International Journal of Engineering & Extended Technologies Research (IJEETR)

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802231

AI-Based Driver Drowsiness Detection using Eye Blink Monitoring with Automated Speed Control and Warning Alert

Manubrindha.S , Nivetha. R, Shalini Priya.V, Priyanka.S, M.E, Dr. Devekirubai. N, M.E., Ph.D

UG Scholars, Department of Artificial Intelligent and Data Science, RP Sarathy Institute of Technology, Salem, Tamil Nadu, India

Assistant Professor, Department of CSE, RP Sarathy Institute of Technology, Salem, Tamil Nadu, India

HOD, Department of CSE, RP Sarathy Institute of Technology, Salem, Tamil Nadu, India

Publication History: Received: 25.02.2026; Revised: 20.03.2026; Accepted: 25.03. 2026; Published: 28.03.2026.

ABSTRACT: Driver drowsiness is one of the major causes of road accidents. This project presents a Driver Drowsiness Detection and Automatic Vehicle Safety System that continuously monitors the driver's eye status using an eye sensor or camera. When the system detects that the driver's eyes remain closed for more than 2 seconds, it identifies a drowsy condition and activates an alert buzzer to warn the driver. If the driver does not respond, the alert is repeated, and continued unresponsiveness confirms prolonged drowsiness.

In such situations, the system automatically reduces the vehicle speed by controlling the fuel supply from the fuel tank to the engine. Simultaneously, the front and rear indicators blink continuously to alert nearby vehicles and improve road safety. Once the driver regains a normal state, the fuel supply is restored, and the vehicle resumes normal operation. This system effectively enhances driver safety, minimizes accident risks, and supports intelligent vehicle control for safer transportation.

KEYWORDS: Driver Drowsiness Detection, Eye Blink Monitoring, Computer Vision, Fatigue Detection, Real-Time Monitoring, Automated Speed Control, Warning Alert System, Road Safety, Non-Intrusive Sensing, Intelligent Transportation System

I. INTRODUCTION

Driver drowsiness is one of the major causes of road accidents across the world, especially during long-distance driving and night travel. When a driver becomes tired or sleepy, their reaction time slows down, attention decreases, and decision-making ability is affected. This significantly increases the risk of accidents, leading to injuries, loss of life, and property damage. Therefore, ensuring driver alertness has become a critical aspect of modern transportation safety systems.

In recent years, various technologies have been developed to address this issue, including sensor-based systems, physiological monitoring, and computer vision techniques. Among these, non-intrusive methods such as camera-based monitoring have gained more importance because they do not require physical contact with the driver. These systems can continuously observe driver behavior and detect early signs of drowsiness, making them more practical and user-friendly.

This project focuses on the development of an AI-Based Driver Drowsiness Detection System using eye blink monitoring. The system uses a camera or eye sensor to track the driver's eye movements in real time. By analyzing whether the eyes are open or closed and measuring the duration of eye closure, the system can accurately identify signs of fatigue. If the driver's eyes remain closed for more than a predefined time, the system assumes a drowsy condition and initiates safety measures.

The system is designed not only to detect drowsiness but also to take immediate action to prevent potential accidents. Initially, an alert in the form of a buzzer is provided to wake the driver. If the driver does not respond to repeated alerts,

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802231

the system automatically reduces the vehicle's speed to minimize risk. At the same time, warning indicators are activated to notify nearby vehicles. Additionally, the system controls the fuel supply from the tank to the engine, which further helps in reducing the vehicle speed gradually and safely.

One of the key advantages of this system is its ability to operate in real time with minimal human intervention. It combines Artificial Intelligence, image processing, and automation to create an efficient and reliable safety mechanism. Unlike traditional systems that only provide warnings, this system takes proactive actions to ensure safety even if the driver fails to respond.

The main objective of this project is to reduce road accidents caused by driver fatigue by providing a smart and automated solution. By integrating detection, alert, and control mechanisms into a single system, this project aims to enhance driving safety and contribute to the development of intelligent transportation systems.

II. LITERATURE REVIEW

Driver drowsiness detection has become an important research area in improving road safety, as a large number of accidents occur due to driver fatigue and loss of concentration. Early studies mainly focused on analyzing driver behavior such as eye blinking, yawning, and head movement. Among these, eye blink monitoring has been identified as one of the most reliable indicators of drowsiness because prolonged eye closure directly reflects fatigue. A widely used parameter in such systems is PERCLOS (Percentage of Eye Closure), which measures the duration for which the eyes remain closed over a period of time and has shown high accuracy in detecting drowsiness.

Several systems have been developed using eye blink sensors that detect whether the driver's eyes are open or closed. If the eye closure exceeds a certain threshold, the system generates an alert. These systems are simple, cost-effective, and suitable for real-time applications, but they often require the driver to wear sensors, which can be uncomfortable and less practical in real-world scenarios.

With the advancement of technology, researchers have shifted towards Artificial Intelligence and Machine Learning approaches. Techniques such as Convolutional Neural Networks (CNN) are used to analyze facial features and detect eye states, while models like Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) are used to study time-based patterns like blinking frequency. These AI-based systems provide higher accuracy and automation by continuously monitoring the driver through a camera and classifying their state as alert or drowsy. However, they require higher computational power and efficient hardware support.

Computer vision-based methods have also gained significant attention, where algorithms such as Haar Cascade, facial landmark detection, and Eye Aspect Ratio (EAR) are used to track eye movement and detect fatigue. These techniques allow non-intrusive monitoring without requiring physical contact with the driver, making them more practical for real-world applications. Combining computer vision with deep learning has further improved the performance and reliability of drowsiness detection systems.

In addition to behavioral and vision-based methods, some research has explored physiological signals such as EEG, ECG, and EOG to detect drowsiness. These methods provide highly accurate results because they directly measure the body's biological signals. However, they are not widely used in practical applications as they require sensors to be attached to the driver's body, making them inconvenient and intrusive.

Recent advancements include multimodal systems that combine multiple techniques, such as eye movement analysis, facial expressions, and vehicle behavior. These hybrid approaches improve accuracy and reliability but increase system complexity and cost. Despite significant progress, many existing systems face challenges such as poor performance in low-light conditions, variations in driver behavior, and high computational requirements. Additionally, some systems lack real-time responsiveness and fail to integrate automatic control mechanisms to prevent accidents.

From the existing literature, it is evident that there is a need for a system that is accurate, cost-effective, and capable of real-time implementation. Most importantly, integrating drowsiness detection with automatic vehicle control can significantly enhance safety. Therefore, this project focuses on developing a system that not only detects driver drowsiness using eye blink monitoring but also takes preventive actions such as alert generation, speed reduction, and fuel control to ensure road safety.

III. RESEARCH METHODOLOGY

This study employs a systematic literature review methodology to analyze the advancements in AI-powered Intrusion Detection Systems (IDS) developed in 2024. The review aims to identify emerging trends, evaluate the effectiveness of various AI techniques, and highlight the challenges and future directions in the field.

The literature search was conducted across several academic databases, including IEEE Xplore, SpringerLink, ScienceDirect, and Google Scholar, using keywords such as "AI-powered IDS," "machine learning," "deep learning," "generative adversarial networks," "reinforcement learning," and "explainable AI." The search was limited to publications from the year 2024 to ensure the inclusion of the most recent developments.

Inclusion criteria for the selected studies encompassed empirical research that demonstrated the application of AI techniques in IDS, with a focus on performance metrics such as detection accuracy, false positive rate, and computational efficiency. Studies that addressed the interpretability of AI models or proposed novel methodologies for enhancing IDS capabilities were also considered.

Each selected study was analyzed to extract key information, including the AI techniques employed, the datasets used, the evaluation metrics reported, and the reported outcomes. A comparative analysis was conducted to assess the strengths and limitations of different approaches and to identify common trends and gaps in the existing literature.

The findings from the literature review were synthesized to provide a comprehensive overview of the current state of AI-powered IDS, emphasizing the advancements made in 2024.

IV. RESULTS AND DISCUSSION

The research methodology for this project focuses on designing and developing an AI-based driver drowsiness detection system using eye blink monitoring and automated vehicle control. The approach is structured in multiple stages, including data acquisition, processing, analysis, decision-making, and control implementation.

Initially, the system setup is established by integrating a camera or eye sensor to continuously monitor the driver’s face and eye movements. The camera captures real-time video input, which serves as the primary data source for detecting drowsiness. This non-intrusive method ensures that the driver is not required to wear any additional equipment, making the system more practical and user-friendly.

In the next stage, the captured video frames are processed using image processing techniques. The system detects the driver’s face and locates the eye region using algorithms such as facial landmark detection or Haar Cascade classifiers. Once the eyes are detected, the system continuously tracks their state (open or closed) across successive frames.

To analyze eye behavior, parameters such as eye closure duration and blink rate are calculated. A threshold value is defined (e.g., eyes closed for more than 2 seconds) to identify drowsiness. If the eye closure exceeds this threshold, the system classifies the driver’s condition as drowsy. In advanced implementations, machine learning or deep learning models such as Convolutional Neural Networks (CNN) can be used to improve detection accuracy by learning patterns from eye images.

After detecting drowsiness, the system moves to the decision-making phase. A control logic is implemented to determine the appropriate response based on the driver’s condition. Initially, a warning alert in the form of a buzzer is activated to notify the driver. If the driver fails to respond, the system repeats the alert multiple times to ensure awareness.

If there is still no response after repeated alerts, the system activates safety control mechanisms. These include automatic speed reduction and activation of vehicle indicators to warn nearby vehicles. The speed reduction is achieved by controlling the fuel supply from the fuel tank to the engine. A control unit (such as a microcontroller) is used to regulate the fuel flow, which gradually reduces engine power and slows down the vehicle.

The system also includes a recovery mechanism. Once the driver regains alertness and opens their eyes normally, the system detects this change and deactivates the safety controls. The fuel supply is restored, alerts are stopped, and the vehicle returns to normal operation.

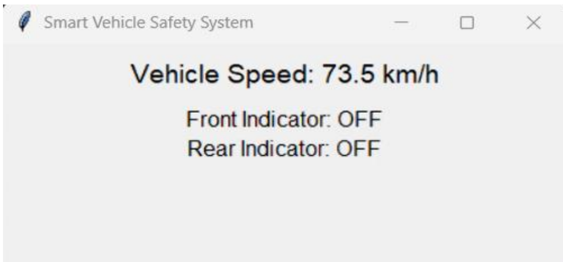
|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802231

Throughout the development process, the system is tested under different conditions such as varying light environments and different driver behaviors to ensure reliability and accuracy. Performance evaluation is carried out based on parameters like detection accuracy, response time, and system efficiency.

Overall, this methodology combines real-time monitoring, image processing, Artificial Intelligence, and automated control to create an effective driver safety system. The structured approach ensures accurate detection of drowsiness and timely intervention to prevent potential accidents.

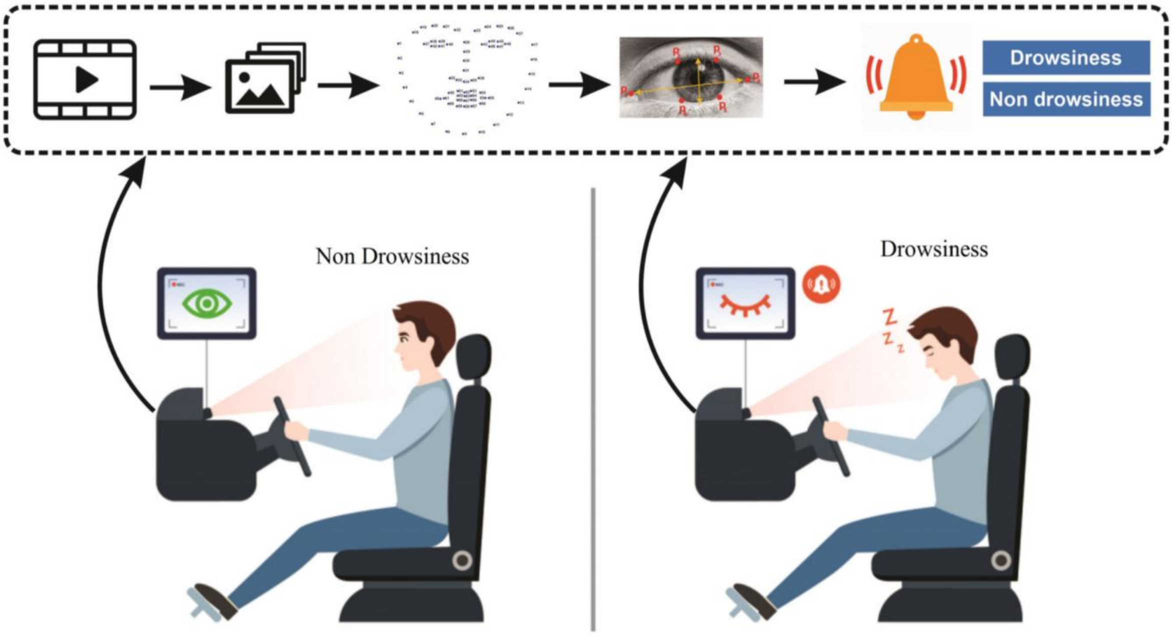


International Journal of Engineering & Extended Technologies Research (IJEETR)

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802231



V. CONCLUSION

The AI-Based Driver Drowsiness Detection System developed in this project successfully addresses one of the major causes of road accidents, which is driver fatigue. By continuously monitoring the driver's eye movements using a camera or eye sensor, the system is able to accurately detect signs of drowsiness in real time. The use of eye blink monitoring proves to be an effective and reliable method for identifying fatigue conditions.

One of the key strengths of this system is its ability not only to detect drowsiness but also to take immediate preventive actions. The alert mechanism, in the form of a buzzer, helps in warning the driver at an early stage. If the driver fails to respond, the system intelligently activates additional safety measures such as automatic speed reduction, blinking indicators, and fuel supply control. These features work together to minimize the chances of accidents and ensure the safety of both the driver and other road users.

The integration of Artificial Intelligence, image processing, and automation makes the system efficient and capable of real-time operation. Unlike traditional systems that rely only on warning alerts, this project introduces a proactive approach by incorporating vehicle control mechanisms. This significantly enhances the effectiveness of the system in critical situations where the driver is unable to react.

Although the system demonstrates strong performance, certain limitations such as sensitivity to lighting conditions, camera quality, and variations in driver behavior were observed. These challenges indicate the need for further improvements, such as advanced AI models, infrared cameras for night detection, and better hardware optimization to increase accuracy and reliability.

Overall, the project achieves its main objective of developing a smart and automated solution to detect driver drowsiness and prevent accidents. It contributes to the field of intelligent transportation systems by providing a cost-effective and practical safety mechanism. With future enhancements, this system has the potential to be implemented in real-world vehicles, thereby improving road safety and reducing accident rates significantly.

VI. FUTURE WORK

1. Improve detection accuracy using advanced deep learning models.
2. Implement infrared cameras for night-time detection.
3. Add yawning detection along with eye blink monitoring.
4. Include head movement and posture analysis.
5. Integrate steering pattern analysis for better accuracy.
6. Add lane departure detection system.
7. Use IoT to send alerts to family members.
8. Develop a mobile application for real-time alerts.
9. Integrate GPS for location tracking during emergencies.
10. Improve system performance under low-light conditions.
11. Enhance detection for drivers wearing glasses or masks.
12. Reduce system cost for large-scale implementation.
13. Optimize processing speed for real-time performance.
14. Use cloud storage for data analysis and monitoring.
15. Integrate voice alert system instead of buzzer.
16. Add automatic braking system for emergency situations.
17. Combine physiological sensors like heart rate monitoring.
18. Implement multi-driver recognition system.
19. Improve system reliability in different weather conditions.
20. Integrate with smart vehicles and ADAS technologies.

REFERENCES

1. 1.Abtahi, S., Omidyeganeh, M., Shirmohammadi, S., & Hariri, B. (2014). Driver drowsiness monitoring based on yawning detection. IEEE International Instrumentation and Measurement Technology Conference.
2. Bergasa, L. M., Nuevo, J., Sotelo, M. A., Barea, R., & Lopez, M. E. (2006). Real-time system for monitoring driver vigilance. IEEE Transactions on Intelligent Transportation Systems, 7(1), 63–77.
3. Ji, Q., Zhu, Z., & Lan, P. (2004). Real-time nonintrusive monitoring and prediction of driver fatigue. IEEE Transactions on Vehicular Technology, 53(4), 1052–1068.
4. Singh, S., & Papanikolopoulos, N. P. (1999). Monitoring driver fatigue using facial analysis techniques. IEEE Intelligent Transportation Systems Conference.
5. Dinges, D. F., & Grace, R. (1998). PERCLOS: A valid psychophysiological measure of alertness. Federal Highway Administration Report.
6. Soukupová, T., & Čech, J. (2016). Real-time eye blink detection using facial landmarks. 21st Computer Vision Winter Workshop.
7. C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor &Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011. DOI: 10.1080/15325008.2010.541746
8. C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of Electrical Engineering, Vol.63 (6), pp.365-372, Dec.2012. DOI: 10.2478/v10187-012-0054-2

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802231

9. C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011. DOI 10.1007/s00202-011-0203-9
10. S.Tamilselvi, R.Prakash, C.Nagarajan,"Solar System Integrated Smart Grid Utilizing Hybrid Coot-Genetic Algorithm Optimized ANN Controller" Iranian Journal Of Science And Technology-Transactions Of Electrical Engineering, DOI10.1007/s40998-025-00917-z,2025
11. S.Tamilselvi, R.Prakash, C.Nagarajan," Adaptive sliding mode control of multilevel grid-connected inverters using reinforcement learning for enhanced LVRT performance" Electric Power Systems Research 253 (2026) 112428, doi.org/10.1016/j.epsr.2025.112428
12. S.Thirunavukkarasu, C. Nagarajan, 2024, "Performance Investigation on OCF and SCF study in BLDC machine using FTANN Controller," Journal of Electrical Engineering And Technology, Volume 20, pages 2675–2688, (2025), doi.org/10.1007/s42835-024-02126-w
13. C. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- Acta Electrotechnica et Informatica Journal , Vol.13 (2), pp.18-31,April-June.2013, DOI: 10.2478/aeei-2013-0025.
14. C.Nagarajan and M.Madheswaran - 'DSP Based Fuzzy Controller for Series Parallel Resonant converter'- Springer, Frontiers of Electrical and Electronic Engineering, Vol. 7(4), pp. 438-446, Dec.12. DOI 10.1007/s11460-012-0212-0.
15. C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.
16. C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007
17. Suganthi Mullainathan, Ramesh Natarajan, "An SPSS and CNN modelling based quality assessment using ceramic materials and membrane filtration techniques", Revista Materia (Rio J.) Vol. 30, 2025, DOI: https://doi.org/10.1590/1517-7076-RMAT-2024-0721
18. M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022
19. 7. Patel, M., & Panchal, T. (2018). Driver drowsiness detection system using image processing. International Journal of Engineering Research & Technology (IJERT).
20. 8. Saradadevi, M., & Bajaj, P. (2008). Driver fatigue detection using mouth and yawning analysis. International Journal of Computer Science and Network Security, 8(6), 183–188.
21. 9. Sahayadhas, A., Sundaraj, K., & Murugappan, M. (2012). Detecting driver drowsiness based on sensors: A review. Sensors Journal, 12(12), 16937–16953.
22. 10. Johns, M. W. (2000). A sleep physiologist's view of drowsiness detection. Sleep Medicine Reviews, 4(5), 421–432.
23. Zhang, Z. (2018). Driver fatigue detection based on eye state analysis. IEEE Access, 6, 4896–4905.
24. Wierwille, W. W. (1994). Overview of research on driver drowsiness definition and detection. Human Factors Journal, 36(4), 658–677.
25. Vicente, J., Laguna, P., Bartra, A., & Bailón, R. (2016). Drowsiness detection using heart rate variability. IEEE Transactions on Biomedical Engineering, 63(12), 2552–2560.
26. Kaur, H., & Kaur, J. (2017). Driver drowsiness detection using MATLAB. International Journal of Advanced Research in Computer Science.
27. Reddy, B. S., & Reddy, B. K. (2019). Real-time driver drowsiness detection using deep learning. International Journal of Innovative Technology and Exploring Engineering (IJITEE).
28. Mathew, A., & Alex, H. (2025). Federated Learning for Secure Genomic Research: Privacy-Preserving AI Solutions for Precision Medicine. Science and Technology: Developments and Applications Vol. 9, 36-43.
29. Jagadeesh, S., & Soundappan, R. S. (2014). Survey on knowledge discovery in speech emotion detection. International Journal of Innovative Research in Computer and Communication Engineering, 2(5), 4476–4481. Retrieved from https://ijircce.com/admin/main/storage/app/pdf/i7mLTWLAd6a4VqXoYxeMRM6m0zylGcBFKaMTHo5H.pdf
30. Soundappan, S. J. (2022). AI-Based Fault Detection and Isolation for Reliability in Modern Power Systems. International Journal of Research Publications in Engineering, Technology and Management (IJRPETM), 5(4), 7106-7110.