iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: VI Month of publication: June 2025

DOI: https://doi.org/10.22214/ijraset.2025.68873

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VI June 2025- Available at www.ijraset.com

Drowsiness Alert System for Safe Driving

Anantha Lakshmi Nukulla[1], Yendru Aparna[2], Bandaru Veera Venkata Dattu[3], Devara Sri Sai Swaroop[4], Vengalapudi Appalakonda[5]
[1, 2, 3, 4]*B.Tech Student, Department of AIML, Aditya University Surampalem, India*
[5]*Assistant Professor, Department of AIML, Aditya University, Surampalem, India*

Abstract: The primary goal of this project is to reduce road accidents around the world. Nowadays, many drivers are unknown when they begin to feel sleepy especially during the night time in vehicles like cars which can result in accidents. To reduce such risks and make roads safer, the project proposes a drowsiness detection and alert system that integrates deep learning and IOT technologies. This system uses a live camera to monitor the facial expressions of the driver to track the movement of eyes and lips. Then the image will be processed by a pre-trained deep learning model such as CNN and LSTM. The system then will generate an alert message to the driver when it figured out that the driver is sleeping by the eye movement of the driver and also gives a voice detection (You are sleeping wake up) and the alert message is a buzzer sound which is placed under the driver seat. It also gives detection when the driver is yawning as it is a sign to sleep. We built it by using python, OpenCV and deep learning models. This system runs in a real time with low-cost and easy to install in vehicles. This project demonstrates a practical implementation of deep learning and IOT in safety of user, leading a real-time monitoring and intelligence decision making to minimize the road accidents.
Keywords: IoT, Deep Learning, Convolutional Neural Network, Long Short Term Memory, OpenCV, Python, ESP- Module, Buzzer.

I. INTRODUCTION

Every year, thousands of road accidents occur due to drowsiness driving leading to injuries and some time to death warranties. Many drivers don't even realize that they are sleeping until it can lead to a big messy thing. Unlike the distractions caused by the phones or external factors, drowsiness is something that affects silently the driver's ability to stay unfocused on the action they are doing. The issue is especially dangerous during long time driving in high way or night time travelling where fatigue is common. There is a need for s system to detect the drowsiness and alert the driver in real-time is more important in nowadays.

This project aims to address that problem by developing a smart Drowsiness Alert System using computer vision and deep learning techniques. The system uses a camera to monitor the driver's facial features—such as eye closure, blink rate, yawning, and head movements. With the help of Python, OpenCV, and a trained Convolutional Neural Network (CNN), the system analyzes these facial cues to decide if the driver is becoming drowsy. If it detects signs of fatigue, it immediately activates an alert mechanism, such as a buzzer or message, to help the driver regain focus and stay safe on the road.

The biggest advantage of this system is that it is non- intrusive—drivers don't have to wear any special devices or sensors. It is also cost-effective and can be installed in personal vehicles, public transport buses, or even fleet trucks. By combining artificial intelligence with real-time monitoring, this system can play a valuable role in preventing accidents and promoting safer driving habits. This project takes a step toward a future where technology actively supports human safety in everyday life.

II. RELATED WORKS

Over the years, many researchers and developers have worked on finding ways to detect driver drowsiness and prevent accidents caused by fatigue. Some of the earlier methods relied on physical sensors that were attached to the driver's body, like EEG (brain wave) or heart rate sensors. While these techniques could be accurate, they were not practical for everyday use because they required drivers to wear uncomfortable devices or medical equipment while driving, which is not convenient or affordable for most people. Later on, some systems were developed that monitored vehicle behavior—like how often the driver swerved or how steady they held the steering wheel. These behavior-based systems could detect unusual driving patterns that might indicate drowsiness. However, these systems often gave false alarms because road conditions, driving styles, or weather changes could also cause sudden movements. They also worked only after the driver was already losing focus, which didn't give enough time to prevent accidents.

In more recent years, with the advancement of artificial intelligence and computer vision, researchers started focusing on camera-based solutions. These systems use regular webcams or dashboard cameras to track the driver's face in real time.

Techniques like facial landmark detection, Eye Aspect Ratio (EAR), and yawn detection became popular for identifying signs of fatigue. Some studies used deep learning models, like CNNs and LSTMs, to improve accuracy and detect patterns more reliably over time. These methods have shown great promise because they are non-invasive and can run on affordable hardware.

While many existing systems have done well in lab conditions, there are still challenges in making them work reliably in the real world—such as dealing with low light, different face shapes, head movements, or people wearing glasses. Our project builds on these previous works but focuses on creating a lightweight, real-time solution that works well on low-cost devices and provides immediate alerts using sound or IoT-based notifications. It combines proven methods like EAR and CNNs with practical features to create a system that's both effective and easy to use in everyday driving situations.

III. LITERATURE SURVEY

In a study by Jap et al. (2009), researchers explored the use of EEG signals to detect driver drowsiness by monitoring changes in brain activity. Their system involved placing sensors on the driver's scalp to record brain wave patterns and classify drowsy states. While the method was scientifically reliable, it was not practical for daily driving because wearing electrodes and wires was uncomfortable and distracting for the user.

Vicente et al. (2011) proposed a non-invasive system using heart rate and skin temperature to monitor fatigue levels. Their research showed that physiological changes in the human body can indicate the onset of drowsiness. However, this approach still required physical contact with sensors, making it less ideal for long-term or real- world use, especially in environments where comfort and ease of use are essential.

Dong et al. (2011) shifted the focus to behavior- based monitoring by analyzing steering wheel movement and lane deviation. Their system tracked how smoothly or erratically a driver handled the vehicle, assuming that unusual patterns could signal drowsiness. While useful, this method struggled in situations where road conditions affected steering, leading to false alarms.

A significant breakthrough came from Bergasa et al. (2006), who introduced a real-time video-based monitoring system using infrared cameras. They tracked the driver's eyes and facial expressions to estimate drowsiness levels. This study laid the foundation for many modern vision-based systems, showing that it's possible to detect fatigue without physical contact, making it more user-friendly and widely applicable.

Soukupová and Cech (2016) made an important contribution by developing the Eye Aspect Ratio (EAR) method, which calculates eye openness using specific facial landmarks. This method became popular due to its simplicity and effectiveness in real-time detection. Many current systems, including the one in this project, use EAR to identify long blinks or closed eyes—strong indicators of drowsiness.

Hassanpour et al. (2020) combined computer vision with deep learning to improve detection accuracy. They trained CNN models to recognize drowsy behaviors from facial images and achieved promising results. Their work demonstrated how AI could outperform traditional rule- based systems and adapt better to different lighting and face conditions, which inspired the use of CNNs in our own system.

Zhang et al. (2021) took it a step further by integrating CNN and LSTM models. While CNNs handled the spatial features (like face and eye position), LSTMs analyzed the time-based patterns (like repeated blinking or yawning). Their hybrid approach provided better accuracy and fewer false positives, especially during longer driving sessions, making it a strong reference for our project.

IV. METHODOLOGY

1) Video Capture: The first step in the system involves real-time video capture. A camera is mounted on the vehicle dashboard to constantly monitor the driver's facial movements, focusing specifically on the eyes, mouth, and head posture. The camera is carefully positioned to ensure a clear view of the driver's face, regardless of head movement or slight obstructions. Since driving conditions vary significantly— from bright daylight to nighttime or low-light environments— it's important that the system can perform reliably across these scenarios. To address this, the setup may include cameras with night vision or infrared capabilities to improve visibility during dark conditions. The goal is to continuously capture accurate and high-quality facial data without distracting the driver.
2) Feature Extraction: Once the video frames are being captured, the next phase is feature extraction, where facial data is analyzed using computer vision techniques. Algorithms such as Haar Cascades and Dlib's facial landmark detector are used to detect and map out key facial points like the corners of the eyes, mouth, nose, and jawline. These landmarks are then used to calculate the Eye Aspect Ratio (EAR) to detect if the eyes are open or closed, and the Mouth Aspect Ratio (MAR) to monitor yawning. Additionally, the system tracks head position to identify any downward tilting, which often signals fatigue. These calculated

features act as the input for the detection algorithm and provide a meaningful way to assess whether the driver is alert or drowsy.

3) Drowsiness Detection: Following feature extraction, the system enters the drowsiness detection phase. Here, the collected facial data is analyzed using deep learning models that are trained to classify the driver's condition as either alert or drowsy. Models such as CNNs and LSTMs are used to understand both the spatial features in each frame and the time- based patterns that develop over several frames. For instance, if a driver's eyes remain closed beyond a certain number of consecutive frames or if yawning is observed frequently within a short span, the system considers these signs of fatigue. Similarly, if the head tilts downward and stays that way for too long, it signals possible drowsiness. The model processes all of these indicators and provides a real-time judgment about the driver's state, triggering the next set of actions if drowsiness is detected.
4) IOT Monitoring: To take the system a step further, it includes IoT-based monitoring and data transmission. This means that when drowsiness is detected, the system can communicate this information beyond the vehicle. Alerts can be sent to a fleet management system, allowing companies to monitor their drivers' performance and take immediate action if needed. It can also upload data to a cloud storage system, where detection events are logged and analyzed for future improvements. Additionally, the system can be linked to smart vehicle technologies that take corrective actions, such as reducing speed or gradually stopping the vehicle in cases of extreme fatigue. This functionality is especially useful for professional drivers—like truckers or cab drivers—who spend long hours on the road.
5) Driver Alert System: The final part of the methodology is the driver alert system, which ensures the driver receives an immediate and unmistakable warning when drowsiness is detected. Depending on the setup, alerts can come in different forms. A loud buzzer or voice message can play inside the car to grab the driver's attention. There can also be visual warnings displayed on the dashboard or smart screen. For stronger feedback, the system may activate physical responses like vibrating the driver's seat or making slight steering corrections if integrated with vehicle control systems. These alerts are designed not just to inform the driver but to bring their attention back to the road before a dangerous situation occurs.

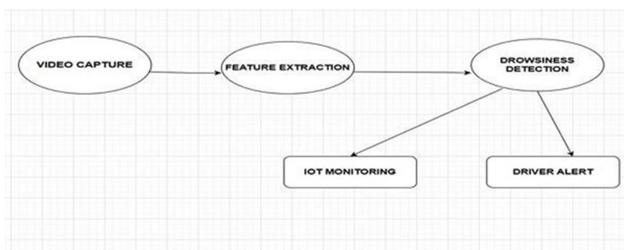


Fig 1. Process Work Flow

V. RESULTS

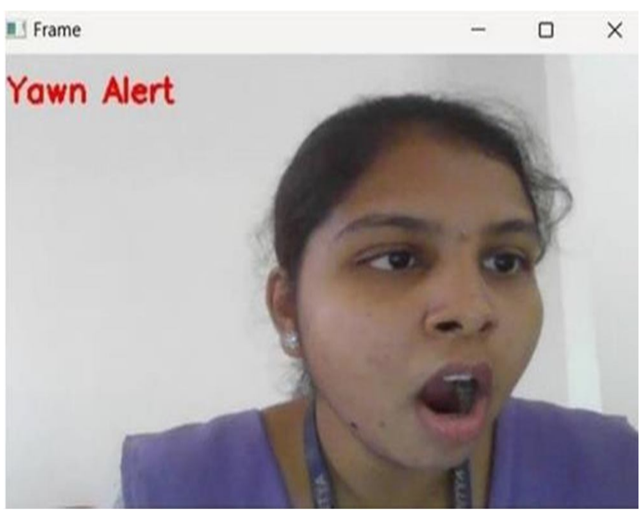


Fig 2. Yawn Alert

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VI June 2025- Available at www.ijraset.com

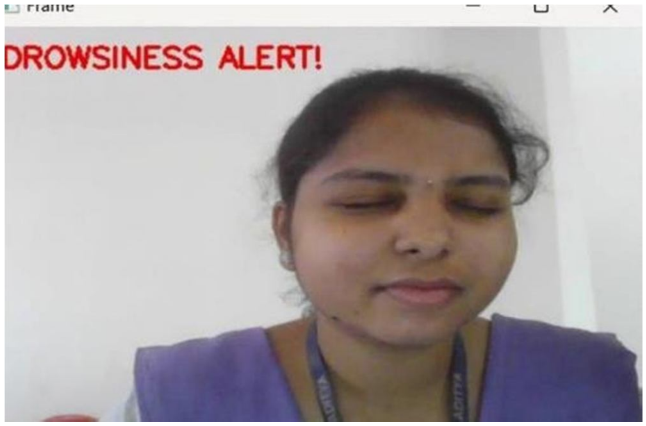


Fig 3. Drowsiness Alert

Fig 4. ESP-Module

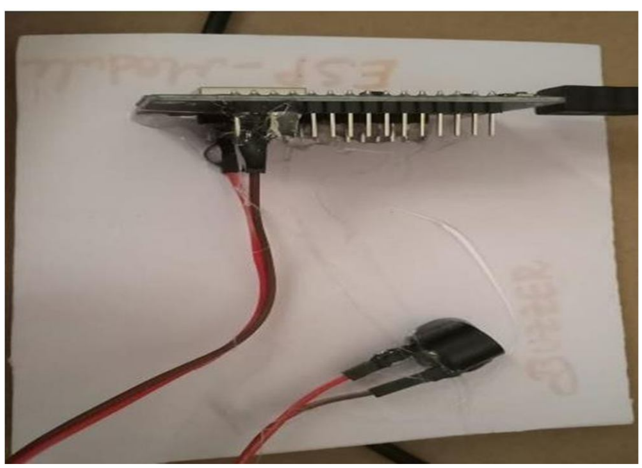


Fig 5. Buzzer

VI. CONCLUSION

Drowsy driving has become a serious safety concern in today's fast-moving world, especially with more people driving long distances, working late-night shifts, or spending long hours on the road. Many drivers don't even realize when they start to feel sleepy, which can lead to slower reactions, poor decisions, and unfortunately, dangerous accidents. To help solve this issue, we developed a smart and simple Drowsiness Alert System that can monitor a driver's face in real time and give quick warnings before anything goes wrong.

This system uses a regular camera and advanced computer vision techniques to track important signs of fatigue like frequent blinking, long eye closure, yawning, and head tilting. We've used tools like OpenCV, Dlib, and deep learning models to analyze facial features and detect when the driver is starting to become sleepy. The system can work in different lighting conditions, and it doesn't require the driver to wear any special devices, making it very easy to use. When drowsiness is detected, it immediately triggers alerts—like buzzer sounds, dashboard messages, or seat vibrations—to help the driver stay awake and focused.

What makes this system even more useful is its ability to connect with IoT technologies. It can send alerts to fleet managers, store logs in the cloud, or even slow down the vehicle if needed, especially in smart vehicles. This makes the solution not just helpful for individuals, but also for transport companies and long-haul drivers who need extra safety on the road. The project is designed to be lightweight, affordable, and practical so that it can be installed in any vehicle, personal or commercial.

In conclusion, this project successfully shows how artificial intelligence, computer vision, and real-time monitoring can come together to prevent accidents and save lives. With a growing number of road accidents due to fatigue, systems like this have the power to make driving safer for everyone. It's a step forward in using technology for public safety, and with a few improvements, this solution can become an essential part of modern driving systems. Our project proves that even a simple idea, when combined with the right technology, can create a big impact in real life.

VII. FUTURE SCOPE

In the future, this Drowsiness Alert System can be bettered by adding more advanced features like voice cautions, gesture recognition, and support for night vision cameras to work more in low light. It can also be connected to smart vehicle systems to automatically control the auto in extreme cases, like decelerating down or stopping safely. With pall storehouse and mobile app integration, motorists or line directors can track fatigue patterns over time. As technology grows, this system can come indeed smarter, more accurate, and extensively used in both particular and marketable vehicles to insure safer peregrinations.

REFERENCES

[1] Johns, M. W. (2000) – In this paper, Johns introduces the Epworth Sleepiness Scale, a widely used method for measuring daytime sleepiness. This tool has been useful in evaluating driver alertness in many drowsiness detection systems.

[2] Khushaba, R. N., Kodagoda, S., Lal, S., & Dissanayake, G. (2011) – This study explores how EEG (electroencephalogram) signals can be used to detect fatigue and drowsiness in drivers. The researchers achieved accurate results by analyzing brain wave patterns.

[3] Vural, E., Cetin, M., Ercil, A., Littlewort, G., Bartlett, M., & Movellan, J. (2009) – The authors present a non-invasive approach for detecting drowsiness using facial expression recognition and eye blink patterns from video frames.

[4] Picot, A., Charbonnier, S., & Caplier, A. (2012) – This research combines physiological signals like EOG and EEG to create a robust drowsiness detection system. The hybrid approach improves the reliability of alert mechanisms.

[5] Wang, Y., Yang, W., Cheng, B., & Wang, Y. (2018) – The paper introduces a real-time system using a deep learning- based CNN model to monitor facial features such as eye closure and yawning for drowsiness detection.

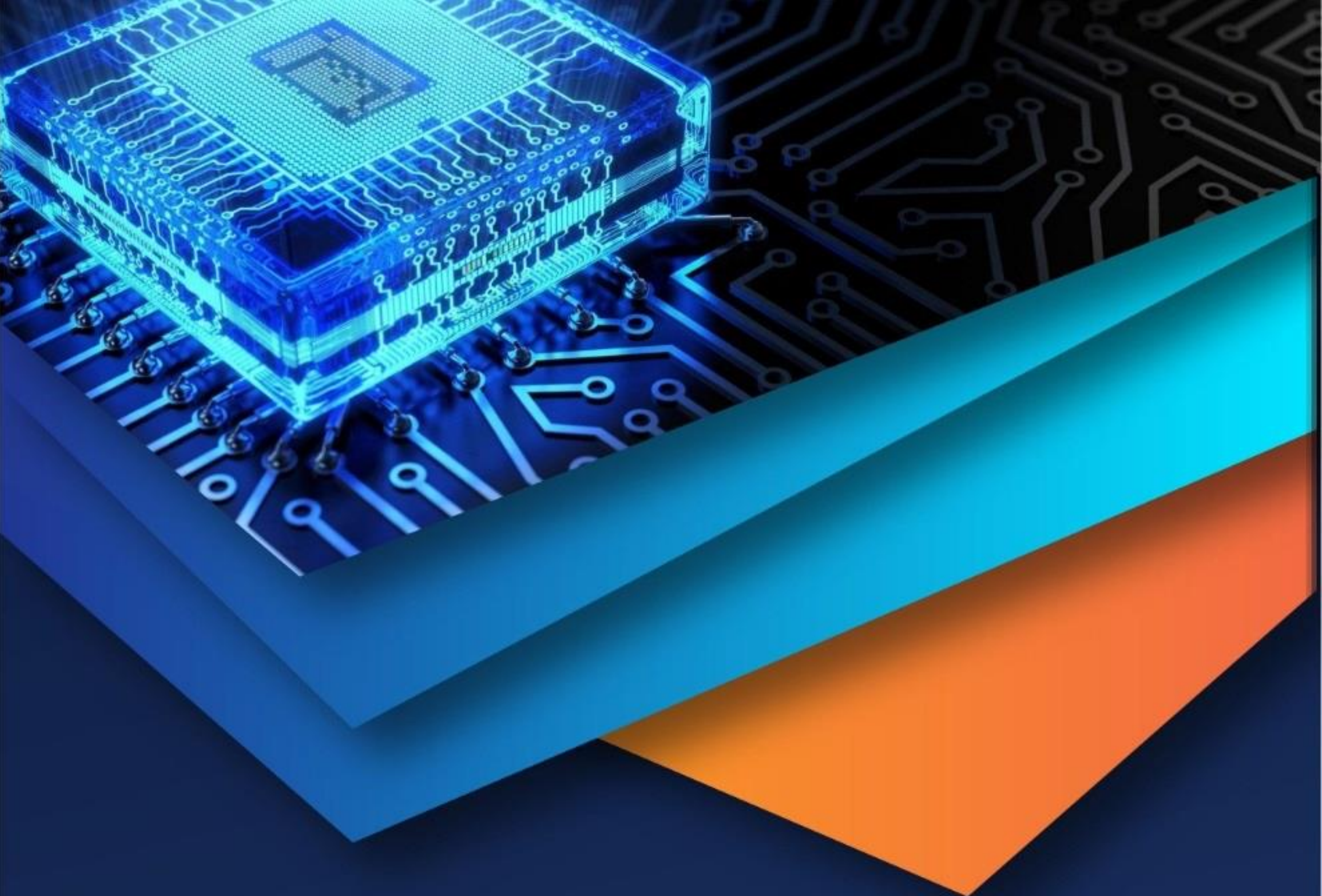
[6] Abtahi, S., Omidyeganeh, M., Shirmohammadi, S., & Hariri, B. (2014) – This study describes a low-cost, camera-based system that tracks eye and head movements. It emphasizes real-world application scenarios with promising accuracy.

[7] Zheng, W., Li, Y., & Lu, B. (2014) – This paper explores how pupil tracking and head posture estimation from webcams can help detect driver fatigue in low-light environments.

[8] Patel, M., Lal, S., Kavanagh, D., & Rossiter, P. (2011) – The authors present an in-depth analysis of how drowsiness affects driver performance and reaction times, laying the groundwork for the need for such alert systems.

[9] Ji, Q., Zhu, Z., & Lan, P. (2004) – A classic paper that proposes a real-time, vision-based driver fatigue monitoring system using IR cameras and facial analysis, which set the path for future advancements in this domain.

[10] Dinges, D. F., & Grace, R. (1998) – This foundational study investigates how eyelid movement (PERCLOS) can serve as a biomarker for drowsiness and is still considered a benchmark in real-time fatigue monitoring.



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY