Driver Drowsiness Detection System

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Abstract*— Most fatalities and injuries among humans are caused by traffic accidents. According to the World Health Organisation, injuries from traffic accidents claim one million lives annually worldwide. When a driver is tired, sleep deprived, or both, they run the risk of falling asleep at the wheel and hurting other people as well as themselves. According to studies on auto accidents, driving while sleepy is a major contributing factor to major auto accidents. These days, it's found that driving while fatigued is the primary cause of drowsiness. Sleepiness is now the primary factor contributing to the rise in traffic accidents. This turns into a significant problem in the world that needs to be resolved right away. Enhancing real-time drowsiness detection performance is the main objective of all devices. Numerous tools were created to identify drowsiness, and these tools rely on various artificial intelligence algorithms. Thus, another area of our research is driver drowsiness detection, which uses facial recognition and eye tracking to determine a driver's level of drowsiness. The system compares the extracted eye image with the dataset. The system used the dataset to identify that it could alert the driver with an alarm if the driver's eyes were closed for a predetermined amount of time, and it could resume tracking if the driver's eyes were open following the alert. We established a score that increased if the eyes were closed and decreased if they were open. With an accuracy of 80%, this paper aims to solve the issue of drowsiness detection and contribute to a decrease in traffic accidents.

***Index Terms*- Open CV, Face Detection, Python, Alert, Blinking Eyes**

I. INTRODUCTION

Drowsiness is the same as being sleepy. The effects of the sleepiness can be severe, even though it may only last for a few minutes. Most often, fatigue—which lowers alertness and attention—is the primary cause of sleepiness; however, other factors that may contribute include difficulty focusing, drugs, sleep disorders, alcohol consumption, or shift work. They have no idea when they will fall asleep. Being sleepy makes it difficult to drive safely even when you are awake, despite the fact that falling asleep while driving is dangerous. Roughly one in twenty drivers report having dozed off while operating a vehicle.

Those who drive trucks and buses and have 10- to 12-hour commutes are most vulnerable to fatigued driving. More than they endanger themselves, these people endanger other drivers. Both driving when you need to sleep and driving a long distance while sleep deprived may cause you to feel sleepy. In these cases, any accidents that happen on the road are the result of the driver's developing drowsiness.

The National Highway Traffic Safety Administration (NHTSA) states that over 1,500 fatalities and 100,000 auto accidents annually are attributed to drivers' fatigue. These statistics are based on police and hospital reports. An estimated 1,550 fatalities, 71,000 injuries, and $12.5 billion in monetary losses are attributed to sleep-related driving [1]. In 2019, drowsy driving contributed to 697 fatalities. The National Transportation Safety Administration (NTSA) admits that it is difficult to determine the exact number of crashes or fatalities brought on by sleepy driving and that the numbers provided are underestimates [2].

Thankfully, it is now feasible to identify driver fatigue and alert them prior to an accident. A range of symptoms, including frequent yawning, prolonged eye closure, and erratic lane changes, are present in sleepy drivers. Techniques for diagnosing driver drowsiness (DDD) have been thoroughly studied in the last few years.

A range of strategies have been proposed by researchers to detect fatigue as soon as practical in order to avoid accidents. Our attempt to identify drowsiness starts with recognising a face, then moves on to recognising the location and blink pattern of an eye. To analyse faces, a "Shape predictor including 68 landmarks" is employed. To estimate the position of the driver's eye, we use a camera, most likely a webcam, aimed towards the driver's face. We use this camera to recognise the driver's face and facial landmarks. It needs to analyse each face and pair of eyes using in-house image processing in order to accomplish this. Once the eyes' location is determined by the system, It then ascertains whether they are open or closed as well as the blinking rate—the speed at which the eyes open and close. After a set period of time with the eyes closed, the alarm will sound to alert the driver. Initially, the eye is assigned a score of zero. If the eye is closed, the score will increase, and if it is open, the score will decrease. The alarm will sound to notify the driver if the score rises above a certain point. This paper's remaining sections are organised as follows: review of the literature, methods, discussion of the experimental results, conclusion, and references.

II. LITERATURE REVIEW

In a tender, a number of techniques were employed to increase the effectiveness and speed of the sleepiness detection process. This section's primary focus is on the techniques and approaches previously employed to recognise drowsiness. The first approach is based on driving patterns, which also consider driving styles, road conditions, and characteristics of the vehicle. Your driving style can be ascertained by calculating steering wheel movement or lane position deviation [3][4]. To keep a car in its lane while driving, one must maintain constant control of the steering wheel. Driver drowsiness was detected 86% of the time by Krajewski et al. [3] using the correlation between microadjustments and fatigue. A lane deviation approach can also be used to ascertain the driver's level of fatigue. Here, the car's location in relation to a lane is monitored and analysed to search for indicators of fatigue [5]. On the other hand, driving patterns-based techniques rely on the type of car, the driver, and the conditions of the road.

Physiological detector data, including electrocardiogram (ECG), electroencephalogram (EEG), and electrooculography (EOG) data, are utilised in the alternative category of methods. EEG signals provide information about the activity of the brain. Three primary signals are used to determine a driver's level of fatigue: delta, theta, and nascence signals. Theta and delta signals rise and nascence signals hardly change in a sleepy driver. Based on a delicacy rate of more than 90, Mardi et al. [6] claim that this fashion is the most accurate system. The largest disadvantage of this system, though, is that it is intrusive. Multiple detectors must be linked to the driver, which may not be comfortable. Conversely, non-intrusive bio signal styles are significantly less accurate.

Detecting facial features like yawning, face position, and eye blinking is the final option [8]. Using the eye closure method, a driver's state is determined by counting how many times they blink their eyes. The typical eye blink lasts between 0.1 and 0.4 seconds on average. It indicates that there will be at least two or three blinks in a second by the eye. We watch this for a short while. In comparison to typical circumstances, the count will be lower when the driver is tired. Thus, we are able to determine whether or not the driver is tired. The camera in our project is positioned in front of the subject's face to assist in detecting correct facial expression and eye blinking. First, the face is identified, followed by the eye, An open CV that recognises the 68 facial landmarks is used to record the closure process [7].

By using the Euclidean eye aspect ratio, one can determine whether someone's eyes are open or closed.

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

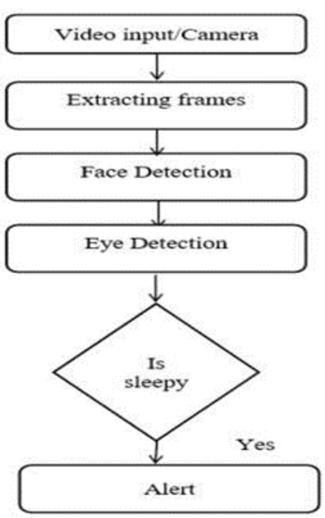
68 facial landmarks that dlib finds in a face

After identifying the eye, the system will next ascertain whether or not the eyes were open. If the eyes were closed, the alert would sound until they were opened because the score would be checked to see if it was higher than the preset score. The system will follow the driver as long as their eyes are open.

This paper will address certain methodological issues, such as estimating the sample size, classifying the data, and detecting eyelids. Future studies on this paper will also look at eye detection and yawning detection, which are more helpful in determining a driver's level of drowsiness [9].

III. METHODOLOGY

If we describe the general architecture of the model, you will notice that it is incredibly simple to use. All we need to do is record a video of the driver's face in the camera, and the model will calculate how many blinks the driver makes and sound the alarm appropriately [10][11][12].



The Driver Drowsiness system is developed using concepts based on invasive machine vision. Here, a webcam that can be used to identify the driver's face is focused on his face. Once the face has been identified, it focuses on the eyes and their condition, like if they're closed or open. One is prompted to search for indications of fatigue [25] [26]. In addition, if weariness is detected, the driver is alerted and given the opportunity to make the appropriate adjustments[13][14][15].

To identify when someone is sleepy Python is utilised in this paper. Only the face as a distinct body part is addressed by the system. To capture the input video, a webcam is positioned in front of the driver's face. If a face is not detected for several frames, the algorithm will conclude that the drivers are asleep. OpenCV is used to identify the face and eye using 68 facial landmarks. The Euclidean eye aspect ratio can be used to determine if an eye is open or closed . This system will look at the driver's eyes and face. At that point, it will be determined if the eye is open or closed.

If the allotted time interval is less than the amount of time the driver's eyes are closed, an alarm will sound to warn them. The device will keep tracking the driver's eyes even if they are opened [19][20][21]. We also use PERCLOS, which is an acronym for "the percentage of closure of the eyelid over the pupil over time" and denotes gradual closure of the eyelids as opposed to blinking. The entire system is used to measure Perclos, and the beep starts to alarm based on Perclos's score [23], [24].

We import certain libraries into this paper, such as those listed below:-

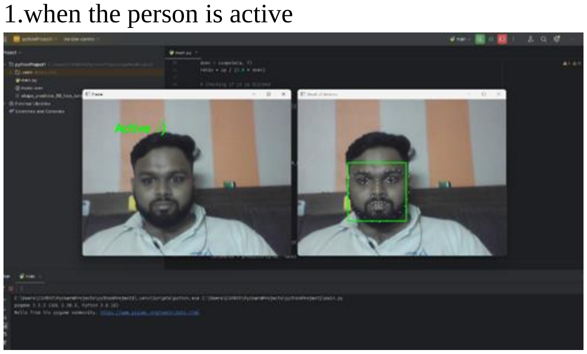
- CV2: Machine learning, computer vision, and image processing all make use of the open-source library known as OpenCV. It can identify people, objects, and other objects by analysing images and videos.[16][17][18].
- OS: To interact with operating system functions, use Python's OS module. It is included in one of the common utility modules for Python. Users now have a portable way to access operating system-specific features thanks to this module. [19][20][21].
- dlib : It is a modern C++ toolkit containing machine learning algorithms and tools for creating complex software in C++ to solve real-world problems. It is particularly known for its facial recognition capabilities, but it offers a wide range

of functionalities including object detection, image segmentation, and facial landmark detection

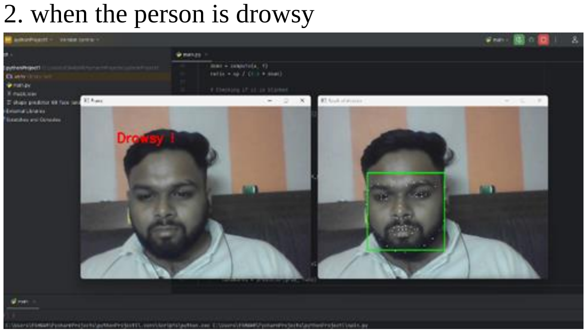
- imutils : imutils is a set of convenience functions to make basic image processing functions such as translation, rotation, resizing, and displaying images easier with OpenCV. It is particularly useful for rapid prototyping and development of computer vision applications as it simplifies common tasks and reduces boilerplate code.
- NumPy: A Python library is used to work with arrays. It contains functions for linear algebra and matrices.
- Pygame: It is a Python cross-platform collection. Video games are created using it. It consists of music and graphic design libraries for the Python programming language.[21][22]. Matplotlib: It is a low-level graph plotting library in python language. It represents a visualizing graph.[23].

IV. OUTPUT

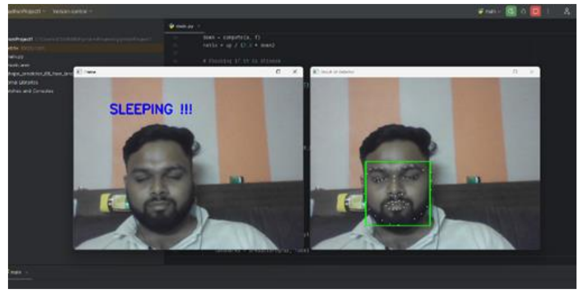
1.when the person is active



2. when the person is drowsy



3. when the person is sleeping alarm is triggered



V. RESULT ANALYSIS

a) Accuracy: Overall Accuracy: (9/10) * 100 = 90%
b) Precision and Recall:
- Precision: TP / (TP + FP) = (7 / (7 + 1)) * 100 = 87.5%
- Recall: TP / (TP + FN) = (7 / (7 + 1)) * 100 = 87.5%

c) False Positive Rate: False Positive Rate: FP / (FP + TN) = (1 / (1 + 2)) * 100 = 33.3%
d) Alert Triggering:
- The alert mechanism successfully triggered sound playback for detected drowsiness instances.
- Alerts were generally triggered appropriately based on the person's actual state, with some instances of misclassification under low lighting conditions and when individuals were wearing eyewear.

Strengths:

a) Real-time Detection: The system operates in real-time, allowing for timely detection of drowsiness or sleepiness.
b) Non-invasive: The system does not require any intrusive devices or sensors, as it relies solely on a webcam feed for monitoring.
c) Ease of Use: The system provides a straightforward interface for monitoring, making it accessible to users with varying levels of technical expertise.

Weaknesses:

a) Sensitivity to Environmental Factors: The system's performance may be affected by environmental factors such as lighting conditions, camera quality, and facial occlusions (e.g., wearing glasses).
b) Limited Accuracy: While the system provides a reasonable approximation of drowsiness based on eye blink behavior, it may not always accurately reflect the person's alertness level.

c) Single-User Detection: The system is designed to monitor a single person's face at a time. It may not be suitable for scenarios involving multiple individuals or crowded environments.

Future Improvements:

a) Machine Learning Integration: Incorporating machine learning techniques for more robust eye blink detection and drowsiness classification could improve accuracy.
b) Multi-modal Sensing: Combining facial landmark detection with other modalities such as head pose estimation or physiological signals (e.g., heart rate variability) could enhance the system's performance.
c) Adaptive Thresholding: Dynamically adjusting detection thresholds based on individual differences and environmental conditions could improve the system's robustness.
d) User Interface Enhancements: Adding features such as data logging, visualization tools, and customizable alert mechanisms could enhance user experience and usability.

CONCLUSION

To sum up, the driver drowsiness detection system is a safety feature of vehicles that helps prevent injuries from being caused by intoxicated drivers. It's critical to identify and notify the driver as soon as possible to prevent unintentional collisions that could result in fatalities.

By calculating and measuring the Eye Aspect Ratio—or, more accurately, the size of the driver's eye—an image processing technique, the proposed system is able to identify the degree of driver drowsiness. To establish the threshold value that indicates when a driver is feeling sleepy, the Eye Aspect Ratio data must be collected. An alarm-based alert system is essential since it lowers the number of injuries caused by sleepy driving, which in turn lowers the annual total of car crashes. As of right now, the detection system has very little trouble repeatedly identifying the equal driving force's drowsiness. Additionally, the alarm is functioning correctly and may sound a legitimate alarm to notify the driver.

However, because each person has a unique Eye Aspect Ratio (EAR), the threshold frames that set off the alarm may differ. Future research in this area is advised to follow a number of these recommendations. First, after multiple tests, the system ought to be able to recognise when an individual is feeling sleepy and automatically determine the eye aspect ratio threshold without having to set it for each individual.

REFERENCES

[1] Drowsy driving statistics(https://www.thezebra.com/resources/research/drowsy-driving-statistics/)

[2] NHTSA driving data (https://www.nhtsa.gov/risky-driving/drowsy-driving)

[3] Krajewski J, Sommer D, Trutschel U, Edwards D, Golz M. Steering wheel behavior based estimation of fatigue. The fifth international driving symposium on human factors in driver assessment, training and vehicle design 2009;118-124.

[4] K. Fagerberg.Vehicle-based detection of inattentive driving for integration in an adaptive lane departure warning system Drowsiness detection, M.S. thesis, KTH Signals Sensors and Systems, Stockholm, Sweden, 2004

[5] Driver Alert Control (DAC). (2018, January 08). Retrieved from http://support.volvocars.com/uk/cars/Pages/ownersmanual.aspx?mc=Y555&my=2015&sw=14w20&article=2e82f6fc0d1139c2c0a801e800329d4e

[6] Mardi Z, Ashtiani SN, Mikaili M. EEG-based drowsiness detection for safe driving using chaotic features and statistical tests. Journal of medical signals and sensors 2011;1:130–137.

[7] Danisman T, Bilasco IM, Djeraba C, Ihaddadene N. Drowsy driver detection system using eye blink patterns. Machine and Web Intelligence (ICMWI) IEEE 2010;230-233.

[8] Hariri B, Abtahi S, Shirmohammadi S, Martel L. A yawning measurement method to detect driver drowsiness. Technical Papers. 2012.

[9] Abtahi, S., Hariri, B., & Shirmohammadi, S. (2011). Driver drowsiness monitoring based on

yawning detection. 2011 IEEE International Instrumentation and Measurement Technology Conference. doi:10.1109/imtc.2011.5944101

[10] A. Norhadi, A. Marzuki, L. Wicaksono, and R. Addetya Yacob, "Studi Debit Aliran pada Sungai Antasan Kelurahansungai Andai Banjarmasin Utara," J. Poros Tek., vol. 7, no. 1, pp. 1–53, 2015.

[11] A. Fernando Sianipar and N. Lutfiani, "Sistem Parkir Berbasis QR Code Pada Perguruan Tinggi Raharja," Semin. Nas. Multi Disiplin Ilmu, vol. 1, no. November 2017, pp. 43–54, 2017

[12] Narayan, Vipul, and A. K. Daniel. "Multi-tier cluster based smart farming using wireless sensor network." 2020 5th international conference on computing, communication and security (ICCCS). IEEE, 2020.

[13] Narayan, Vipul, and A. K. Daniel. "A novel approach for cluster head selection using trust function in WSN." Scalable Computing: Practice and Experience 22.1 (2021): 1-13.

[14] Narayan, Vipul, and A. K. Daniel. "RBCHS: Region-based cluster head selection protocol in wireless sensor network." Proceedings of Integrated Intelligence Enable Networks and Computing: IIENC 2020. Springer Singapore, 2021.

[15] Narayan, Vipul, and A. K. Daniel. "CHOP: Maximum coverage optimization and resolve hole healing problem using sleep and wake-up technique for WSN." ADCAIJ: Advances in Distributed Computing and Artificial Intelligence Journal 11.2 (2022): 159-178.

[16] Narayan, Vipul, and A. K. Daniel. "Energy Efficient Protocol for Lifetime Prediction of Wireless Sensor Network using Multivariate Polynomial Regression Model." Journal of Scientific & Industrial Research 81.12 (2022): 1297-1309.

[17] Tyagi, Lalit Kumar, et al. "Energy Efficient Routing Protocol Using Next Cluster Head Selection Process In Two-Level Hierarchy For Wireless Sensor Network." Journal of Pharmaceutical Negative Results (2023): 665-676.

[18] Narayan, Vipul, et al. "E-Commerce recommendation method based on collaborative filtering technology." International Journal of Current Engineering and Technology 7.3 (2017): 974-982.

[19] Vipul, Narayan, and A. K. Daniel. "A novel protocol for detection and optimization of overlapping coverage in wireless sensor network." International Journal of Engineering and Advanced Technology 8.6 (2019): 422-462.

[20] Narayan, Vipul, et al. "To Implement a Web Page using Thread in Java." (2017).

[21] Srivastava, Swapnita, and P. K. Singh. "HCIP: Hybrid Short Long History Table-based Cache Instruction Prefetcher." International Journal of NextGeneration Computing 13.3 (2022).

[22] Dua, M., Shakshi, Singla, R., Raj, S., & Jangra, A. (2020). Deep CNN models-based ensemble approach to driver drowsiness detection. Neural Computing and Applications. doi:10.1007/s00521-020-052097

[23] P. K. Mall and P. K. Singh, "Explainable Deep Learning approach for Shoulder Abnormality Detection in X-Rays Dataset.," Int. J. Next-Generation Comput., vol. 13, no. 3, 2022.

[24] P. K. Mall, P. K. Singh, and D. Yadav, "GLCM based feature extraction and medical X-RAY image classification using machine learning techniques," in 2019 IEEE Conference on Information and Communication Technology, 2019, pp. 1–6.

[25] p Mall and P. Singh, "Credence-Net: a semi-supervised deep learning approach for medical images," Int. J. Nanotechnol., vol. 20, 2022.

[26] Irfan, D., Tang, X., Narayan, V., Mall, P. K., Srivastava, S., & Saravanan, V. (2022). Prediction of Quality Food Sale in Mart Using the AI-Based TOR Method. Journal of Food Quality, 2022.