date many methods are proposed for fatigue detection like Remote photoplethysmography(rPPG): It is a video based method that monitorschange in blood to measure pulse rate.

$$f_{PERCLOS} = \frac{n_{close}}{N_{total}} \times 100\%$$

- Electrooculography(EOG): It records the eye movements by detecting a voltagedifference between the cornea and retina.
- Convolutional neural network(CNN): It detects the states of eyes and mouth fromROI images.
- Artificial neural networks: It stimulates the network of neurons that make up ahuman brain so that computer will act as human.

Fatigue detection system refers to feeling tired or exhausted whereas drowsiness refersto being abnormally sleepy but they are quite similar to each other.

II. INTERFERENCE

Driver fatigue detection methods are implemented using various algorithms and dataset. The Performance of algorithm is truly depend on the accuracy as well as techniques of that algorithm. The datasets are also important term in accuracy. In Remote photoplethysmography (rPPG) method each signal play important role for capturing driver's drowsiness or fatigue. This techniques provide much more security to the vehicle as well as driver. This method provide a more accuracy using physical features. There are many method uses various features for driver drowsiness or fatigue detection. Driving fatigue or drowsiness can be also monitored by using driver's blood as well as heart rate. In that method the special camera is used which is RGB Camera. The MFRNN dataset used in this method . The datasets used in this method provide stability to the system. The MFRNN method is used to detect driver fatigue or drowsiness state by calculating driver's heart pluse rate. An RGB camera's has disadvantage in accurate calculation due to the different coloured light as well as movement of whole body and. Mostly the Driver fatigue detection methods are implemented using eye state, which include various parameters. The methods based on ROI region uses CNN to calculate the percentage of eye closeness and also the eye open-close frequency. It is calculated as:

Where, *total N* is the complete count of frames in a given time. The method can work incondition of wearing glasses. CNN give result '1' for eye-open and '0 'for close.

For now a days Driver drowsiness is also big issue, for vehicle accidents. To overcome this there are many techniques or methods are proposed to reduce the accidents. The DriCare method detects the drivers' drowsiness using yawn and eye open-close rate without using anyequipment in real contact with human body. By joining the features of the eyes and mouth using Regin Of Interest . EOG method is also used to detect the driver drowsiness. EOG signal has detection rate of more than 80%.T here are addition of electronic devices onto the skin.

Many methods are developed based on face detection and eye detection and using this info driver drowsiness detected. For the face detection, there are many techniques like using python libraries Open CV or Delib and many more. Then the eye detection is needed for thatthere are methods in which eye is extracted from face using facial landmarks.

EEG is extremely quick and proficient strategy to distinguish driving weariness. Consequently different techniques are proposed to recognize driver weakness utilizing it. The tests were completed utilizing in simulated driving environment for some particular measure of time. In[32] an ESTCNN calculation is proposed to distinguish exhaustion which naturally takes in legitimate provisions from EEG signals. [33] 4 kinds of entropies were determined as characteristics. All capabilities were utilized as the contribution of an gradient boosting decision tree,[34] CNBLS can exceptionally further develop the discovery results, the proposed procedure has progressed the EEG identification methods.in [35]the MLPHVG procedure, which grants in discovering exhaustion driving just as seeing into the brain shortcoming conduct was proposed. In [38] The current work recommended utilizing move picking up, contingent just upon single EEG station to upgrade framework convenience. Systems involving single EEG channel for fatigue detection are more usefull as they can be implemented in real time due to small equipment required and it is practically possible.

Driver drowsiness detection using deep learning is one among the foremost effective methods for identifying drowsiness in real time. Various methods are proposed involving such.[11]targets at developing a true time driver inspecting engine using deep learning while being OS agnostic . It deploys a Convolutional neural network for detection, classifying different images , extraction of features, and alerting.[17] to cover the most delicate sleepy features, we include a face monitoring system supported by a face expression descriptor .[19] the CNN aims to find facial alignments from variety of faces their temporal dependencies are found out from the data that was provided.[25]This research demonstrates impactful method for drowsiness detection of drivers. It supports head posture alignment detection and eye-pupil detection by extracting details from facial region initially. In[27]the Heart Rate Variability is mainly used to analyze the drowsiness levels.

III. COMPARISON TABLE OF METHODS , DATASET & ACCURACY

Paper Id	Methods	Dataset/models	Accuracy
Yin-Cheng Tsai, Peng-Wen Lai, Po-Wei Huang(2020)[1]	Remote Photoplethysmography (rPPG) Signal Method.	ANN1,ANN2, ANN3,ANN4,ANN5	90.13%
A Balasundaram ,SAshokkumar (2020)[2]	Open CV AndPyhton	-	88%
Gulbadan Sikanderand Shahzad Anwar(2020)[3]	Facail Action Units	CNN,AlexNet, GoogleNet	95.17%
Guanglong Du TaoLi, Chunquan Li (2020) [4]	Integrating heart rateand Facial parameter method.	RNN,MFRNN	92.88%
D.Jayanthi, M.Bommy (2018) [5]	EOG Signal Method.	-	94%
Anirban Dasgupta,Anjith George (2018) [6]	Eye State and CNNmetod	CNN	91.45%
Gulbadan Sikander,ShahzadAnwar (2018) [7]	Remote Photoplethysmography (rPPG) Signal With RGB cameraMethod.	HVR, SVM	95%
R.C. Coetzer and G.P. Hancke (2013)[8]	hypovigilancemethod	ANN,SVM,Ad aBoost	96.70%
mens,Kaufmann,Em ma Klotz (2020) [25]			
Umit Budak, VarunBajaj, Yaman Akbulut, Orhan Atilla and Abdulkadir Sengur(2019) [26]	Electroencephalogram(EEG), long-short term memory(LSTM)	AlexNet, VGG16, Deep CNN	94.31%
Marco Javier Flores·José María Armingol·Arturo dela Escalera (2010) [27]	Advance DriverAssistance System(ADAS)	-	94.56%
Koichi Fujiwara, Erika Abe,Keisuke Kamata, Chikao Nakayama, YokoSuzuki,Toshitaka Yamakawa (2018) [28]	EEG, Heart rate variability(HRV)	Auto regressive model (AR)	88%
Jing-Ming Guo &Herleeyandi	CNN , LSTM	ACCV	84.85%

Markoni (2018) [29]			
A F M SaifuddinSaif, Zainal Rasyid Mahayuddin (2020) [30]	pupil detection usingDCNN	OpenCV	98.97%
Francesca Trenta , Sabrina Conoci , Francesco Rundo, Sebastiano Battiato(2019) [31]	HRV , Photoplethysmography(PPG)	PPG Signal ,CNN , RNN	99%
Zhongke Gao,Xinmin Wang,Yuxuan_Yang ,Chaoxu Mu,QingCai,Weidong Dang,Siyang Zuo (2019) [32]	ESTCNN with EEG	CNN-B	97.37%
JianFeng Hu, Jianling min (2018) [33]	GBDT with EEG	-	94%
Yuxuan Yang, Zhongke Gao,Yanli Li,QingCai,Norbert Marwan, JürgenKurths	CNBLS using EEG	-	99.36%

IV. CONCLUSION

This research paper is a comparison and review of methods and their dataset it also includes the advanced methods in the field of driver drowsiness and fatigue state detection. There is a high possiblity of risk with driver because fatigue/drowsiness and can cause major issues to surroundings and the human life. In drowsy state driver not able to control the vehicle as he in the sleepy mode which causes the trouble to driver and in worst case driver sometimes dead. Driver fatigue means after long period of continuous driving, driver experiences physical and mental functional disorder. The researches have been done in the field of driver fatigue/drowsiness detection. Still much things can also be done to develop real-time and accurate technique that works very good and better.

A comparisons of the technologies in the given table have their own pros and cons and also there is mentioned advance technique for overcome their cons. Physical attributes and vehicular attributes can be used at same time for accurate real time drowsiness detection. The facial parameter are described in all the techniques are eye-ball movement, eye blinking rate, closed eyes, yawn, head rotations and many more. It's suggested that physical features ofdriver and characteristics of driver, could provide better accuracy.

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