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A Study on Fatigue among Drivers with Machine Learning by Using CNN and SVM

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Abstract: A major contributing factor to traffic accidents is driver fatigue brought on by long stretches of driving, lack of sleep, boredom, or any combination of these. Therefore, it has been suggested that fatigue detecting systems be used to warn or alert drivers. But how early driver fatigue is detected frequently affects how well the system works. Conventional techniques aim to identify driver fatigue in real time; however, in numerous crucial situations, like the takeover transition phase in fully automated driving, this detection may come too late. Therefore, the objective of this work is to predict the driver's transition from non-fatigue to fatigue during highly automated driving using physiological indications. First, we used the ground truth for driver fatigue, which is PERCLOS, or the percentage of time the eyelids are closed. Subsequently, we selected the physiological features that were most important for anticipating driver weariness in advance. Finally, we used these crucial physiological characteristics to create prediction models that, by applying a method called nonlinear autoregressive exogenous network, could forecast the exhaustion transition at least 13.8 seconds in advance. The recommended method's potential was demonstrated by the accuracy of tiredness transition prediction for highly automated driving (F1 measure = 97.3 percent and a score of 99.1 percent for two types of models, respectively).
Keywords: Fatigue Among Drivers, Machine Learning [AutoML], PERCLOS, CNN, SVM, EAR, LAR.

I. INTRODUCTION BACKGROUND

The work provides an overview of drivers among fatigue, outlining will be causes, effects, and possible mitigation strategies. The definition of fatigue, its pharmacological and psychosocial aspects, and its course are covered in the first section. In its Annual Report, the Ministry of Road Transport and Highways focuses on "Road Accidents in India-2022." The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) provided the data/information for this report in standardized forms from state and local police departments on a calendar year basis through the Asia Pacific Road Accident Data (APRAD) base project. The research states that in 2022, there were 4,61,312 traffic accidents throughout the States and Union Territories (UTs), with 1,68,491 fatalities and 4,43,366 injuries. Compared to the previous year, there has been an increase of 11.9% in accidents, 9.4% in fatalities, and 15.3% in injuries. In its Annual Report, the Ministry of Road Transport and Highways focuses on "Road Accidents in India-2022." The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) provided the data/information for this report in standardized forms from state and local police departments on a calendar year basis through the Asia Pacific Road Accident Data (APRAD) base project. The investigation states that in 2022, there were 4,61,312 traffic accidents throughout the States and Union Territories (UTs), with 1,68,491 fatalities and 4,43,366 injuries. Compared to the previous year, there has been an increase of 11.9% in accidents, 9.4% in fatalities, and 15.3% in injuries.

A. Research Questions

The five main causes of fatigue are described as:

1) Its Lack of Sleep or poor sleep for drivers
2) It has Internal body clock or circadian rhythm
3) The Task on Tine (TOT) for working long hours.
4) It will have Monotonous tasks for lack of stimulation.
5) It has Individual characteristics to including medical conditions to drivers.

The paper discusses how fatigue impacts driving behaviors, including steering, speed choice, and following. It also discusses why compensatory techniques are insufficient for dealing with, driver fatigue, as well as highlights key variation among people.

The predominance of tired driving throughout shift workers, Domestic drivers, inexperienced drivers, and experienced drivers are reported based on research findings. There are also descriptions of the signs of crashes caused by weariness, how often they occur, and the data pertaining to the link between exhaustion and risk. An additional emphasis on the conditions and risks facing a number of driver categories that are more susceptible to Driver fatigue: adolescent drivers, professional and truck drivers, shift workers truckers as well as staff who suffer from sleep problems with breathing. paper concludes with a discussion of potential countermeasures, including enforcement and legislation, fatigue management programs, in-vehicle detection and alert, publicity, infrastructure, and a review of the need for more information. Based on the techniques used to identify indicators of drowsiness, drowsiness detection systems are categorized into three categories in the literature: systems based on visuals, automobiles, and biology. Measures based on biology are in the first group. Blood pressure, electromyography (EMG), electrocardiography (ECG), electroencephalography (EEG), and electro-oculography (EOG) are some of these measurements. Fatigue in this type of system is determined by determining how the signal deviates from the standard state's attributes and determining whether the new signal implies fatigue or not. In order to track fluctuations in the car's movement patterns, the second category of vehicle-based measurements makes use of a range of sensors deployed to measure various vehicle and street data. To ascertain the driver's level of fatigue, vehicle-based systems look at behavioural changes in the car, such as abnormal steering wheel angle, speed, or lane deviation. The third group consists of image-based measurements, which are mostly focused on the driver's face and head sleepiness indicators. By keeping a watch on the drivers' head motions and facial features including their mouth, eyes, eyebrows, and breathing, these systems may identify when a motorist is sleepy.

B. *What is Fatigue?*

Numerous definitions of fatigue can be found in literary works. It is common to use the phrases "fatigue," "sleepiness," and "drowsiness" interchangeably. One of the easiest signs of weariness to recognize is sleepiness. The neurobiological demand for sleep that results from physiological waking and sleep signals is known as sleepiness. There has long been a link between work performance and fatigue. A psychological state of low energy and reluctance to finish a task can also be referred to as fatigue. Whereas tiredness tells the body to halt any continuous activity, whether it be mental, physical, or just being awake, sleepiness is the desire to sleep. While the causes of fatigue and sleepiness may differ, both lead to a reduction in both physical and mental functioning. This section addresses the biological and psychological aspects of weariness in addition to components well as evolution.

C. *Physiological components*

Physiological changes in heart rate, muscle tone, head, eye, and head movement, as well as brain wave activity, are linked to fatigue. When one is tired, the person's humidity, cardiac activity, blood pressure, respiration, which is and production of adrenaline all decrease.

Microsleeps, or little stretches of 4–5 seconds of sleep, can be brought on by fatigue. Because biological-based systems can compare continuous changes in physiological signals, they can detect drowsiness early on. However, the majority of biological-based systems need electrodes to be connected to the driver's body. For the driver, this arrangement is usually inconvenient and difficult. It also contains noise that reduces accuracy by weakening the signal. Vehicle-based systems tend to be reliant on the kind of vehicle and are subject to an extensive spectrum of influences, including as weather, road features, ranging and the driving style, habits, and experience of the driver. The quality of the camera and its reactivity to different lighting conditions are strongly related to the constraints of image-based systems.

D. *Progression of Fatigue*

Through vigilance tasks, the evolution of tiredness research has been examined. Vigilance tasks, such watching security cameras or a radar display, require the user to stay focused on the task at hand while anticipating and reacting to an unusual or unexpected incident.

Fatigue research using vigilance tasks has demonstrated that brief periods of normal functioning (e.g., perceiving signals promptly and responding appropriately) alternate with periods of reduced functioning (e.g., missing signals or responding extremely slowly) [28]. Theoretically, weariness can be explained as more than just a passive phenomenon. Deactivation processes (such as slower functioning and less attention) and compensatory processes interact to cause fatigue.

II. LITERATURE REVIEW

Many terms of reference are used in the literature on the design of drowsiness detecting systems. "Fatigue" is another name that is used, even if "drowsiness" is more common. The phrases "weariness" and "sleepiness" are synonymous despite their distinctions. "The reluctance to continue a task as a result of physical or mental exertion or a prolonged period of performing the same task" is the definition of weariness. The desire to go to sleep is called sleepiness, sometimes known as drowsiness. In essence, being sleepy is the result of an intense biological need to sleep. Many factors, such as medications, long work hours, sleep disorders, poor quality or insufficient sleep, and prolonged periods of vigilance, might contribute to drowsiness. Thus, their relationship is obvious, as fatigue produces sleepiness. Although they are distinct concepts, some researchers regarded sleepiness and weariness as equal since they produce similar results; for example, in our study, we refer to these systems as "drowsiness detection systems."

1) A comprehensive analysis of the identification and forecasting of driver fatigue Bangabandhu Sheikh Mujibur Rahman Science & Technology University, Md. Ebrahim Shaik Department of Civil Engineering.

The majority of studies shows that sleepiness among drivers is still a serious safety concern and a major factor in car incidents that result in fatalities. The process of creating more accurate ways to quantify it has advanced gradually. This substantially impedes the development of driver sleepiness understanding and recognition (Lenn´e and Jacobs, 2016). Accurately identifying tiredness is a critical first step in reducing the societal cost of road accidents. With an emphasis on what happens while driving, this study also examines the research on developing devices that aim to detect and predict driver drowsiness.

2) Driver Drowsiness Detection and Alert System, Priyadarshini Bhagwati College of Engineering, Nagpur, Maharashtra, India; Department of Computer Science and Engineering, Swapnil Titare, Shubham Chinchghare, K. N. Hande.

To avoid these accidents, we propose a system that will warn the driver if they are distracted or drowsy. With 1.3 million deaths annually, auto accidents rank as the primary cause of death. Driver fatigue or distraction is the primary cause of the majority of these collisions. Driving while sleepy impairs focus, attentiveness, activity, and awareness. It also makes judgments more slowly and occasionally not at all. Sleepiness impairs mental clarity, makes it harder for a driver to operate a vehicle properly, and raises the possibility of human mistake, which can result in fatalities and serious injuries [5]. The driver's mistake rate had dropped. Day or night, countless individuals travel great distances on the road. Accidents can be caused by sleep deprivation or distractions like talking on the phone or interacting with a passenger, among other things.

3) Development of fatigue prediction models

Fatigue prediction models are valuable tools in road safety systems because they have the potential to quantify fatigue occurrences and identify the primary elements contributing to exhaustion. These prediction techniques enable authorities and individual trucking businesses to identify potential safety hazards by studying the non-linear pattern underlying influential variables, as well as quantify the impact of developed methods in terms of weariness among LHTDs.

4) According to India's Road Accidents in 2022 are released by the Ministry of Road Transport & Highways.

The Indian Ministry of Road Transport and Highways has released the annual report on road accidents for the year 2022, and it contains some concerning trends and statistics. According to the study, there were 4,61,312 traffic incidents in 2022, resulting in 1,68,491 fatalities and 4,43,366 injuries. These figures indicate an increase of 11.9% in accidents, 9.4% in fatalities, and 15.3% in injuries over the previous year (Press Information Bureau).

Key findings of the report include:

1) Speeding has been found to be the main cause of traffic accidents, being responsible for 72.3% of all incidents, 71.2% of fatalities, and 72.8% of injuries.
2) Locations of incidents: Straight roadways accounted for 67% of all incidents, with "hit from back" encounters accounting for 21% of all accidents. The bulk of accidents (about 75%) happened on clear days; only 16.6% of all accidents happened in inclement weather, such as rain, fog, or hail.
3) Types of Vehicles: Two-wheelers were involved in the highest number of accidents, followed by cars and pedestrians
4) State-specific Data: Sikkim recorded the highest death rate (17 per 10,000 registered vehicles), However, Tamil Nadu (64,105) reported the biggest number of accidents.

III. METHODOLOGY / MATERIAL

One of the main causes of traffic fatalities and accidents is driver weariness. Identifying and forecasting driver weariness can aid in the creation of road safety solutions. Advances in machine learning, namely in Automated Machine Learning (AutoML) techniques, present encouraging prospects for precisely forecasting driver weariness. Several studies have been conducted on driver fatigue, which is characterized by less consciousness and poor performance. Physiological (such as heart rate variability, electroencephalogram) and behavioral (such as eye closing, gaping) as well as performance-based (such as response time) warning signs are traditional approaches for identifying fatigue. Even while these techniques work well, they are not always appropriate for real-time applications and frequently require for continuous monitoring. This review of the literature examines the body of research on the use of AutoML to predict driver weariness, emphasizing important approaches, conclusions, and gaps in the body of knowledge.

A. Proposed Fatigue Among Drivers Detection System for Vehicles

First Phases in Fatigue Among Drivers detecting System and also the data collection to this research study.

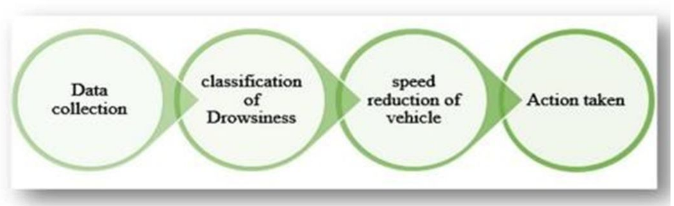

Fig: - Phases in Fatigue Among Drivers detecting System

B. Data Collections

Data gathering from all of the sensors, including the eye blink and heartbeat sensors, is done in the first phase. The driver's heart rate and eye blink rate are counted by the eye blink and heart beat sensors as soon as they detect movement in the vehicle. Every five seconds, these sensors produce data that indicates the degree of drowsiness. The information gathered by the heart rate sensor and eye blink sensor is processed further to identify the three different categories of driver drowsiness: awake, drowsy, and a sleep.

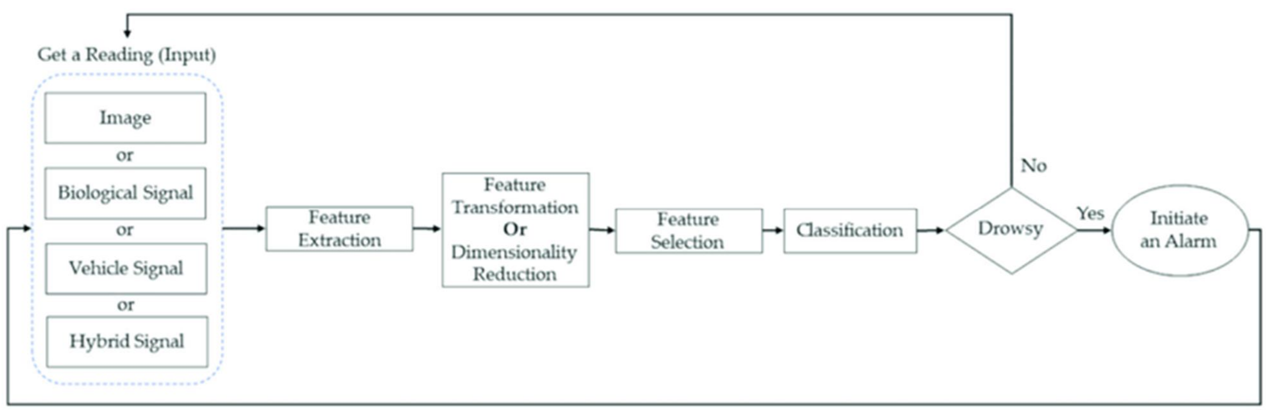

Fig: - The Data Collection Process.

The data Collection from the Model is fixed Infront on vehicle in the Infront for driver, in Model the scan the driver image with based on three parameters 1) Biological Signals , 2) Vehicle Signals and 3) Hybrid Signals and then it will process to transformations and checking Dimensionality of the driver image , then it is classification will be done for feature extraction then it detect the drowsy , if it is drowsy then it will initiate and alert the driver with the Alram .

1) Biological Signals

This type of drivers has sensors and other body-attached technological devices monitoring them for signs of fatigue. The condition of the driver can be assessed by paying attention to body temperature, brain activity, heart rate, pulse rate, and other physiological parameters. To detect and improve performance in this domain, three primary signals are utilized: electroencephalography (EEG),

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electrooculography (EOG), and electrocardiography (ECG). The length of ocular closure and the speed of eye blinking are used to gauge how fatigued the driver is. Drivers can detect tiredness easily because their eye motions and the way their lids move when they sleep change. This technology estimates the frequency of eye blinking and the duration of eye closure by tracking the position of the irises and the states of the eyes throughout time. Furthermore, this kind of device employs a remotely mounted camera to record video, after which computer vision techniques are used to successively localize the positions of the face, eyes, and eyelids in order to calculate the ratio of closure. One can tell if a motorist is sleepy by watching them closely and paying attention to how often they blink.

a) *Eye Tracking:* Tracks the frequency and length of blinks, or the proportion of closed eyes The percentage of the pupil's eyelid closing over time, or PERCLOS.
b) *Head Movements:* Identifies nodding or other sleep-related head position alterations.
c) *Facial Expression Analysis:* Recognizes indicators of fatigue, including drooping eyelids or yawning.

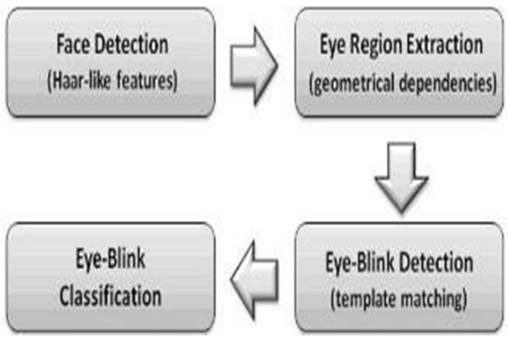


Fig: - Scheme of the proposed algorithm for eye-blink detection

2) *Vehicle Signals*

During field trials, the location of the lane is tracked using an external camera. Numerous studies have shown that the likelihood of drowsiness-related performance mistakes is not reliably predicted by driving measures. Steering Patterns: Unusual steering is an indication of sleepiness and can be detected by observing the way the steering wheel moves. Lane Departure: Uncontrolled or frequent lane exits could indicate a loss of focus brought on by weariness. Variations in Speed: Unusual changes in speed may be a sign of lowered attention. The way a normal driver and a tired driver operate an automobile may differ. Any change in these measurements that rises above a specific threshold indicates a considerable increase in the likelihood that the driver is weary. These data include lane deviations, steering wheel movement, and accelerator pressure. Steering wheel movement and lateral lane position are the two vehicle-based measures that are most commonly utilized. Steering angle sensors are widely used in vehicles to evaluate driver weariness since they can measure movement of the steering wheel. The steering actions of the driver are monitored by an angle sensor installed on the steering column. Another crucial indicator of the driver's level of sleepiness is the car's placement in the lateral lane.

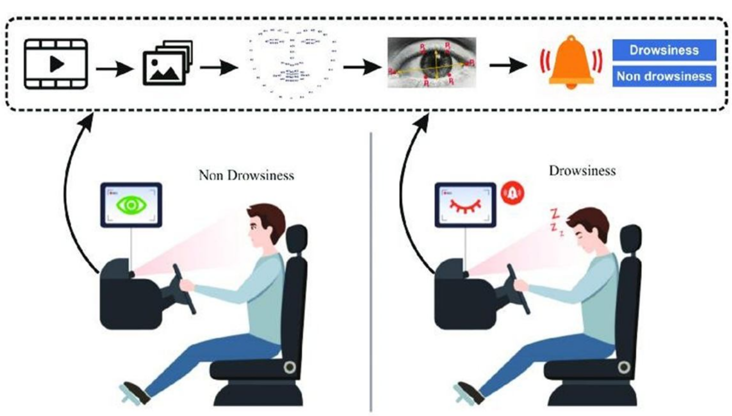


Fig: Shows Driver position and Vehicle Signals

3) Hybrid Signals

In order to identify driver drowsiness, hybrid signals integrate these different signals using algorithms that have the ability to weigh and analyse them all at once. These signals are frequently processed by machine learning algorithms, which identify patterns associated with sleepiness. For example: Data Fusion Techniques: Integrate and interpret signals from various sources to create a comprehensive picture of the condition of the driver. Finding the most pertinent aspects from each kind of signal that are reliable predictors of sleepiness is known as feature extraction and selection. Classification techniques: Utilize techniques such as Random Forests, Support Vector Machines (SVM), and Neural Networks to categorize the driver's condition according to the hybrid signals.

C. Data Processing

Data processing in this context consists of various phases, including data collection, preprocessing, feature extraction, and classification. This is a high-level description of the data processing workflow for detecting driver sleepiness.

1) Data Acquisition

Collect data from numerous sensors, including cameras for facial analysis, EEG sensors for brain activity, steering patterns, vehicle speed, and physiological sensors for heart rate and eye movement. Video Streams: In-cabin cameras capture the driver's facial expressions and eye movements. Physiological Signals: Record heart rate, skin temperature, and EEG data.

2) Preprocessing

Data Cleaning: Remove noise from sensor data by filtering out extraneous background noise or dealing with missing data points. Signal Processing: Extract meaningful patterns from physiological signals using signal processing techniques such as FFT and filtering. Image Processing: For video data, use techniques such as face detection, eye tracking, and blink detection. Convert videos to frames for analysis. Normalization is the process of bringing all features of a data set into a similar range for comparison.

3) Feature Extraction

Facial attributes: Take video data and extract attributes such as eye closure rate, yawning frequency, head position, and gaze direction. Physiological Features: Determine heart rate variability, EEG signal patterns (alpha and beta waves), and other physiological indicators. Vehicle data: Examine steering tendencies, lane departure frequency, and speed fluctuations. Observe reaction time, blink rate, and saccadic movement (fast eye movement).

4) Classification/Detection

Auto Machine Learning Models: Train models (e.g., SVM, Random Forest, CNNs, RNNs) to determine whether the driver is tired or alert based on extracted features. Deep Learning: Use deep learning models such as CNNs for image-based detection (e.g., facial recognition, eye state classification) and RNNs for temporal patterns in physiological signals. Real-Time Processing: Use real-time detection technologies to continuously evaluate data and send alerts when drowsiness is detected.

a) Evaluation

Accuracy: Assess the detection system's accuracy, sensitivity, and specificity. False Positives/Negatives: Determine the frequency of false positives (alerting when not drowsy) and false negatives (failing to detect drowsiness). Latency: Make sure the system processes data and detects drowsiness with minimal delay.

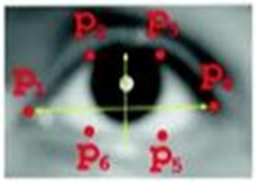
b) Alert System Integration

Real-Time Alerts: When drowsiness is identified, the system sends alerts such as alarms, seat vibrations, or steering wheel resistance. Driver Interaction: In autonomous driving scenarios, the system may encourage the driver to take a break or assume control of the vehicle.

Fig: The Alert System Model,

c) EAR [Eye Aspect Ratio]

In facial Expression Analysis the Eyeblink is used for detection fatigue among drivers to saving life and monitoring and tracks eye blinks while driving a vehicle. The eye aspect ration is calculated by distance between the eye's towards horizontal and vertical landmarks When the inner and outer corners of the eyes are expanded, the space between the upper and lower eyelids is larger. Which is the basis for the EAR calculation. A lower EAR score is obtained when the eyes are closed because there is less space between the eyelids. The space between the eyelids gets smaller while the eyes are closed, resulting in a lower EAR score.



$$\mathrm{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Fig: Eye Aspect Ratio calculations

where the six hallmark places for the eye are p1, p2, p3, p4, p5, and p6. In particular, the points of interest in the inner and outer regions of the eye are designated as p1 and p4, respectively, while the landmarks in both the lower and upper eyelids are designated as p2, p3, p5, and p6. when a specific threshold is reached by the EAR value, it may indicate that the eyes are closed, either completely or partially, which would indicate weariness or drowsiness. These gadgets can alert drivers of fatigue by continuously monitoring the EAR value, which helps to avoid accidents caused by fatigued drivers. Technologies for detecting driver sleepiness usually use an EAR threshold value of 0.3. The EAR value drops as the eyelids close; values below 0.33 suggest that the eyes are closed completely or partially. The EAR will be calculated based on six hallmarks placed on the eyeblinks that the threshold will be 0.3 the values to eyelids will be closed.

d) Lip's Aspect Ratio (MAR)

A common measure of mouth openness used in emotion detection and facial expression analysis is the MAR. By calculating the ratio of the lip-to-lip distance, MAR is determined. The MAR value drops as the distance between the lip's decreases. The Lip Aspect Ratio (LAR) is a frequently used metric for assessing openness in facial expression analysis and emotional detection. It is calculated by dividing the distance between the lips's horizontal landmarks (the corners) and vertical benchmarks (the top and lower lips). MAR is capable of identifying a wide range of facial expressions, including as frowns and grins, as well as emotions like hope and sorrow. The LAR computation is predicated on the idea that when someone is mouth is open, their top and lower lips are farther apart than their mouth's corners. But when the lips are pursed.

$$\mathrm{MAR} = \frac{|EF|}{|AB|}$$

Fig: Lip's Aspect Ratio Formula

Where A and B are horizontal hallmarks at the corners of the lip's, it will be calculated as E and F are vertical hallmarks towards the top and bottom lips respectively. A person's lip's may be closed or partially will be closed the values of LAR will be changed below acertain threshold. This may be a sign of stress, bereavement, or ignorance. LAR can also be used in conjunction with the Eye Aspect Ratio (EAR) to detect signs of exhaustion or drowsiness. If both the EAR and LAR levels are below average, it may indicate that the person is tired or sleep deprived.

e) CNN Result

After training data on a huge dataset with CNN Algorithm produced the outstanding accuracy results approaches with exceptional performance for both the training and testing phases to demonstrates to effectiveness as to produce some powerfully algorithm that can efficiently divide data into appropriate groups. The model is a good contender for a number of machine learning and artificial intelligence applications due to its consistent and o remarkable outcomes, which show its dependability and adaptability for real-world settings.

1. CNN	Head swaying, eyes blinking, and yawning	It will have RGB video input of a driver with 68 properties for driver	78.61% accuracy

f) SVM Result

The Supervised Machine Learning (SVM) technique is used to solve regression and classification problems. It is mostly used, nevertheless, to solve categorization problems. The SVM will function by calculating the following: blink frequency (BF), maximum closure duration (MCD), percentage of eyelid closure (PERCLOS), video data, many facial traits, and diverse ethnicities with real-time data (Accuracy = 87.00%).

SVM	blink rate, blinking of the eyes,	Video data for Maximum Closure Duration (MCD)	87.00% accuracy

IV. CONCLUSION

This study investigated the various methods for assessing a driver's level of tiredness and on fatigue Among drivers that can be detected using a variety of methods, including subjective, driving-based, Biological Signals, and behavioral examinations. These tools were also thoroughly examined, and their advantages and disadvantages were identified. Participant-based driver sleepiness investigations require a significant amount of time and resources, and efforts to gauge sleepiness in ongoing on-road research. The availability of licensed and discreet real-world surveillance equipment will make it easier to conduct realistic driving studies. Different methods for detecting tiredness have been highlightedconsisting of the participants, dataset, sleepiness measures, classification strategy, accuracy, and a list of important variables. This section concludes with suggestions and improvements for possible new research avenues. Hopefully, this study will provide a solid platform for academics and researchers who want to learn more about identifying and forecasting fatigue in drivers. The figures demonstrate that the wave line grew when the eyelids were closed. The wave line moved around the threshold line, indicating a drowsy driver when the eyes were almost closed and not at all when they were open. The eye-wave rate dropped to point 20 when the eyes were open wide. The accuracy of sleepiness detection in various settings was reported in this study. When a driver leaned their head, the detection accuracy was higher than 78.61%. The total accuracy was 87.00% when the driver's mouth was open and eyes were closed. Insufficient information and assessment measures, like sample size, validation process, and statistical analysis, make it difficult to properly evaluate the validity and generalizability of the reported accuracy values. The EAR equation was used to quantify blinking, and two classes of eye wave line fluctuations were created: "Open" (signaling that the driver was not sleepy) and "Closed" (signaling tiredness). Through the integration of both algorithms—the eye-tracking approach and the facial landmark-based approach—the suggested method enhanced the estimation of the driver's level of tiredness. We think that combining these techniques will result in sleepiness detection that is more accurate and dependable. Nevertheless, more information about certain algorithms and their performance measures is needed to properly assess how effective the suggested strategy is.

REFERENCES

[1] Template Correspondence [Online] 21 April 2014 [Sep. 8, 2014] cited Haarcascade samples are used for real-time detection of sleepy drivers. Sandesh D, Saraswathi V, and Dr. Surya Prasad J.
[2] A Comprehensive Method for Non-intrusive Identification of Driver Fatigue. Yu, Xun. Duluth, 2012.
[3] "Early Identification and Detection of Driver Drowsiness by Hybrid Machine Learning," Altameem, A. Kumar, R. C. Poonia, S. Kumar, and A. K. J. Saudagar, IEEE Access, Vol. No. 9, 2021.
[4] "Real-Time Warning System for Driver Drowsiness Detection Using Visual and Information," M. J. Flores, J. M. Armingol, and A. de la Escalera, Journal of Intelligent and Robotic Systems, Springer, 2019.
[5] Real-time drowsiness detection algorithm for driver state monitoring systems, J.W. Baek, B. Han, K. Kim, Y. Chung, S. Lee, in 2018 Tenth International Conference on Ubiquitous and Future Networks (ICUFN), Prague (2018)
[6] In the 2019 4th International Conference on Pattern Recognition and Image Analysis (IPRIA), Tehran, Iran, N. Moslemi, R. Azmi, and M. Soryani presented their work on driver distraction recognition using 3D convolutional neural networks.
[7] The Systematic Analysis of Automobile Tiredness Diagnosis and Prediction. Ebrahim Shaik, Department of Civil Engineering, Bangabandhu Sheikh Mujibur Rahman Science & Technology University, Gopalganj-8100, Dhaka, Bangladesh, January 2023,
[8] Acquiring spatiotemporal characteristics with 3D convolutional networks; Proceedings of the IEEE International Conference on Computer Vision, Tran D., Fergus R., Torresani L., Paluri M., Bourdev L.

[9] Face description with local binary patterns: Application to face recognition., Honen T., Hadid A., Pietikainen M. Pattern Anal. 2016.
[10] INVEDRIFAC A Video and Image Database of Faces of In-vehicle Automotive Drivers, India. 2019. [(accessed on 20 September 2021)]. Available online: https://sites.google.com/site/invedrifac/.
[11] Gwak J., Hirao A., Shino M. An investigation of early detection of driver drowsiness using ensemble machine learning based on hybrid sensing. Appl. Sci. 2020; 10:2890. doi: 10.3390/app10082890. [CrossRef] [Google Scholar]