Journal of Computer and Electrical Sciences (JCES)- Volume-1 Issue-4, April 2026
ISSN: 3049-2602

REAL-TIME DRIVER DROWSINESS DETECTION SYSTEM USING VISION TRANSFORMER

P. Rohini Keerthi [1], K. Kishore Kumar[2]

[1]Student, Department of Computer Science and Engineering, Andhra Loyola Institute of Engineering and Technology, Vijayawada, NTR, Andhra Pradesh, India
[2]Assistant Professor, Department of Computer Science and Engineering, Andhra Loyola Institute of Engineering and Technology, Vijayawada, NTR, Andhra Pradesh, India

Email: rohinikeerthi05@gmail.com

Abstract: *Driver drowsiness is a leading cause of road accidents around the world. Fatigue lowers focus, slows reaction times, and impacts decision-making. Keeping track of driver alertness can help prevent these accidents and improve road safety. This paper introduces a real-time driver drowsiness detection system that uses a Vision Transformer (ViT) model to classify eye states accurately. The system is trained on a dataset of about 84,900 images of open and closed eyes to boost detection performance and reliability. During operation, a webcam captures video frames while computer vision techniques locate the driver's face and extract the eye area. The system analyzes the extracted eye images with the Vision Transformer model to determine if the eyes are open or closed. If it detects that the eyes are closed for too long, it sends an alert to the driver. The experimental results show that this model achieves an accuracy of around 98.8%. This indicates that the system can effectively spot driver fatigue and help create safer driving conditions.*

Keywords: **Driver Drowsiness Detection, Vision Transformer, Deep Learning, Computer Vision, Eye Detection, Real –Time Monitoring, Artificial Intelligence, Driver Monitoring System, Fatigue Detection, Image Classification, OpenCV, Eye State Recognition.**

1.INTRODUCTION

Driver safety is a key issue in today's transportation systems. Driver fatigue leads to many road accidents. Long hours of driving, insufficient rest, and dull driving conditions can lower a driver's focus and slow their reaction time. Current driver monitoring systems mostly use basic computer vision techniques and manual observation to spot signs of fatigue, like eye closure and blinking patterns. However, these traditional methods often struggle to work well in real-time because of changes in lighting and driver movements. Recent progress in artificial intelligence and deep learning has created better systems for examining driver behavior. Vision Transformer models are great at image recognition tasks. They capture important visual patterns more effectively than older methods. This work proposes a real-time driver drowsiness detection system based on a Vision Transformer model that identifies driver fatigue through

eye state analysis. The system has three main components to improve detection accuracy and allow real-time monitoring:

• Real-Time Face and Eye Detection

• Vision Transformer-based Eye State Classification

• Automatic Alert Generation for Driver Warning

The system aims to provide a reliable and efficient way to detect driver drowsiness and enhance road safety.

2. LITERATURE SURVEY

Driver drowsiness detection is an important research area, as drowsiness while driving is a significant cause of road accidents. Many researchers have proposed systems for driver drowsiness detection using computer vision techniques and deep learning algorithms. Some studies have used deep learning algorithms like VGG-16 and VGG-19 for driver drowsiness detection, which have achieved an accuracy of about 95%. Some studies have proposed systems based on the eye blink rate and yawn detection using Haar Cascade classifiers. Some studies have proposed systems based on machine learning algorithms like SVM for analyzing the features of the eyes. This algorithm has achieved an accuracy of about 91.3%. Some studies have proposed systems based on facial landmark detection using Dlib, which detects the movement of eyes and mouths by analyzing the Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR). This algorithm has achieved an accuracy of about 96.71%. Recently, some studies have proposed systems based on Convolutional Neural Network (CNN) algorithms and other light deep learning algorithms, which have achieved an accuracy of about 98.7%.

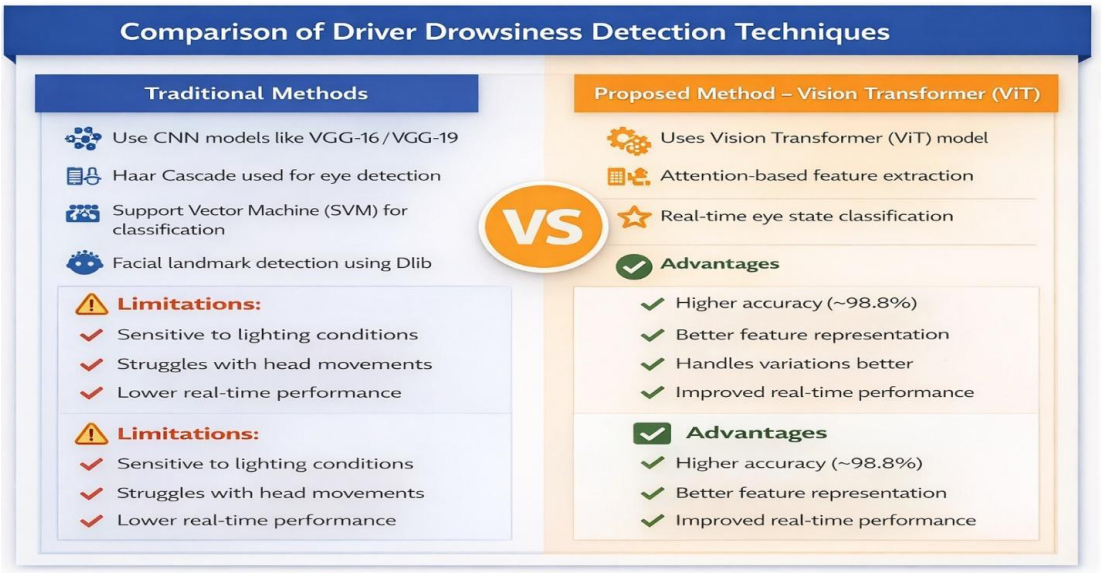

Fig 1: Comparison with other works

3.PROPOSED SYSTEM

The proposed system develops a real-time driver drowsiness detection model using a Vision Transformer (ViT) to monitor the driver's eye state. A dataset of approximately 84,900 images of open and closed eyes was used for training. To improve model performance, random oversampling was applied to balance the dataset, and data augmentation techniques such as rotation, cropping, and sharpness adjustments were used to handle variations in lighting and facial appearance. A pre-trained ViT model (google/vit-base-patch16-224-in21k) was adopted and enhanced with additional fully connected layers using ReLU activation and dropout to improve classification accuracy and prevent overfitting.

For real-time detection, a webcam captures video frames, which are processed using OpenCV**.** A Haar Cascade classifier detects the driver's face and extracts the eye region, which is then analyzed by the trained model to classify the eye state as open or closed**.** If the eyes remain closed continuously with a probability greater than 0.5**,** the system triggers an audio alarm to alert the driver. The proposed system achieved an accuracy of approximately 98.8%**,** demonstrating its effectiveness in detecting driver fatigue and improving road safety.

Advantages of proposed system

- Higher Accuracy:
  The system achieves an accuracy of about 98.8%**,** which is higher than many existing methods.
- Better Feature Extraction:
  The Vision Transformer (ViT) captures subtle eye features and long-range visual patterns more effectively than traditional CNN-based approaches.
- Improved Generalization:
  Training on a large and balanced dataset helps the model perform well under different lighting conditions and facial variations.
- Real-Time Operation:
  The system processes live webcam video with minimal delay, making it suitable for real-time driver monitoring.

Algorithms Used

- Vision Transformer (ViT) – Used for eye-state classification.
- OpenCV – Used for real-time video capture and face/eye detection.

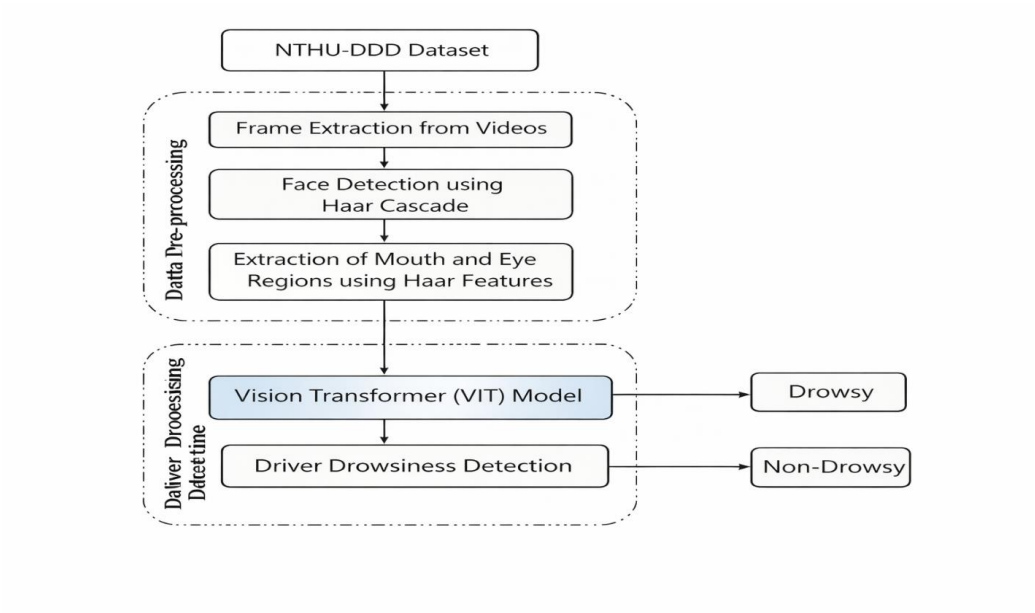

Fig 2: System Architecture

4.METHODOLOGY

The methodology of the proposed system will be as follows:

The proposed system for driver drowsiness detection uses various modules to efficiently handle the data, train the model, and then perform the detection. The following are the main modules used in the proposed system:

• User Module:
This module helps the users register and use the system by giving access to the login page. After activation by the admin, the user can upload the data and perform the classification. The system then shows the performance results.

• Admin Module:
This module helps the admin handle the system and user accounts. The admin can activate the users and check the uploaded data. The admin can also check the performance of the model.

• Dataset Management:
This module helps handle the dataset used in the system. The dataset consists of images and videos of the driver in both drowsy and non-drowsy conditions.

• Data Preprocessing:
This module helps in the preprocessing of the dataset. The dataset consists of images and videos of the driver. The images are then preprocessed by extracting the frames from the videos. The images are then resized and noise reduced. The face region is then detected.

• Deep Learning Model:

This module uses the Vision Transformer model for the detection of drowsiness. The model uses the self-attention mechanism to detect the state of the eyes. The model detects the state of the eyes by dividing the images into patches. The patches help the model detect the state of the eyes.

5.IMPLEMENTATION AND RESULTS

The proposed driver drowsiness detection system is developed as a web-based application. The overall architecture is modular in nature. The frontend is developed using HTML, CSS, and Django templates. The backend is developed using Python programming. The dataset used for training and testing purposes contains images representing open and closed eyes. Data preprocessing methods are used to improve data quality. The data preprocessing methods used are image resizing, removal of noise, and facial region detection. The deep learning module is developed using Vision Transformer (ViT). The ViT model is used for eye state classification and driver fatigue detection. The ViT model works on patches and uses self-attention for important visual patterns. The developed model is tested using dataset images and webcam feed. The results show that the developed model can achieve an accuracy of 98.8% for eye state classification. The developed system can detect eye closure for a long time and can generate alerts for the driver.

The driver drowsiness detection system is developed as a web-based application. The overall architecture is modular in nature. The overall architecture can be explained as follows:

- Frontend: Developed using HTML, CSS, and Django templates
- Backend: Developed using Python and Django framework
- Deep Learning: Developed using Vision Transformer (ViT) and OpenCV
- Dataset: Developed using Driver Drowsiness Eye Image Dataset

Key features include:

- User registration/login interface
- Upload and management of dataset
- Eye state classification using Vision Transformer
- Real-time drowsiness detection using webcam
- Display of performance metrics such as accuracy and precision

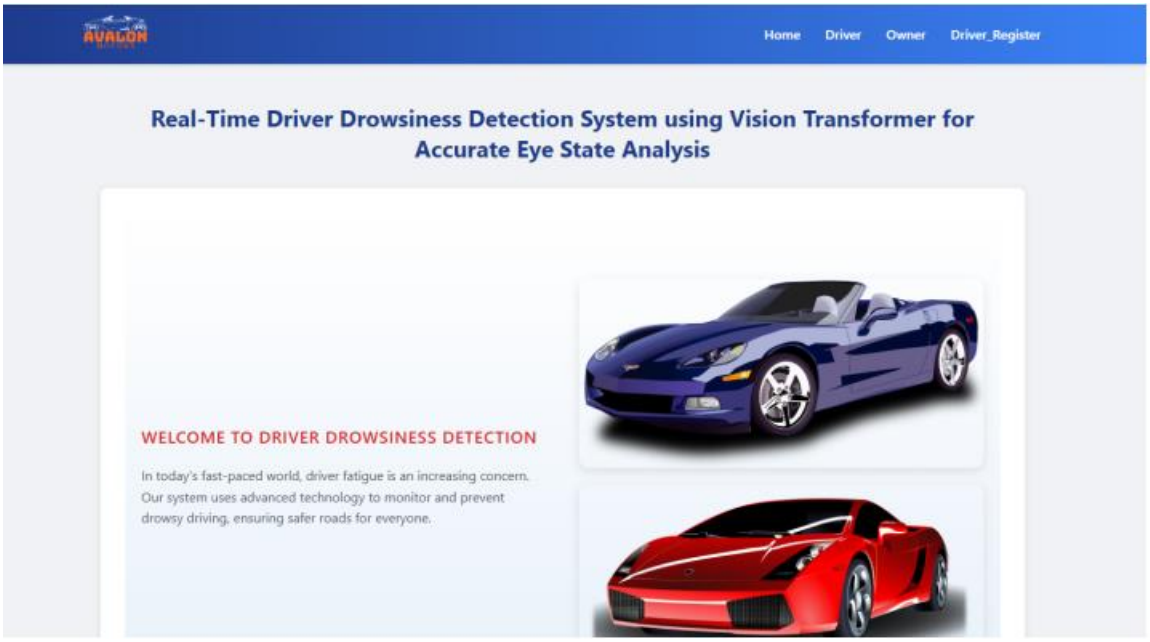

Fig 3: Home Page

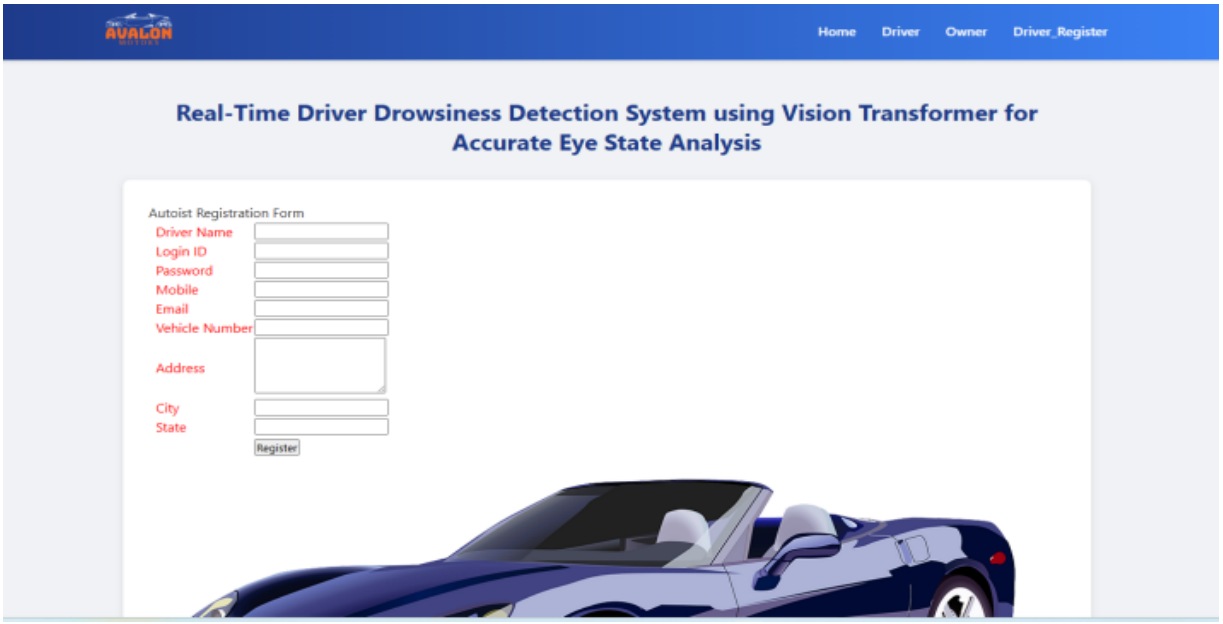

Fig 4: Registration Form

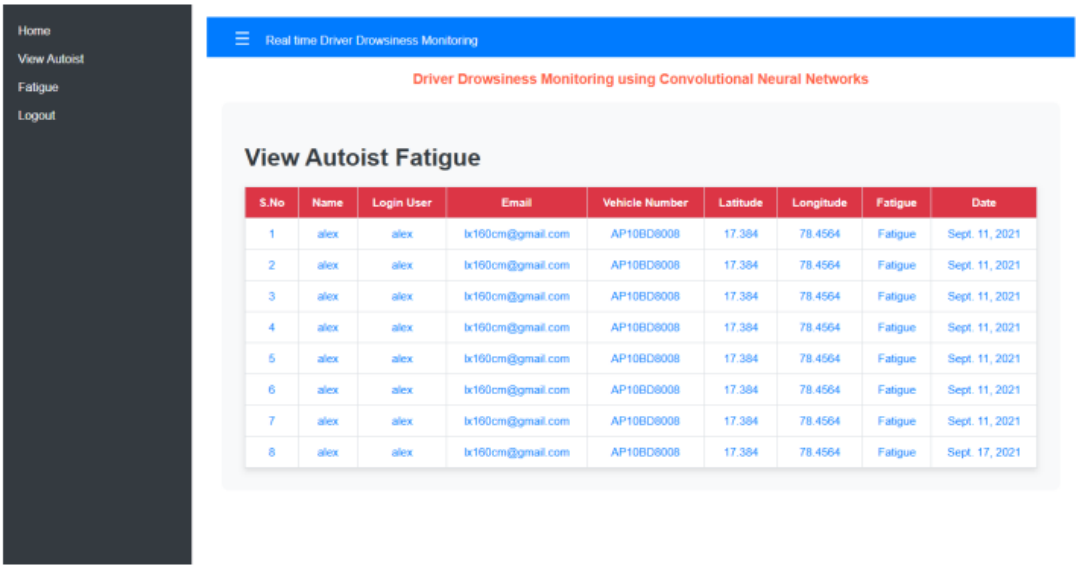

Fig 5: Fatigue Values

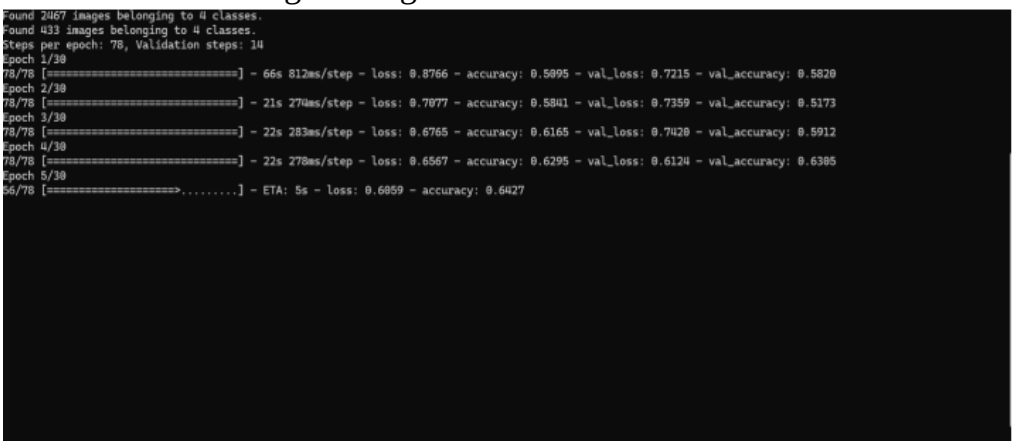

Fig 5: Training using ViT model

Fig 6: Drowsiness Detected

6.FUTURE SCOPE

A driver fatigue detection system can be improved with the addition of other indicators such as head pose estimation, yawning detection and heart rate monitoring to create a more accurate representation of driver drowsiness. The system must also be optimized for real world conditions (i.e. poor lighting and different driver positions) so as to work effectively in the real world. Use of other types of cameras (e.g. infrared) will improve the performance of the system to provide accurate detection during the evening hours. Additionally, the model could be placed on embedded systems including Raspberry Pi or NVIDIA Jetson in order to provide a low-cost, real time solution to the user in the vehicle. Real-time alerts will also be made possible through integration with Advanced Driver Assistance Systems (ADAS) and/or Internet of Things (IoT) platforms, thus, increasing safety on roads through improved awareness of each other while driving.It can also be enhanced by incorporating machine learning-based models for intelligent recommendations. Real-time API integration with government databases can also enhance the accuracy and reliability of the system. Furthermore, the system can be enhanced by incorporating intelligent chatbot interactions through the use of advanced NLP techniques. The scalability of the system can also be enhanced through optimized indexing techniques.

7.CONCLUSION

This study proposes a real-time system for detecting driver drowsiness. The proposed system is based on image processing and utilizes a Vision Transformer (ViT) model for eye movement recognition. The proposed system has shown promising results with an accuracy of 98.8%, as it was trained on an 80-10-10 dataset. Additionally, an alarm system has been incorporated to alert the driver when drowsiness is detected. This helps the driver to regain his attention, thereby preventing any accidents. The proposed system is efficient for real-time applications, and it provides effective monitoring of driver alertness. The proposed system is an efficient solution for preventing accidents due to driver fatigue.

REFERENCES

[1] H. Ahuja, S. Saurav, S. Srivastava and C. Shekhar, "Driver Drowsiness Detection using Knowledge Distillation Technique for Real Time Scenarios," 2020 IEEE 17th India Council International Conference (INDICON), New Delhi, India, 2020, pp. 1–5, doi: 10.1109/INDICON49873.2020.9342263.

[2] H. Garg, "Drowsiness Detection of a Driver using Conventional Computer Vision Application," 2020 International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC), Mathura, India, 2020, pp. 50–53, doi: 10.1109/PARC49193.2020.236556.

[3] W. Hussein and M. S. A. El-Seoud, "Improved Driver Drowsiness Detection Model Using Relevant Eye Image's Features," 2017 European Conference on Electrical Engineering and Computer Science (EECS), Bern, Switzerland, 2017, pp. 261–265, doi: 10.1109/EECS.2017.55.

[4] A. Kumar and R. Patra, "Driver Drowsiness Monitoring System using Visual Behaviour and Machine Learning," 2018 IEEE Symposium on Computer Applications & Industrial Electronics (ISCAIE), Penang, Malaysia, 2018, pp. 339–344, doi: 10.1109/ISCAIE.2018.8405495.

[5] C.-Y. Lin, P. Chang, A. Wang and C.-P. Fan, "Machine Learning and Gradient Statistics Based Real-Time Driver Drowsiness Detection," 2018 IEEE International Conference on Consumer Electronics-Taiwan (ICCE-TW), Taichung, Taiwan, 2018, pp. 1–2.

[6] S. Mohanty, S. V. Hegde, S. Prasad and J. Manikandan, "Design of Real-Time Drowsiness Detection System using Dlib," 2019 IEEE International WIE Conference on Electrical and Computer Engineering (WIECON ECE), Bangalore, India, 2019, pp. 1–4, doi: 10.1109/WIECON-ECE48653.2019.9019910.
[7] I. Belakhdar, W. Kaaniche, R. Djmel and B. Ouni, "A Comparison between ANN and SVM Classifier for Drowsiness Detection Based on Single EEG Channel," 2016 2nd International Conference on Advanced Technologies for Signal and Image Processing (ATSIP), Monastir, Tunisia, 2016, pp. 443–446, doi: 10.1109/ATSIP.2016.7523132.
[8] D.-L. Nguyen, M. D. Putro and K.-H. Jo, "Eyes Status Detector Based on Lightweight Convolutional Neural Networks Supporting Drowsiness Detection System," IECON 2020 – 46th Annual Conference of the IEEE Industrial Electronics Society, Singapore, 2020, pp. 477–482, doi: 10.1109/IECON43393.2020.9254858.
[9] A. Revelo, R. Álvarez and F. Grijalva, "Human Drowsiness Detection in Real Time Using Computer Vision," 2019 IEEE Fourth Ecuador Technical Chapters Meeting (ETCM), Guayaquil, Ecuador, 2019, pp. 1–6, doi: 10.1109/ETCM48019.2019.9014884.
[10] K. S. Sankaran, N. Vasudevan and V. Nagarajan, "Driver Drowsiness Detection using Percentage Eye Closure Method," 2020 International Conference on Communication and Signal Processing (ICCSP), India, 2020.
[11] A. A. Suhaiman, Z. May and N. A. A. Rahman, "Development of an Intelligent Drowsiness Detection System for Drivers using Image Processing Technique," 2020 IEEE Student Conference on Research and Development (SCOReD), Batu Pahat, Malaysia, 2020, pp. 233–236, doi: 10.1109/SCOReD50371.2020.9250948.
[12] C. C. Ukwuoma and C. Bo, "Deep Learning Review on Driver Drowsiness Detection," 2019 4th Technology Innovation Management and Engineering Science International Conference (TIMES-iCON), Bangkok, Thailand, 2019, pp. 1–5, doi: 10.1109/TIMES-iCON47539.2019.9024642.