International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

EV VEHICLE DRIVE MONITORING SYSTEM USING EYE BLINK DETECTIVE WITH EMAIL AND THING SPEAK ALERT

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Abstract

The EV Vehicle Drive Monitoring System Using Eye Blink Detection with Email and ThingSpeak Alert is designed to improve driver safety by monitoring the driver's eye activity and detecting possible drowsiness while driving an electric vehicle. Driver fatigue and reduced alertness can increase the risk of accidents, especially during long-distance or continuous driving. The proposed system provides an automated method for detecting signs of driver sleepiness and generating timely alerts.

The system uses an eye-blink detection sensor or camera-based eye monitoring module to continuously observe the driver's eye condition. A microcontroller processes the detected eye-blink information and determines whether the driver is alert or showing signs of drowsiness. If the driver's eyes remain closed for longer than a predefined time, the system identifies a possible fatigue condition and activates a warning alert.

In addition to the local warning, the system can send an email alert to a predefined recipient and upload the monitoring information to the ThingSpeak IoT platform. This allows the driver's condition and alert information to be monitored remotely through an internet-connected system. Data such as eye status, alert condition, and event information can be recorded for further analysis.

The proposed system provides a real-time, low-cost, and IoT-enabled driver monitoring solution for electric vehicles. It can help reduce the risk associated with driver drowsiness by providing immediate warnings and remote notifications. The system can be further enhanced with heart-rate monitoring, facial recognition, steering-pattern analysis, GPS tracking, mobile notifications, and AI-based driver behavior analysis.

I. Introduction

The EV Vehicle Drive Monitoring System Using Eye Blink Detection with Email and ThingSpeak Alert is designed to improve driver safety by monitoring the driver's eye activity and identifying signs of drowsiness while driving. Driver fatigue is a major safety concern because reduced alertness and prolonged eye closure can delay the driver's response to road conditions. An automated monitoring system can provide an early warning and help the driver remain attentive.

The proposed system uses an eye-blink detection sensor or camera-based eye monitoring module to continuously monitor the driver's eyes. The sensor detects changes in the eye state and sends the information to a microcontroller. The

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microcontroller processes the eye-blink duration and compares it with a predefined threshold to determine whether the driver is alert or experiencing possible drowsiness.

When prolonged eye closure is detected, the system activates a buzzer or warning alarm to immediately alert the driver. If the drowsy condition continues, the system can use an internet-connected communication module to send an email alert to a predefined recipient. This provides an additional safety mechanism when the driver does not respond to the local warning.

The system also integrates the ThingSpeak IoT platform to upload and visualize driver-monitoring data. Information such as eye status, drowsiness events, alert conditions, and timestamps can be transmitted to the cloud for remote monitoring and analysis. This makes it possible to observe the system's status from a connected device.

II. Literature Survey

Research on driver drowsiness detection systems has increased significantly because driver fatigue and reduced alertness can lead to delayed reactions and road accidents. Existing research broadly classifies drowsiness detection into vision-based, physiological, vehicle-behavior-based, and hybrid approaches. Recent reviews indicate that eye activity, facial behavior, physiological signals, and vehicle parameters are commonly used to identify driver fatigue.

Early research focused on behavioral and physiological indicators such as eye blinking, yawning, head movement, EEG, ECG, and steering behavior. These studies showed that combining multiple indicators can provide more reliable drowsiness detection than depending on a single parameter. However, physiological methods may require sensors attached to the driver, which can reduce comfort and practicality.

Eye-blink detection has become an important approach because changes in blinking behavior and prolonged eye closure can indicate increasing drowsiness. Researchers have used infrared sensors and cameras to identify whether the driver's eyes are open or closed. Recent reviews report that eye-blink duration, blink frequency, and related ocular features are useful indicators for real-time driver monitoring.

Researchers have also developed Arduino-based eye-blink monitoring systems because microcontrollers provide a low-cost and relatively simple platform for real-time monitoring. A 2025 study demonstrated an eye-blink monitoring system using an infrared sensor and Arduino Pro Mini, where abnormal blink patterns triggered an audible warning for driver fatigue.

Another recent Arduino-based study used an Arduino Nano and an infrared eye-blink sensor to detect prolonged eye closure and activate a buzzer. The study emphasized the advantages of low cost, low power consumption, and simple implementation compared with more complex camera-based systems. It also identified AI and telematics integration as possible future improvements.

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With the development of computer vision and deep learning, researchers have moved toward camera-based driver monitoring. Facial landmarks, eye-aspect ratio, percentage of eyelid closure (PERCLOS), yawning, and head pose can be extracted from video streams. Deep-learning models can learn complex patterns from these features, but their performance can be affected by lighting conditions, glasses, camera position, and differences between drivers.

Research has also investigated the combination of drowsiness detection with IoT technologies. IoT-based systems can transmit driver-monitoring information to cloud platforms, allowing data to be stored, visualized, and monitored remotely. A 2023 study combined driver drowsiness detection with IoT and deep-learning techniques and highlighted the value of considering multiple fatigue indicators such as blinking, head position, and yawning rather than relying on facial information alone.

Recent research further emphasizes real-time and multimodal driver monitoring. Modern systems may combine visual, physiological, and vehicle-based information to improve robustness. However, adding more sensors and processing techniques increases hardware complexity, computational requirements, cost, and integration challenges. Current reviews also highlight the importance of real-world testing, reliable alerting, privacy, and low-latency processing.

Based on the existing literature, the proposed EV Vehicle Drive Monitoring System Using Eye Blink Detection with Email and ThingSpeak Alert focuses on a simple and cost-effective IoT-enabled approach. An eye-blink sensor monitors the driver's eye condition, while a microcontroller processes the blink duration and identifies possible drowsiness. A local buzzer can warn the driver, while an email notification can provide a remote alert. The system can also upload driver-monitoring information to ThingSpeak for cloud-based visualization and analysis. This combination of eye-blink detection, embedded control, IoT monitoring, email notification, and cloud data logging provides a practical foundation for improving driver safety in electric vehicles.

III. System Analysis

System analysis is an important stage in developing the EV Vehicle Drive Monitoring System using eye blink detection. The system is designed to continuously monitor the driver's eye condition and identify possible drowsiness while driving. An eye-blink detection sensor or camera is used to detect whether the driver's eyes are open or closed. A microcontroller processes the sensor information and calculates the duration of eye closure. A predefined threshold is used to distinguish normal blinking from prolonged eye closure. When drowsiness is detected, the system activates a buzzer to immediately alert the driver. If the condition continues, an internet-connected module can send an email alert to a predefined recipient. The system also sends monitoring data to the ThingSpeak cloud platform for remote visualization. Parameters such as eye status, drowsiness events, and alert conditions can be recorded for analysis. The system is designed to provide real-time monitoring with minimum driver interaction. The hardware and software components are integrated to provide reliable detection and communication.

Existing System

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In the existing system, driver safety is mainly supported through manual observation, conventional vehicle safety features, and basic warning mechanisms. Some vehicles use cameras or sensors to monitor driver behavior, but these systems may require expensive hardware and advanced processing units. Traditional fatigue detection may depend on vehicle parameters such as steering movement, lane position, or driving patterns. Such methods may not directly identify the driver's actual eye condition. Basic eye-blink systems may only activate a local buzzer without providing remote notifications. Conventional systems may also lack cloud-based data storage and visualization. Manual monitoring of driver alertness is not reliable because the driver may not recognize their own level of fatigue. Fixed threshold systems can sometimes interpret natural blinking incorrectly if the detection parameters are not properly configured. Existing systems may also have limited connectivity for sending information to family members or monitoring personnel. Lack of remote alerts can reduce the opportunity for timely intervention. Therefore, an integrated eye-blink, alert, email, and IoT monitoring system can provide a more comprehensive safety solution.

Disadvantages of Existing System

- Requires manual monitoring of driver alertness.
- Basic systems may provide only local alarms.
- Limited remote notification capabilities.
- Some advanced systems can be expensive.
- May require complex processing hardware.
- Traditional vehicle-based methods may not directly monitor eye activity.
- Limited cloud-based monitoring.
- No continuous storage of drowsiness events in basic systems.
- Incorrect threshold settings may cause false alerts.
- Performance can be affected by sensor positioning.
- Limited access to historical monitoring data.
- Requires additional intervention in some situations.

Proposed System

The proposed system provides an integrated solution for monitoring driver alertness using eye-blink detection, email notification, and ThingSpeak IoT monitoring. An eye-blink sensor or suitable camera-based module continuously monitors the driver's eye condition. The microcontroller receives the sensor output and processes the eye status in real time. The system measures the duration of eye closure to distinguish normal blinking from prolonged closure. When the driver's eyes remain closed beyond the predefined threshold, the system identifies a possible drowsiness condition. A buzzer is activated immediately to warn the driver and encourage them to regain attention. If the drowsiness condition continues, an internet-enabled communication module sends an email alert to a predefined recipient. At the same time, relevant monitoring information can be uploaded to the ThingSpeak cloud platform. The user can view recorded data and alert conditions remotely through the IoT dashboard. The system provides continuous monitoring without requiring the driver to manually operate it. The proposed design can be implemented using low-cost embedded hardware and suitable communication modules. Overall, the system combines local

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safety alerts and remote IoT monitoring to provide an effective driver drowsiness detection solution.

Advantages of Proposed System

- Provides continuous eye-blink monitoring.
- Detects prolonged eye closure.
- Provides immediate buzzer alerts.
- Sends email notifications remotely.
- Supports ThingSpeak cloud monitoring.
- Provides real-time data visualization.
- Stores monitoring information for analysis.
- Reduces dependence on manual monitoring.
- Uses relatively low-cost hardware.
- Provides automatic alert generation.
- Can be integrated with EV safety systems.
- Can be enhanced with AI and additional sensors.

IV. Methodology

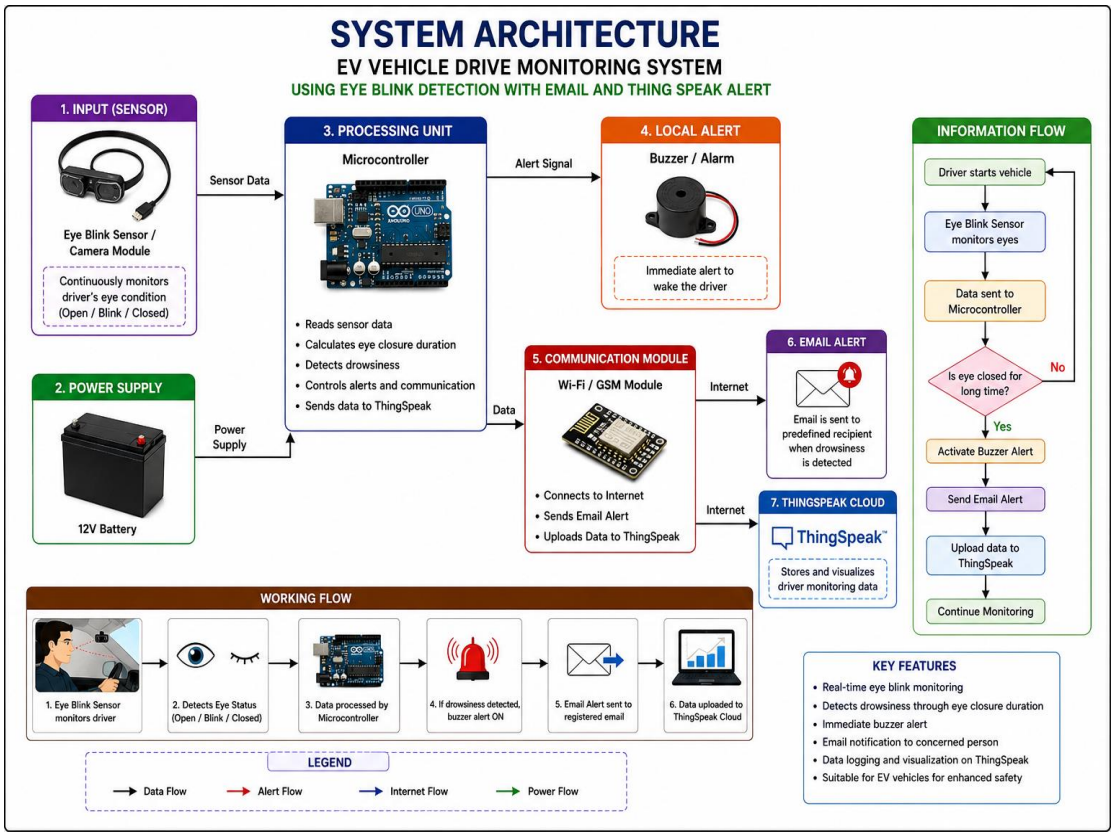
The methodology begins with identifying the requirements for monitoring driver alertness and selecting suitable hardware components. An eye-blink sensor or camera-based detection module is installed at an appropriate position to monitor the driver's eyes. A microcontroller is connected to the sensor and programmed to continuously read the eye-status information. The system determines whether the eyes are open, normally blinking, or closed for an extended period. A threshold value is defined to distinguish normal blinking from a possible drowsiness condition. When prolonged eye closure is detected, the microcontroller activates a buzzer to warn the driver immediately. An internet-enabled communication module is configured to connect the system to the network. If the drowsiness condition persists, the system sends an email alert to a predefined recipient. The system also uploads selected monitoring data to the ThingSpeak platform through the communication module. The cloud dashboard displays information such as eye status, drowsiness events, and alert conditions. The complete system is tested under different blinking and eye-closure conditions to evaluate its response. Finally, sensor positioning, threshold values, alert timing, and communication reliability are adjusted to improve overall system performance.

System Architecture

The system architecture represents the complete workflow of the EV Vehicle Drive Monitoring System from eye detection to local and remote alerts. The process begins with the driver operating the electric vehicle while the eye-blink sensor continuously monitors the driver's eye condition. The sensor sends eye-status information to the microcontroller for processing. The microcontroller analyzes the duration and frequency of eye closure using the programmed detection algorithm. If normal blinking is detected, the system continues monitoring without generating an alert. If prolonged eye closure is detected, the controller identifies a possible drowsiness condition. The buzzer module is then activated to provide an immediate warning to the driver. The communication module connects the system to the internet when

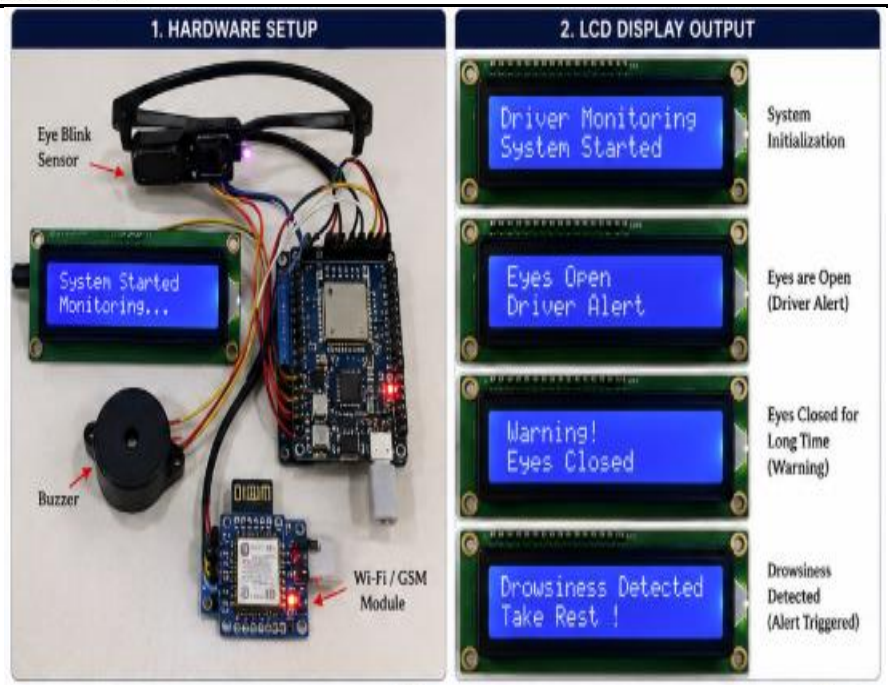
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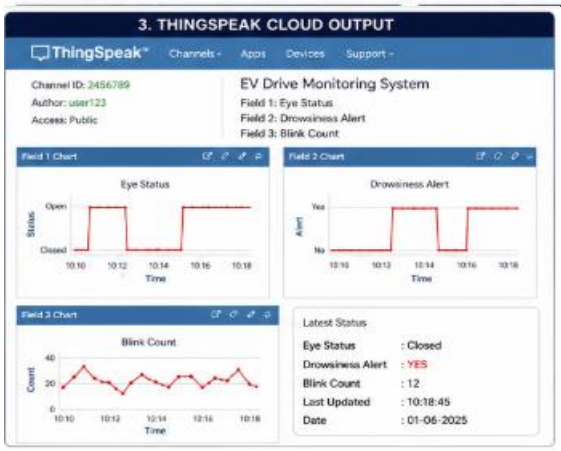
remote notification is required. An email alert is sent to the predefined recipient when the specified drowsiness condition occurs. At the same time, monitoring information is transmitted to the ThingSpeak cloud platform. The ThingSpeak dashboard stores and displays the collected data for remote observation and analysis. The power supply provides the required energy to the microcontroller, sensor, communication module, and alert components. Overall, the architecture provides a complete eye sensing, data processing, drowsiness detection, local alert, email notification, and IoT monitoring system for EV driver safety.

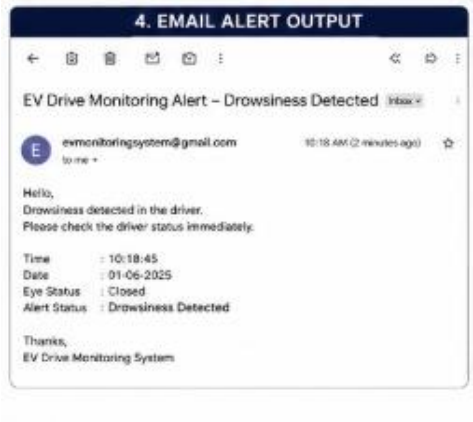


V. Result and Output

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6. TEST RESULTS SUMMARY

Test No.	Eye Status	Eyes Closed Duration (sec)	System Response	Alert Generated	Result
1	Open	–	Normal Monitoring	No	Pass
2	Closed	2 sec	Warning (Buzzer ON)	No	Pass
3	Closed	4 sec	Drowsiness Detected	Email + ThingSpeak	Pass
4	Open	–	Normal Monitoring	No	Pass
5	Closed	5 sec	Drowsiness Detected	Email + ThingSpeak	Pass

VI. Conclusion

The EV Vehicle Drive Monitoring System Using Eye Blink Detection with Email and ThingSpeak Alert successfully demonstrates an effective approach for monitoring driver alertness and detecting possible drowsiness in real time. The system continuously monitors the driver's eye condition and identifies prolonged eye closure using an eye-blink detection sensor.

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When drowsiness is detected, the system activates a buzzer alert to immediately warn the driver. In addition, the system sends an email notification to a predefined recipient, providing an additional layer of safety. The integration of ThingSpeak enables driver-monitoring data and alert information to be uploaded and visualized remotely through the IoT platform.

The proposed system reduces the need for manual monitoring and provides a low-cost, real-time, and IoT-enabled safety solution for electric vehicles. Testing demonstrates that the system can detect eye-closure conditions and respond with appropriate alerts.

Overall, the project successfully combines eye-blink detection, microcontroller technology, IoT, email communication, and ThingSpeak cloud monitoring to improve driver safety.

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