WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

DOPIDET - Driver Drowsiness Detection

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ABSTRACT

The aim of this research is to develop a non-intrusive system capable of detecting fatigue in humans and issuing a timely warning to prevent accidents caused by drowsy driving. According to expert studies, around one-quarter of serious motorway accidents are caused by drivers who fail to recognize their drowsy state in time to take a break. To address this issue, the proposed system will monitor the driver's eyes using a camera and an algorithm to detect signs of fatigue. The warning output will be in the form of an alarm and pop-ups, which can only be deactivated manually by correctly answering a simple mathematical question. In case of a drowsy response, the system will plot a graph of the input variables and issue a warning signal in the form of text and sound to indicate the driver's fatigue level, which can be used to evaluate their driving performance.

Keywords: Alert Alarm, DLIB, Drowsiness, EAR, MAR.

1. INTRODUCTION

Real-time drowsiness behaviors related to fatigue include eye-closing, head nodding, and changes in brain activity. To monitor drowsiness, we can measure physiological signals such as brain waves, heart rate, and eye blinking, or physical changes like sagging posture, leaning of the driver's head, and the open/closed state of their eyes. In this research, a camera-based system is proposed to detect symptoms of driver fatigue using an algorithm to monitor the driver's eyes. The system will issue a warning in the form of an alarm and pop-ups to avoid the driver from sleeping. The eye area can be estimated using optical flow, sparse tracking, or frame-to-frame intensity differencing and adaptive thresholds. An algorithm to detect eye blinks is proposed using a recent facial landmark detector to derive a single scalar quantity that reflects the level of eye opening.

The first technique of measuring physiological signals is accurate but not realistic as it requires attaching sensitive electrodes on the driver's body, which can be annoying and distracting. The second technique of measuring physical changes is non-intrusive and well-suited for real-world conditions using a video camera to detect changes. Microsleeps lasting 2-3 minutes are good indicators of fatigue, and by continuously monitoring the driver's eyes, the system can detect the sleepy state and issue a timely warning.

2. BACKGROUND

Driver drowsiness detection is a technology that aims to detect the level of fatigue or drowsiness of a driver while they are operating a vehicle. The goal of this technology is to alert the driver or even take preventive measures, such as slowing down or stopping the vehicle, to prevent accidents caused by driver fatigue.

There are various approaches to detecting driver drowsiness, including using sensors that track the driver's eye movements, facial expressions, body posture, and steering behavior. These sensors can detect signs of fatigue, such as frequent blinking, yawning, drooping eyelids, and slow reaction times. Some systems also incorporate machine learning algorithms to analyze these signals and predict the level of drowsiness.

3. REVIEW OF LITERATURE

A survey of existing literature and methodologies was conducted to find research gaps in their approaches and models. The survey consisted of many articles in the literature, and the most relevant articles were shortlisted.

According to a study by Sishir and Anjali [1], drowsiness is a significant contributor to fatal accidents worldwide, leading to numerous deaths and injuries. Research has indicated that drivers who lack sufficient sleep or experience fatigue are particularly susceptible to drowsiness while driving. To address this issue, the authors of the study proposed a new experimental model aimed at detecting driver drowsiness and reducing the number of accidents caused

by this problem, ultimately improving transportation safety. The proposed model utilizes two methods for detecting drowsiness, including capturing the driver's face, performing eye retina detection and facial feature extraction, and calculating blinking values while setting appropriate threshold values

In their paper, Bano & Saxena [2] discussed the importance of image processing and computer vision, particularly image segmentation, for various applications such as scene understanding, medical image evaluation, robotic perception, video surveillance, augmented reality, and compression. With the rising numbers of deaths and injuries caused by human errors in road accidents each year, drowsiness and driving have become a particularly risky and challenging issue to identify. After alcohol, drowsiness is the second leading cause of road crashes. Detecting driver drowsiness is a critical vehicle safety technology that can help prevent accidents caused by sleepy drivers. The paper presents various methods for detecting driver drowsiness and provides challenging comparisons among these methods.

Dhairya Shah [3] In today's fast-paced world, where nearly everyone owns a vehicle, road accidents are on the rise. Many of these accidents can be attributed to drivers being drowsy or fatigued. Unfortunately, the number of deaths and injuries resulting from drowsy driving continues to increase each year. To help reduce the number of accidents caused by driver exhaustion and promote road safety, this project introduces the Advanced Assistance to Driver Drowsiness (AADD) module. Using computer vision and artificial intelligence (AI), our proposed system automatically detects driver drowsiness by analyzing their face and eyes and computing the percentage of time their eyes are closed (PERCLOS), a scientifically validated measure of drowsiness.

WANGHUA DENG [4] The human face is a vital part of the body as it conveys essential information. When a driver is fatigued, their facial expressions can differ from their normal state, such as yawning and blinking more frequently. However, previous algorithms have not been able to track these changes accurately. To overcome this, we propose a new face-tracking algorithm that improves the precision of tracking. We also introduce a novel detection method that identifies specific facial regions based on 68 key points to assess the driver's condition. Our system, DriCare, combines information from the eyes and mouth to alert drivers to their level of fatigue. We conducted experiments that showed that DriCare has an accuracy of approximately 92%.

In his work, Ashish Kumar [5] highlighted that driver fatigue is a leading contributor to road accidents and fatalities. As a result, detecting driver drowsiness and providing an alert is an active research focus. To this end, the current study aims to develop a low-cost, real-time driver drowsiness detection system with acceptable accuracy.The system records video using a webcam and employs image processing techniques to detect the driver's face in each frame. Facial landmarks are then identified, and the eye aspect ratio, mouth opening ratio, and nose length ratio are calculated. Based on these values, the system determines whether the driver is drowsy using adaptive thresholding techniques. Additionally, offline machine learning algorithms have been implemented.

According to Shirisha Vadlamudi [6], drowsy driving is responsible for a significant number of motor vehicle crashes worldwide, with studies indicating that 10%-30% of crashes can be attributed to driver fatigue. Fatigue can have costly consequences on safety, health, and quality of life. Various methods can be used to detect driver drowsiness, including algorithms based on behavioral gestures, physiological signals, vitals, and vehicle-based indicators. For instance, drowsiness can be detected by analyzing steering wheel movement and lane change patterns, such as slow drifting and fast corrective steering. To address this issue, the author develops a prototype that uses artificial intelligence techniques, specifically utilizing open-source tools like TensorFlow Lite on a Raspberry Pi development board, to detect driver drowsiness in automobiles.

Challa Yashwanth [7] has noted that technology has made significant strides in improving comfort and safety for drivers over the past 50 years. Despite these advancements, accidents still occur due to various reasons, including driver fatigue. The paper focuses on solving this problem by using advanced Artificial Intelligence algorithms to detect driver fatigue and the extent of drowsiness. The proposed algorithm employs eye and mouth vertical distances, eye closure, yawning, and other facial features engineered for this purpose to detect driver drowsiness.

Mashfiq Shahriar Zaman's research [8] highlights the gradual increase in human-centric accidents, with driver drowsiness being a significant contributor. To prevent accidents related to drowsiness, researchers have proposed methods that use facial expression analysis to detect signs of drowsiness and ensure driver safety. However, current state-of-the-art models can only detect drowsiness and alert the driver. The traditional approach to drowsiness detection involves two stages - analyzing facial features to detect drowsiness and alerting the driver accordingly.

According to Suhandi Junaedi and Habibullah Akbar's research [9], driving a vehicle is a complex task that demands the driver's full attention to prevent accidents on the road. Fatigue and distractions are significant risk factors that can cause traffic accidents, severe injuries, and even fatalities. To address this problem, the researchers propose a computer vision-based method for detecting driver drowsiness using video footage captured by a camera. The proposed method involves identifying the driver's face in each frame of the video and then detecting their eyes. The iris regions of the left and right eyes are used to calculate the PERCLOS measure, which determines the percentage of time that the eyes are closed. The researchers evaluated the method using the YawDD video dataset, and their results indicate that the PERCLOS value is higher when the driver is drowsy than when they are alert.

C. M. Sheela Rani [10] points out in her study that the number of major road accidents is on the rise, with most of them being attributed to driver's negligence. A survey carried out in 2015 found that approximately 78% of these accidents were caused by drivers. To tackle this issue and reduce the number of accidents, Rani proposes a monitoring system that alerts drivers when they are at risk of dozing off. The system processes real-time video footage of the driver's face and tracks their eye and mouth movements to identify signs of drowsiness, such as eye closure and yawning rates. An alarm goes off to alert the driver if the system detects that they are drowsy or already asleep. Haar-cascade classifiers that run parallelly on the extracted facial features are used by the system to detect eye closure and yawning.

4. ANALYSIS

Table 1 presents a detailed analysis of previous studies with a tabular view of the techniques, benefits, and limitations mentioned in each article. This simplifies the validation process and clearly describes the different types of techniques and methods previously used to identify gastric cancer using mask R-CNN model.

Table 1 Analysis Table

Sr No	Title	Summary	Techniques	Advantages
1	Driver Drowsiness Detection. [1]	The paper presents a new experimental model for detecting driver drowsiness to reduce accidents caused by this problem. Two methods are used: eye retina detection and facial feature extraction, and elastomeric sensors integrated with an Arduino module to calculate driver hand pressure on the steering wheel.	Arduino module with elastomeric sensors and Eye retina detection and facial feature extraction	Capturing the driver's face, detecting eye retina and facial features, and calculating blinking values with threshold values set.
2	A Comparative Analysis of using Various Machine learning Techniques based on Drowsy Driver Detection [2]	This paper presents various methods for detecting driver drowsiness and compares them, focusing on machine learning methods based on facial expressions and eye state.	Image processing or computer vision, machine learning methods such as SVM, CNN, or HMM, eye detection, mouth detection, and face detection. HMM was found to achieve more accurate results in comparison to other methods.	Detecting driver drowsiness is important for road safety and can help reduce the number of accidents caused by drowsy driving.
3	System to Detect Driver Drowsiness[3]	The project aims to reduce road accidents caused by driver exhaustion by presenting a module for Advanced Assistance to Driver Drowsiness (AADD), which detects driver drowsiness through Computer Vision and AI. The proposed algorithm records, detects, and studies the driver's face and eyes to compute PERCLOS, a measure of drowsiness associated with eye closure.	Computer Vision and Artificial Intelligence are used in this project for automatic driver drowsiness detection. An algorithm is proposed to record, detect and study the driver's face and eyes to compute PERCLOS.	The proposed module can help reduce the number of accidents caused by driver exhaustion, thus increasing road safety.
4	Real-Time Driver-Drowsiness Detection System Using Facial Features. [4]	The paper proposes a system called DriCare that detects driver fatigue using facial expressions like blinking and yawning. The system uses video images and a new face-tracking algorithm for tracking accuracy.	Video images and a new face-tracking algorithm.	DriCare can alert the driver using a fatigue warning without equipping their bodies with devices.
5	Driver Drowsiness Monitoring System using Visual Behavior and Machine Learning. [5]	The article describes a study that presents a low-cost and non-intrusive drowsiness detection system to solve the problem of drowsy driving. The system uses a webcam and image processing techniques to detect facial landmarks and compute eye aspect ratio, mouth opening ratio, and nose length ratio.	Webcam, image processing techniques, and machine learning algorithms.	Low cost, non-intrusive nature, real-time operation, and high accuracy

6	An embedded Intelligence engine for driver drowsiness detection. [6]	The article discusses the prevalence of motor vehicle crashes caused by drowsy driving and the various methods for detecting driver fatigue. One method involves using algorithms based on behavioural gestures, physiological signals, and vitals	TensorFlow Lite, a Raspberry Pi development board, and artificial intelligence techniques.	Low cost, portability, and high accuracy
7	Driver's Drowsiness Detection. [7]	The sentence discusses the advancements in technology that have improved comfort and safety in vehicles, and the problem of driver fatigue as a cause of accidents.	Ability to detect drowsiness in real-time, improving safety for drivers.	The accuracy was improved to 81.8%
8	An Algorithmic Approach to Driver Drowsiness Detection for Ensuring Safety in an Autonomous Car.[8]	The proposed approach involves using facial expression analysis to detect drowsiness and a two-stage process to alert the driver and take additional safety measures such as locating a safe parking space and sending a distress message to authorities.	Facial expression analysis algorithms and distress messaging systems.	Increased safety and the ability to take additional safety measures.
9	Driver Drowsiness Detection Based on Face Feature and PERCLOS.[9]	Contact-based methods using physiological signals have been used to detect drowsiness, but a contactless system is more suitable for real-world conditions.	HAAR, CNN.	Vision to detect drowsiness by recognizing the face, detecting the eyes, and calculating the PERCLOS measure.
10	Drowsiness Detection Based on Eye Closure and Yawning Detection. [10]	The sentence describes a proposed monitoring system that can alert drivers when they are about to fall asleep while driving to reduce the number of accidents caused by driver fatigue.	The system employs Haar-cascade classifiers to detect eye closure and yawning in the extracted facial features.	Live video feed focused on the driver's face to track eye and mouth movements, and an alarm sounds if the driver is drowsy or already asleep

5. CONCLUSION

The current study developed an automated system for detecting drowsiness of the driver. The developed system not only detects drowsiness but also provides a solution to the driver by suggesting nearby hotels for taking rest. This can help in reducing the number of accidents caused due to drowsy driving. However, it is important to ensure that the alarm and pop-up message do not distract the driver further and cause any inconvenience. It would be beneficial to conduct user studies to evaluate the usability and effectiveness of the system.

ACKNOWLEDGEMENT

I would like to express my gratitude and appreciation to all those who gave me the possibility to complete this report. Special thanks are due to my supervisor, Prof Akshaya Prabhu, whose stimulating suggestions and encouragement helped me throughout the fabrication process and in writing this report. I am also sincerely thankful for the time spent correcting my many mistakes.

I would like to extend my thanks to the staff of the Computer Department and Computer Lab for their support and assistance during this project. Their permission to use the computers during college hours was instrumental in allowing me to work on this project.

Thank you all for your contributions to this work.

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