Driver Drowsiness Detection Using Python

Amina Manaf
Dept. of CSE
College of Engineering Kidangoor
Kottayam, Kerala, India
aminamanaf8@gmail.com

Ance Maria Joseph
Dept. of CSE
College of Engineering Kidangoor
Kottayam, Kerala, India
annsmaria07@gmail.com

Angel Joy
Dept. of CSE
College of Engineering Kidangoor
Kottayam, Kerala, India
angeljoy164@gmail.com

Anjaly Anilkumar
Dept. of CSE
College of Engineering Kidangoor
Kottayam, Kerala, India
anjalyuanilkumar@gmail.com

Rekha K S
Dept. of CSE
College of Engineering Kidangoor
Kottayam, Kerala, India
rekhaks@ce-kgr.org

***Abstract*—Drowsiness has emerged as a pervasive global concern, proving to be a major factor in catastrophic accidents that result in fatalities and severe injuries. The topic proposes novel experimental model designed to detect driver drowsiness, aiming to mitigate the occurrence of accidents and enhance overall transport safety. The approach integrates two distinct methods for effective drowsiness detection. Firstly, facial recognition techniques are employed to capture the driver's face and perform eye retina detection. Facial features are extracted, and blinking values are calculated. Threshold values for blinking are then established to gauge the driver's level of drowsiness. Secondly, an Arduinomodules equipped with force sensors, is integrated into the system. The module continuously monitors the real-time pressure exerted by the driver's hands on the steering wheel.Threshold values for hand pressure are set to determine the driver's engagement level.The decision-making process involves synthesizing the results from both methods to make a comprehensive assessment of the driver's alertness. If either the facial recognition system or the force sensors indicate drowsiness beyond the set thresholds, an alert is triggered. The implementation includes an alert system that provides visual, auditory, or haptic cues to prompt the driver to take corrective action upon detecting drowsiness.This dual-method approach aims to create a robust system for detecting and addressing driver fatigue, ultimately contributing to the reduction of accidents caused by drowsydriving and promoting overall road safety.**

I. INTRODUCTION

Drowsy driving poses a pervasive threat, contributing to numerous accidents and fatalities globally. In response, our project introduces an advanced drowsiness detection system, merging facial feature analysis and real- time monitoring of hand pressure on the steering wheel through an Arduino-based system. Facial feature analysis utilizes a diverse dataset, applying rigorous preprocessing to extract cues like blink- ing frequency and head pose. An eye detection algorithm ensures precise monitoring, enhancing accuracy in assessingdrowsiness levels. Simultaneously, force sensors integrated into the steering wheel, connected to an Arduino module, offer real-time hand pressure data, enriching the system's information layers.The synergy between facial feature anal- ysis and hand pressure monitoring is orchestrated by a sophisticated decision-making algorithm, effectively combining outputs for heightened accuracy. The alerting mechanism em- ploys visually and auditorily designed alerts, ensuring timely notifications without causing distraction. In extreme cases, emergency measures automatically halt the vehicle, trigger- ing help requests to authorities via email. A driver rating system, implemented through a web application, provides continuous feedback, contributing to an adaptive loop that improves system accuracy over time.Rigorous testing underdiverse driving conditions ensures the system's reliability, aiming to significantly reduce accidents caused by drowsy driving. The project lays the groundwork for future intelligent transportation system advancements, extending applications beyond drowsiness detection.

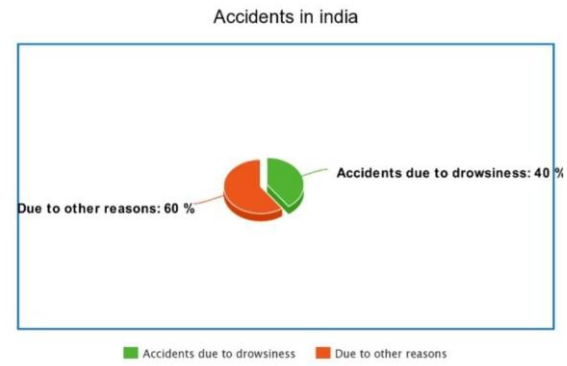

Fig.1. Ratio of accidents due driver drowsiness.

II. MOTIVATION

In recent years, there has been an alarming increase in road accidents caused by drowsy driving, highlighting the urgent need for effective drowsiness detection systems. Traditional methods of detecting driver fatigue, such as subjective self-assessment or physical sensors attached to the body, often lack

IJERA Volume 04, Issue 01
DOI: **10.5281/zenodo.12535327**

accuracy and real-time monitoring capabilities. As a result, there is a growing interest in leveraging technology, specifically image processing and hardware integration, to develop more reliable and efficient drowsiness detection solutions.

Python and Arduino emerge as powerful tools in this domain, offering a seamless integration of software and hardware components necessary for building robust drowsiness detection systems. Python's versatility in image processing libraries such as OpenCV allows for the analysis of live video streamsto track eye movements and detect signs of drowsiness. On the other hand, Arduino provides a flexible and accessible platform for interfacing with sensors and actuators, enabling real-time feedback and alerts based on the detected levels of driver fatigue.

III. LITERATURE SURVEY

A. "Image Recognition based Driver Detection using Python"

Regarding our approach,image processing based driver detection plays a crucial role in monitoring driver alertness in real-time. Drowsy driving poses a significant threat to road safety, making the development of effective drowsiness detection systems imperative. With advancements in image processing technology, this system have garnered attention for their potential to monitor driver alertness through the analysis of eye movements and blinks captured in live video streams.This approach uses key methodologies such as frame conversion to grayscale, eye centroid localization, and connected component analysis that are examined in detail.This approach has demonstrated the feasibility of using image processing techniques to track eye movements and detect blinks as indicators of drowsiness. By converting video frames to grayscale and employing algorithms for eye centroid localization and connected component analysis, this system can effectively monitor driver alertness in real-time.While drowsiness detection system utilizing image processing techniques this approach offers valuable insights into driver alertness monitoring.This approach effectively addresses the limitations that is crucial for enhancing reliability across diverse driving conditions and individual characteristics.

B. "Real-Time EAR Based Drowsiness Detection Model for Driver Assistant System"

The proposed drowsiness detection system relies on Dlib Facial Feature detection algorithms and the Eye Aspect Ratio (EAR) to assess driver alertness, with a 30 fps video feed capturing real-time frames for analysis. The system, trained on a diverse dataset,preprocesses images through binarization and noise removal, focusing on the eye region.It calculates EAR and triggers an alarm when drowsiness is detected. Limitations include dependence on dataset representativeness, potential computational constraints affecting real-time performance, challenges in generalizing to individual variations, susceptibility to environmental factors impacting facial feature detection, and the risk of false positives/negatives. Additionally, the system's efficacy hinges

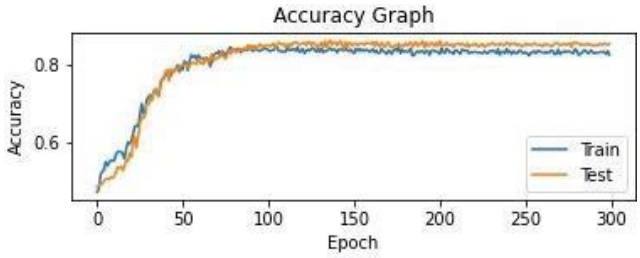

Fig. III.1: *Accuracy vs epochs graph for train and test dataset*

on the quality of the camera feed, emphasizing the need for ongoing refinement to enhance its reliability across diverse driving conditions and individual

C. "Driver Drowsiness Detection based on Monitoring of Eye Blink Rate"

This driver monitoring project is structured into three main groups, focusing on driver performance, the driver's state, and their combined assessment. The driver's state is categorizedinto two primary strategies: image- based signals and drowsiness/fatigue-based image processing signals. Utilizing eye movements and facial expressions, the system detects signs of drowsiness, even in varying lighting conditions witha dashboard-installed webcam. When the system identifiesa drowsy state, it triggers a loud alarm to warn the driverand passengers. The workflow involves video input, face and eye detection,drowsiness tracking, and an alerting stage with an alarm. While this approach is effective in providing timely warnings, potential limitations may include challenges in accurately distinguishing drowsiness from other facial expressions and the need for careful consideration of false positives to ensure a reliable and non-intrusive driver alert system.

D. " Advanced Driver Assistance System for the drowsiness detection using facial landmarks"

The proposed solution adopts the Scrum methodology for its iterative and incremental project management approach. The system architecture begins with webcam image acquisition, followed by image processing involving resizing and grayscale conversion.Eye openness is assessed using the Eye Aspect Ratio (EAR), triggering an alarm if it falls below a predefined threshold over a specified time interval. While the Viola Jones algorithm is initially considered for drowsiness detection, facial landmarks become crucial for accuracy due to unsatisfactory results under varying lighting conditions. These landmarks, represented by 68 coordinates, enable the extraction of eye points for EAR calculation. Preliminary results indicate an 87 percentage accuracy in drowsiness detection based on facial landmarks. The system, implemented in Python with OpenCV and imutils, shows promise for realworld testing in a vehicle environment, though challenges such as variations in lighting conditions and facial movements require further evaluation for robustness andreliability.

TABLE VI : CONFUSION MATRIX FOR EYE STATE CLASSIFICATION OF FOUR DIFFERENT GENRES USING OUR PROPOSED METHOD CONSIDERING NTHU-DDD [22]

Actual Class	Predicted Class			
	Without glasses at day	With glasses at day	Without glasses at night	With glasses at night
Without glasses at day	98.7	0.7	0.4	0.2
With glasses at day	0.4	98.6	0.3	0.7
Without glasses at night	0.5	0.7	97.4	1.4
With glasses at night	0.8	1.5	1.6	96.1

E. "An Integrated system for Driver's Drowsiness Detection Using Deep Learning Frameworks"

The study "An Integrated System for Drivers' Drowsiness Detection Using Deep Learning Frameworks" introduces a new way to spot driver drowsiness by combining deep learning methods. It uses cameras in vehicles to collect data, improves image quality, and applies deep learning to analyze facial features for signs of drowsiness. This systemis good at detecting drowsiness in real-time, which can alert drivers and prevent accidents effectively. However, it relieson cameras, which may raise privacy concerns and can be affected by lighting or obstacles. Also, it needs a lot of computing power. Future work could improve accuracy under different conditions and explore other data sources like body signals.Integrating with advanced driver assistance systems could enhance safety further. Despite challenges, this system shows promise in making roads safer by preventing accidents caused by drowsy driving.

F. "Driver Drowsiness Detection Using Machine Learning Algorithm" The research article "Driver Drowsiness Detection Using Machine Learning Algorithm" proposes a method to detect driver drowsiness through machine learning. By collecting data such as eye movements and facial expressions using sensors and cameras in vehicles, the system employsmachine learning algorithms to analyze and classify the driver's drowsiness level. This approach enables real-time drowsiness detection, potentially preventing accidents caused by driver fatigue. While offering automated analysis of complex data patterns and integrating seamlessly into existing vehicles, the system faces challenges including reliance on accurate sensor data and the need for sufficient labeled training data. To enhance accuracy and applicability, future research could focus on refining algorithms, incorporating additional sensors for complementary data, and developing personalized models tailored to individual drivers. Despite these challenges, the system represents a promising avenue for improving road safety by automating drowsiness detection and intervention mechanisms.

G. "Early Identification and Detection of Driver Drowsiness" The research article "Early Identification and Detection of Driver Drowsiness by Hybrid Machine Learning"introduces a novel approach for early identification anddetection of driver drowsiness using a hybrid machine learning model. Integrating multiple data sources such as physiological signals, vehicle dynamics, and driver behavior, the system employs a hybrid machine learning algorithm to analyze and classify drowsiness levels. This approach capitalizes on complementary information from diverse data sources, enhancing accuracy and robustness in drowsiness detection. By combining physiological signals like heart rate variability with vehicle dynamics data such as steering wheel movements and lane deviation, the system offers a comprehensive understanding of the driver's state and behavior, enabling timely interventions to prevent potential accidents.Despite potential challenges related to data integration and computational complexity,future refinements could enhance the model's performance through advanced techniques like deep learning and reinforcement learning. Integration of additional data sources and development of adaptive learning mechanisms could further improve the system's effectiveness. Overall, the proposed hybrid machine learning approach presents a promising solutionfor enhancing road safety through early identification and detection of driver drowsiness, with potential applications in intelligent transportation and driver assistance systems.

H. "System-on-Chip Based Driver Drowsiness Detection and Warning System"

The research paper "System-on-Chip Based Driver Drowsiness Detection and Warning System" presents an innovative approach utilizing System-on-Chip (SoC) technology for detecting and warning against driver drowsiness. The system integrates multiple sensors, including facial recognition cameras, infrared sensors, and accelerometers, into a single SoC platform to capture physiological and behavioral signals indicative of drowsiness. Its compact design minimizes hardware complexity and power consumption while enabling real- time processing and analysis directly on the chip. Byemploying a multimodal approach to drowsiness detection, the system improves accuracy and reliability.Challenges include sensor fusion and algorithm optimization, with potential impact from environmental factors like lighting conditions. Future improvements may involve further algorithm optimization, integration of additional sensors, and development of adaptive machine learning algorithms. Overall, the SoC-based approach presents a promising solution for enhancing road safety through realtime drowsiness detection and warning systems, with potential applications in automotive safety and intelligent transportation

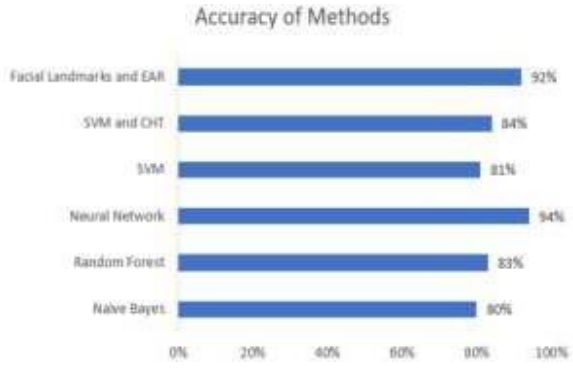

Fig. III.2: Comparison of methods

IV. METHODOLOGY

The proposed system architecture integrates facial feature analysis and Arduino-based hand pressure monitoring. The combination of these two methods enhances the reliability and robustness of the drowsiness detection system.

1. Facial Feature Analysis

1.1 Data Collection - Utilizing a camera, the system captures images of drivers displaying various levels of drowsiness to create a diverse dataset.
1.2 Preprocessing - Image preprocessing techniques are applied to enhance facial features, followed by face detectionto extract relevant information.
1.3 Feature Extraction - An eye detection algorithm monitors blinking frequency, extracting features such as eye closure duration and head pose.
1.4 Blinking Threshold - Blinking values are calculated, and threshold values are set to determine drowsiness based on eye-related features.

2. Arduino Integration

2.1 Hardware Setup - Force sensors are integrated into the steering wheel, and an Arduino module is connected tothe car's system.
2.2 Real-time Monitoring - The system continuously monitors the force applied to the steering wheel in realtime, setting threshold values for hand pressure indicating drowsiness.

3. Decision Integration - Results from facial feature analysis and Arduino module are combined using an algorithm to make a final decision on the driver's drowsiness status.

4. Alerting Mechanism - An alert system is implemented, providing visual and auditory alerts to notify the driver of detected drowsiness.

5. Emergency Measures - In extreme drowsiness scenarios, the system automatically stops the car and sends help requests via email to relevant authorities

6. Driver Rating System - A web application is developed for driver rating based on attentiveness, incorporating afeedback loop to enhance system accuracy over time.

V. CONCLUSION

This introduces a novel method for detecting drowsiness based on two key factors: capture and detect, followed by integration. In the capture and detect phase,critical data related to a person's drowsiness, such as facial features or eye move- ment, is gathered and analyzed using advanced algorithms. The second phase involves integrating the identified indicators to form a holistic assessment of drowsiness. The entire processis validated using Arduino, ensuring real-time applicability and feasibility.By combining these two factors and leveraging Arduino technology, this aims to provide a comprehensive and practical solution for accurately detecting drowsiness in indi- viduals. The future scope of the proposed drowsiness detection system includes integrating advanced sensing technologies, incorporating machine learning for continuous improvement, exploring Internet of Things (IoT) connectivity, adapting the system for use in autonomous vehicles, developing user- friendly interfaces, collaborating with traffic management sys- tems, expanding applications beyond driving, and implement- ing adaptive intervention strategies. These advancements aimto enhance the system's accuracy, broaden its applications, and contribute to improved safety and well-being in diverse environments.

REFERENCES

[1] I. K. Kumar, V. Agarwal and M. S. Reddy,"Image Recognition based Driver Drowsiness Detection using Python," 2022 International Confer- ence on Electronics and Renewable Systems (ICEARS), Tuticorin, India, 2022,pp.992995,doi:10.1109/ICEARS53579.2022.9752167.

[2] P. Singh, S. Mahim and S. Prakash, "Real- Time EAR Based Drowsiness Detection Model for Driver Assistant System," 2022 International Con-ference on Signal and Information Processing (IConSIP), Pune, India, 2022, pp. 1-4, doi:10.1109/ICoNSIP49665.2022.10007514.

[3] P. Baby Shamini, M. Vinodhini, B. Keerthana, S. Lakshna and K. R. Meenatchi,"Driver Drowsiness Detection based on Monitoring of Eye Blink Rate," 2022 4th International Conference on Smart Systems and Inventive Technology (ICSSIT),Tirunelveli, India, 2022, pp. 1595-1599, doi:10.1109/ICSSIT53264.2022.9716304.

[4] L. D. S. Cueva and J. Cordero, "Advanced Driver Assistance System for the drowsiness detection using facial landmarks," 2020 15th Iberian Conference on Information Systems and Technologies (CISTI), Seville, Spain, 2020, pp. 1- 4, doi:10.23919/CISTI49556.2020.9140893.

[5] B. Ganguly, D. Dey and S. Munshi, "An Integrated System for Drivers' Drowsiness Detection Using Deep

Learning Frameworks,"2022 IEEE VLSI Device Circuit and System (VLSIDCS), Kolkata, India, 2022, pp. 55-59, doi:10.1109/VLSIDCS53788.2022.9811442.

[6] N. Prasath, J. Sreemathy and P. Vigneshwaran, "Driver Drowsi- ness Detection Using Machine Learning Algorithm," 2022 8th In- ternational Conference on Advanced Computing and Communica- tion Systems (ICACCS), Coimbatore, India,2022, pp. 01-05, doi: 10.1109/ICACCS54159.2022.9785167.

[7] Altameem, A. Kumar, R. C. Poonia, S. Kumar and A. K. J. Saudagar, "Early Identification and Detection of Driver Drowsiness by Hybrid Machine Learning," in IEEE Access, vol. 9, pp.162805-162819, 2021, doi: 10.1109/ACCESS.2021.3131601.

[8] B. Yazici, A. Ozdemir and T. Ayhan, "System- on-Chip Based Driver Drowsiness Detection and Warning System," 2022 Innovations in Intel- ligent Systems and Applications Conference(ASYU), Antalya, Turkey, 2022, pp. 1-5,doi:10.1109/ASYU56188.2022.9925481