wjert, 2021, Vol. 7, Issue 4, 247-256. Review Article ISSN 2454-695X

World Journal of Engineering Research and Technology

WJERT

www.wjert.org SJIF Impact Factor: 5.924

REAL TIME DETECTION OF DRIVER DROWSINESS USING AI TECHNOLOGIES

Bhavana D.*[1] and Parinitha J.[2]

[1]Dept. of TCE, SJCIT.

[2]Assistant Professor, Dept. of ECE, SJCIT

Article Received on 20/05/2021 **Article Revised on 10/06/2021** **Article Accepted on 30/06/2021**

***Corresponding Author**
Bhavana D.
Dept. of TCE, SJCIT.

ABSTRACT

The World Health Organisation has identified road traffic injuries as a major global public health problem. Most of the accidents occur due to driver's drowsiness. Early detection driver drowsiness can reduce the number of accidents occurring. Driver drowsiness can be identified by various factors driver's physiological features, Driver's visual features and vehicle variables. In this paper we have discussed about the classification of human driver Inattentive and Aggressive Driving Behavior (HIADB). Followed by briefly discussed about the different approaches and technologies used for early detection of Driver's Drowsiness. Compared the different approaches used for detection of Face, Eyes, Mouth, processing techniques, imaging techniques popular methods is discussed based on the advantages and limitations. Finally concluded with which is the best approach used for face, eye and mouth for face tracking Driver's Drowsiness detection

***INDEXTERMS*:** Driver drowsiness detection, Face tracking, Fatigue or drowsiness detection human inattentive driving behavior.

INTRODUCTION

Drowsy driving is one of the main causes of traffic accidents. When a person does not get the required amount of sleep, their ability to properly function is affected. A lot of statistics reported about road accidents that happened because of driver fatigue and drowsiness. Drowsiness leads to approximately 40% of crashes on highways. Drowsiness is the most

frequent contributor to crashes. The main objective of this paper is to review different driver drowsiness detection techniques in detail so that people can easily decide which detection techniques are better and also to help in making decision on drowsiness accurately as this review is based on the recent techniques. Driver fatigue can be detected over a wide range by leveraging dual Near-infrared (NIR) cameras, however, physical characteristics that can be observed by a naked eye cannot be detected. Aggressive driving emotion detection-based convolution neural networks (CNN) method has used both NIR and thermal cameras where NIR cameras can detect facial feature points and measure their changes and Thermal cameras can measure temperature changes in a driver's body, which cannot be checked by the naked eye. This paper focuses on the most recent deep learning-based systems, algorithms and techniques for the detection of Human Driver Inattentive and Aggressive Driving Behavior (HIADB) by classifying human Inattentive driving behavior (HIDB) into two major categories; Distraction and Fatigue/Drowsiness. Aggressive driving behaviors often result in property as well as bodily injury damages. The paper presents an arithmetic based method to solve the problem related to the detection of drowsiness. Three stages were involved They are Face detection, Eye position detection and Eye tracking. This paper provides an efficient method for the detection of the state of the driver. many countries and government officials are paying attention to the implementation of solutions to improve driving safety.

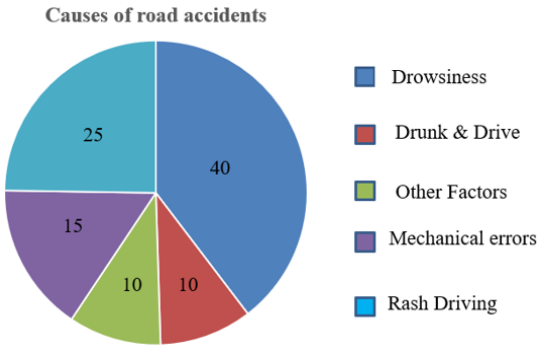

Figure 1: Causes of Road Accidents.

Drowsiness or sleepiness can be described as a biological state where the body is in-transition from an awake state to a sleeping state. There are obvious signs that suggest a driver is drowsy, such as:

1. Frequently yawning.
2. Inability to keep eyes open.
3. Swaying the head forward.

4. Face complexion changes due to blood flow.

The structure of our paper which is as follows: In Section 2, we first classify and discuss the Human driver Inattentive Driving Behavior (HIDB) detection and then discuss Human driver Aggressive Driving Behavior (HADB). In Section 3 we give an overview of deep learning algorithms that are particularly employed for detecting HIADB. In Section 4 We have discussed the desktop-based approach. The image processing technique is most important for drowsiness detection as it focuses on face detection, eye detection, mouth detection, feature extraction, and face tracking Compared the different approaches and finally we conclude the paper.

CLASSIFICATION OF HUMAN DRIVER INATTENTIVE DRIVING BEHAVIOR

Human Driver Inattentive Driving Behavior is classified into 2 major categories Driver Distraction (DD) and Drowsiness. Another risky one is Aggressive Driving Behavior. Here we are mainly focusing on different ways for Drowsiness Detection shown in figure 2.

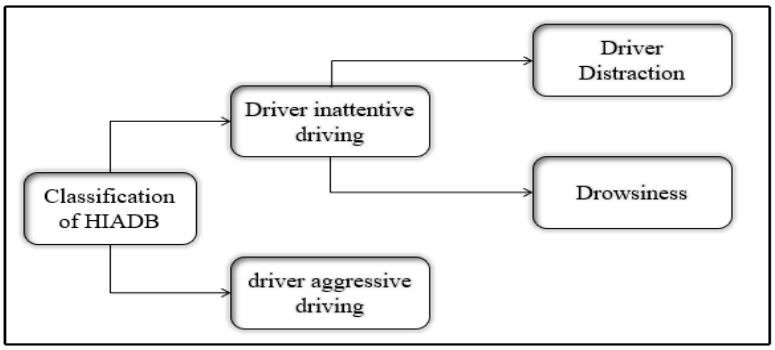

Figure 2: Classification of HIADB.

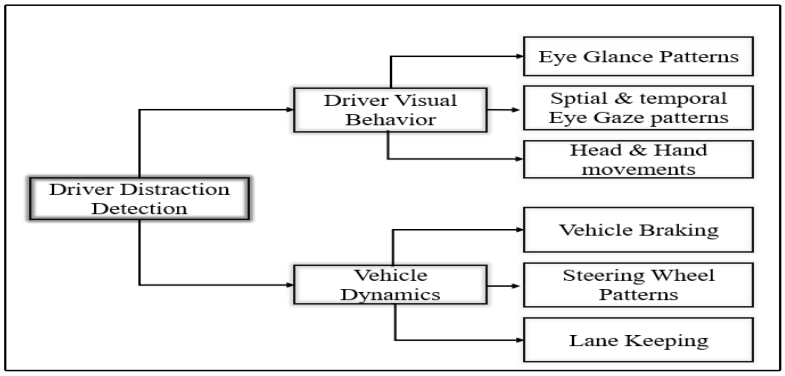

Figure 3: Driver Distraction Detection.

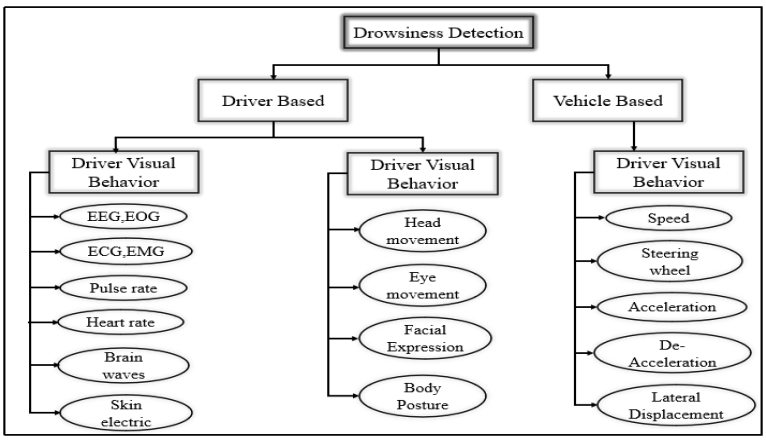

Figure 4: Drowsiness Detection.

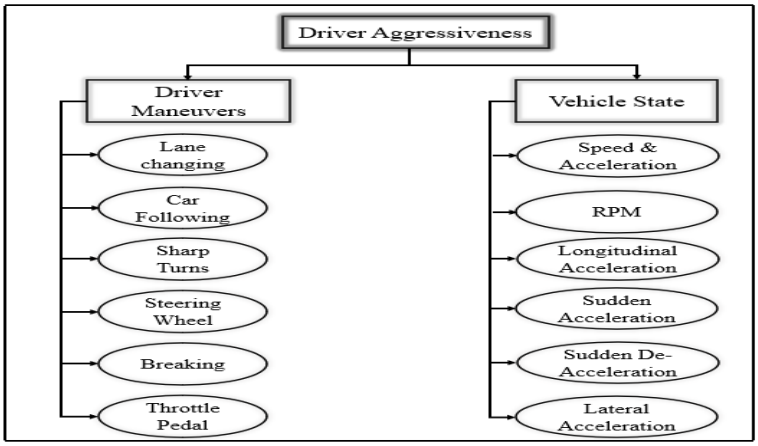

Figure 5: Aggressive Detection.

Figure 3 Shows Distraction of human driver can degrade his driving performance resulting in unplanned speed changes, hiccups in vehicle control, and drifting outside the lane edges, which ultimately increases the chance of a motor vehicle crash. Human driver distractions are of six kinds including visual, cognitive, manual, auditory, olfactory and gustatory distraction.

Figure 4 shows Categorization detection of Human driver fatigue or drowsiness into two major types of measures Driver-based measures and Vehicle-based measures. Driver's drowsiness can be detected by identifying initial signs of fatigue before a critical situation arises eye tracking data acquired from 53 subjects in a simulated driving experiment and simultaneously recorded multichannel electroencephalogram (EEG) signals to detect drowsiness of a driver.

Figure 5 shows Aggressiveness of a human driver into two types; Habitual Aggressiveness (Intentional) and Situational or Occasional Aggressiveness (non-intentional). Hidden Naive

Bayes classifier was employed to detect angry driving during the on-road driving experiments.

ALGORITHMS

The deep learning models that are employed for the detection of Human driver Inattentive and Aggressive Driving Behavior (HIADB) are of two kinds; Generative models and Discriminative models. Generative model is a branch of unsupervised deep learning that learns any kind of data distribution and captures the joint probability.

1. Convolution Neural Networks (CNN)

Kunihiko Fukushima was the first who introduced Convolutional Neural Networks (CNN) by designing neural networks with multiple pooling and convolutional layers. CNN has been widely adopted in the applications for image classification, speech recognition, video classification, action recognition, and sentence classification. CNNs, often called ConvNet, have two main components; the feature extraction part and the classification features are detected by performing a series of convolutions and pooling operations using two hidden layers.

2. Recurrent Neural Networks (RNN)

Recurrent Neural Networks (RNN) are neural networks with time varying behavior including the notion of dynamic change over time. Different kinds of RNNs include Deep Transition (DT) RNN, DT-RNN with shortcut connections, Deep Transition-Deep Output (DOT) RNN and Stacked RNN, quasi-recurrent neural networks (QRNN), hierarchical multiscale recurrent neural network (HM-RNN). RNNs are called recurrent or recursive because they perform the same task for every element of a sequence and the output depends upon the previous computations.

DIFFERENT APPROACHES

Processing Techniques

In Table 1, we have listed the hardware used for processing techniques, i.e. to process the images and to detect whether the driver is drowsy or not. There you also find the advantages and disadvantages of each hardware device.

Table 1: Hardware used for processing techniques.

Ref	Hardware	Advantages	Limitations
[11]	FPGA (Field Programmable Gate Array)	Faster than conventional microprocessors and flexible in programming	Slower than ASIC
[12]	Raspberry Pi	Low cost and power consumption	Not compatible with X86 operating systems
[13]	OMAP (Open multimedia applications platform)	Has onboard face detection module that can be used for camera focus control	Lacks the high-resolution with high resolution images

Imaging Techniques

In Table 2, we have listed the camera used for imaging techniques, i.e. to capture the images of the driver during driving. There you also find the advantages and disadvantages of each device. Image processing forms of image import, analysis, manipulation, and image output. The main goals of image processing techniques include processing, detection, and tracking of faces, eyes, and mouth, and feature extraction of facial components.

Table 2: Imaging Techniques.

Ref	Camera	Advantages	Limitations
[14]	VGA	Video conferencing and still used in applicable handheld gadgets	Low resolution
[15]	IP CCTV (not the analogue CCTV)	Low cost and power consumption High resolution, can cover a much wider area than an analog CCTV camera	Infirm security system
[16]	Webcam	Produce video in multi-megapixel resolutions, and few can run at high frame rates such as the PlayStation Eye	Continuously connected to web for an indefinite time.
[17]	PI Camera	Able to make use of the graphics processing capability of the Broadcom CPU.	Limited memory

Face Detection Techniques

Table 3: Face Detection Techniques.

Ref	Techniques	Advantages	Limitations
[16]	Learning-based (using Viola Jones method)	Good Robustness	Ineffective to detect titled faces and sensitive to lighting conditions
[17]	Feature-based (in HSV color space)	Average Robustness and the chromaticity is decoupled from the intensity	Non-removable singularities
[18]	Feature-based (in RGB color space)	Removes the brightness information from the RGB signal	Performance varies with skin color and low robustness.
[19]	Feature-based (in YCbCr color space)	Luminance independent. Make color space attractive for skin color segmentation.	Very low robustness and doesn't give proper information of skin.

In Table 3, we have listed the face detection techniques along with the advantages and limitations. The learning based technique is more robust than feature-based technique. But both of them usually fail in night light and some real-time stages.

Eye Detection Techniques

Table 4: Eye Detection Techniques.

Ref	Techniques	Advantages	Limitations
[19]	Support Vector Machine (SVM)	Increase the overall robustness of the system and uses the kernel trick	The head position does not deviate a lot when fully awake. Need long training time on large data sets.
[20]	Haar Classifiers	Execution speed and detection accuracy are high.	Complexity is definitely increasing, less robustness to different lighting conditions
[21]	Vision-Based Intelligent Algorithm (Convolutional Neural Networks)	Feasible to train easier to integrate and time complexity is O(n)	Need to provide both quantitative and qualitative result, difficult to determine the window size

Eyes and eye region are the most vital part for drowsiness detection. Most of the drowsiness detection system detects drowsiness by comparing the condition of eyes and eyelid

movement. Mainly eye detection depends on head position.

Mouth/Yawn Detection Techniques

Table 5: Mouth/Yawn Detection Techniques

Ref	Techniques	Advantages	Limitations
[12]	Latent Dirichlet Allocation (LDA)	Probabilistic model and gives categories for free in any dataset, very high accuracy	Topics are soft-clusters, much information needed.
[13]	Haar-like Features	High execution speed and works even if the driver turns his face	Incredible complexity, accuracy depends on different lighting conditions.
[14]	Improved Fuzzy C-Means clustering technique	Works robustly at night time because of the IR illuminator being used	Performance decreases during daytime especially in bright days, fails to detect when the head is rotated

We listed the mouth detection techniques in Table 5, along with advantages and limitations. LDA, Haar-like Features, Fuzzy C-Means Clustering are the most used techniques to detect mouth or yawn. Among them, some systems detect mouth based on color features of lips but they can only work properly in suitable light conditions and color image.

CONCLUSION

Road accidents are a global scourge in which Human driving behavior is an important factor, affecting road safety that ultimately leads to loss of human lives. face detection, viola jones method (learning based) is preferred as it is much popular. For eye detection, haar-classifier technique is suggested as it has better execution speed and accuracy. Haar classifier technique also gives better performance in case of mouth detection The most recent deep learning-based solutions for human driver Inattentive and Aggressive Driving Behavior (HIADB) detection were reviewed systematically and comprehensive comparative analysis (quantitatively and qualitatively) was performed, highlighting their detection accuracies. There are many techniques that are based on behavioral methods and machine learning that can be utilized for the purpose of driver drowsiness detection. The main goal of these systems is to detect a slight change in a driver's facial expression that contains drowsiness information. We conclude that HIDB and HIADB can be efficiently detected and accurately assessed by using

multiple sources of information

REFERENCES

1. Younes Ed-Doughmi, Najlae Idrissi and Youssef Hbali Real-Time System for Driver Fatigue Detection Based on a Recurrent Neuronal Network J. Imaging, 2020; 6: 8. doi:10.3390/jimaging6030008.
2. Bhargava Reddy, Ye-Hoon Kim, Sojung Yun, Chanwon Seo, Junik Jang Real-time Driver Drowsiness Detection for Embedded System Using Model Compression of Deep Neural Networks.
3. Jongseong Gwak, Akinari Hirao and Motoki Shino An Investigation of Early Detection of Driver Drowsiness Using Ensemble Machine Learning Based on Hybrid Sensing Published: 22 April 2020. Appl. Sci., 2020; 10: 2890. doi:10.3390/app10082890.
4. V B Navya Kiran, Raksha R, Anisoor Rahman, Varsha K N Driver Drowsiness Detection International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org NCAIT - Conference Proceedings, 2020.
5. ZhangLi Analysis on the Influence of Aritificial Intelligence Development on Accounting International Conference on Big Data, Artificial Intelligence and Internet of Things Engineerings, 2020.
6. Mkhuseli Ngxande, Jules-Raymond Tapamo, Michael Burke Driver drowsiness detection using Behavioral measures and machine learning techniques: A review of state-of-art techniques 2017 Pattern Recognition Association of South Africa and Robotics and Mechatronics International Conference (PRASA-RobMech) Bloemfontein, South Africa, November 29 - December 1, 2017.
7. Ajay Shrestha And Ausif Mahmood Review of Deep Learning Algorithms and Architectures 2169-3536 IEEE. Translations and content mining are permitted for academic research, 2019.
8. Monagi H. Alkinani, Wazir Zada Khan, And Quratulain Arshad, Detecting Human Driver Inattentive and Aggressive Driving Behavior Using Deep Learning: Recent Advances, Requirements and Open Challenges, 2018.
9. Wanghua Deng Ruoxue Wu Real-Time Driver-Drowsiness Detection System Using Facial Features, 2016; 4.

10. Anis-Ul-Islam Rafid, Amit Raha Niloy, Atiqul Islam Chowdhury, A Brief Review on Different Driver's Drowsiness Detection Techniques I.J. Image, Graphics and Signal Processing, 2020; 3: 41-50.
11. Guang Chen, Lin Hong, Jinhu Dong, EDDD: Event-Based Drowsiness Driving Detection Through Facial Motion Analysis With Neuromorphic Vision Sensor 1558-1748 © 2020 IEEE IEEE SENSORS JOURNAL, 2020; 20(11): 1.
12. Jongmin Yu, Sangwoo Park, Sangwook Lee, Driver Drowsiness Detection Using Condition-Adaptive Representation Learning Framework 1524-9050 © IEEE, 2018.
13. https://prezi.com/r_0klsftnn_w/driver-fatigue-detection-system/ accessed on April 20, 2021.
14. https://www.scribd.com/doc/79200398/Drowsy-Driver-Detection accessed on April 28, 2021.
15. Taner Danisman, Ioan Marius Bilasco, Chaabane Djeraba, Nacim Ihaddadene. Drowsy Driver Detection System Using Eye Blink Patterns. International Conference on Machine and Web Intelligence, Oct, Alger, Algeria, 2017; 230-233.
16. S. Thorat, P. Nagare, S. Mulay, Drowsiness Detection Raspberry PI 3 model B. International Jounal of Computer Engineering & Applications, May 2018.
17. Jiadi Yu, Zhongyang Chen, Yanmin Zhu, Yingying (Jennifer) Chen, Linghe Kong, Minglu Li, Fine-Grained Abnormal Driving Behaviors Detection and Identification with Smartphones. IEEE Transactions on Mobile Computing, August 2017; 16: 8.
18. A. Khandakar, M. E. H. Chowdhury, R. Ahmed, A. Dhib, M. Mohammed, N. A. M. A. Al-Emadi, and D. Michelson, ''Portable system for monitoring and controlling driver behavior and the use of a mobile phone while driving,'' Sensors, 2019; 19(7): 1563.
19. ASIRT. (2019). Road Safety Facts. [Online]. Available: https://www.asirt. org/safe-travel/road-safety-facts/ accessed on may 1, 2021.
20. WHO. (2018). Global Status Report on Road Safety 2018. [Online]. Available: https://www.who.int/violence_injury_prevention/road_ safety_status/2018/%en/ accessed on may 5, 2021.
21. A. P. van den Beukel, M. C. van der Voort, and A. O. Eger, ''Supporting the changing driver's task: Exploration of interface designs for supervision and intervention in automated driving,'' Transp. Res. F, Traffic Psychol. Behaviour, 2016; 43: 279–301.
22. Bagus G. Pratama, IgiArdiyanto, Teguh B. Adji, "A Review on Driver Drowsiness Based on Image, Bio-Signal, and Driver Behavior", IEEE, July 2017.