Anti-Sleep Alarm for Drivers Using IR Eye-Tracking Cameras

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Anti-Sleep Alarm for Drivers Using IR Eye-Tracking Cameras

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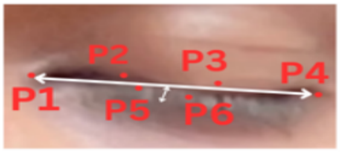
Introduction

The ever-increasing number of Road Accidents and casualties caused due to them has been a grave concern regarding road safety. Road Accidents not only affect the person at fault but also, many times, claim the lives of innocent passers-by and fellow motorists. According to a WHO report, 1.24 million road traffic deaths occur yearly. It has been reported that a substantial number of times, the cause of accidents is the driver's fatigue or drowsiness. Prolonged periods of driving, irregular sleep patterns, and monotonous road conditions can lead to a decrease in driver alertness, causing lapses in attention and, in extreme cases, unintentional microsleep episodes. The consequences of drowsy driving are alarming, with accidents, injuries, and fatalities occurring all too frequently. The existing countermeasures to combat driver fatigue involve taking short breaks, caffeine consumption and audible alarms. Each of these solutions has its limitations, making them less effective. The alarm system, such as the lane departure warning system, is beneficial, but often, it reports abnormality in driving when the driver has already entered a state of dozing. A proactive approach is necessary to ensure timely intervention and save lives.

Considering the severe need for effective countermeasures to the problem, our research proposes a method by which the driver can be alerted while driving the moment he seems drowsy so that any mishap can be prevented. Blink detection technology has gained prominence in various domains, from healthcare to human-computer interaction. Our research leverages this technology to create a non-invasive, real-time alert system. By continuously monitoring the driver's eye blinks, the system can detect patterns associated with drowsiness or fatigue. When such patterns emerge, the system triggers an alarm, interfacing with Raspberry Pi to activate a buzzer, alerting the driver to their compromised state and prompting them to take necessary measures to ensure safety.

The outcome of this research project is expected to have a substantial impact on road safety. By utilising advanced technology to identify driver fatigue proactively, we aim to reduce the incidence of accidents caused by drowsy driving. In this paper, we develop an efficient blink detection algorithm capable of running in real-time.

The anti-sleeping alarm system has the potential to save lives, reduce injuries, and enhance the overall well-being of drivers and passengers.



Literature Survey

Several works have previously been done on anti-sleep alarms, and in this section, we aim to go over those works briefly, building a background for our paper.

Studies were done to understand the sleep patterns of humans [1]. The sleep of humans has been identified in two different stages, namely Rapid Eye Movement (REM) and Non Rapid Eye Movement (NREM). The NREM phase is the phase of light sleep. Brain activity is high in the REM sleep stage. Other studies have capitalised on these eye movements to measure the drowsiness of drivers aiding in driving.

A system of sleep detection has been proposed by Adnan Ahman et al. [2], where an eye sensor is used along with Arduino (esp8366). The eye sensor has a transmitter and receiver. The amount of IR rays transmitted by the transmitter is more for open than closed eyes. This difference is converted into corresponding voltages, and a buzzer is sounded accordingly. The most significant limitation of this method was that the reflectivity of IR rays is subject to head movements and outer lighting conditions. Another limiting factor was the response time. The sounding of the buzzer is done after the eye is closed and hence is not practical in avoiding harm.

Another significant study was done [3] wherein the authors proposed using a camera and a Raspberry Pi. The camera footage would be used to locate the eyes and check if the eyes are open or closed based on distances between predetermined markers. An interval of 4 frames detects if the eyes are blinking or closed. This method suffers the same limitation as before, as the driver needs to be alerted while drowsy and not after he has shut his eyes if accidents are to be averted.

Research Contributions

In this paper, we are proposing an application that uses the footage of the camera and a pre-trained Deep Learning model to analyse the behaviour of the driver, observing patterns in eye movements, such as blink rate, redness of the eyes, dilation of pupils, etc. to identify if the driver is drowsy well in advance such that a potential accident can be averted.

Proposed Methodology

Our proposed methodology for an anti-sleep alarm uses blink detection to prevent accidents on the road due to drowsiness-like conditions. The system integrates an infrared eye-tracking camera, a Raspberry Pi and a buzzer. This will help us to monitor the driver's attentiveness.

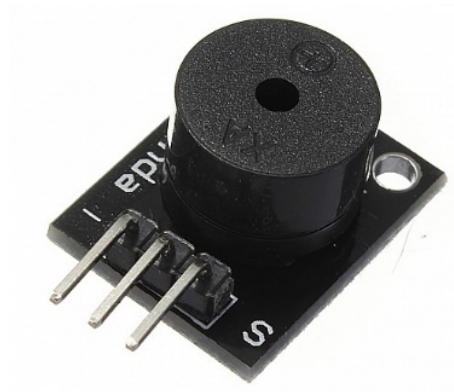
Connections:

1. Eye-Tracking IR Camera - Raspberry Pi: Connect the camera module to Raspberry Pi's camera port (CSI connector).

2. Buzzer - Raspberry Pi: GPIO pins of the buzzer to Raspberry Pi. Pins will be configured accordingly in the code.

The above picture shows a Raspberry Pi - a compact and single-board computer as our central processing unit. A compatible Raspberry Pi OS is also installed. Essential libraries and Packages like OpenCV for image processing and GPIO library for the buzzer are also used.

An eye-tracking IR camera, shown above, will capture images in the infrared spectrum to monitor eye movements. The camera will be acquiring images continuously. We will use OpenCV - a robust image processing framework - for facial detection algorithms, which will help us to extract the region of interest, the eyes region, on the driver's face. The blink detection algorithm will identify blinks - indicators of drowsiness within the eye region. The eye closure duration will be calculated on the Raspberry Pi, and steps will be taken accordingly.



When drowsiness is detected, the buzzer, shown above, will sound by controlling the GPIO pins on the Rasberry Pi. This will be our alert mechanism.

Conclusion

The Blink Detection system, with its real-time monitoring, will help us combat drowsy-driver-related accidents. This system, made up of an IR eye-tracking camera, Raspberry Pi and a buzzer, will monitor driver attentiveness to detect drowsiness and issue timely alerts for the driver to act accordingly. Our proposed methodology accounts for a cost-effective solution focusing on timely response. Ultimately, in the future, integration of in-vehicle alerts and mobile alerts could also happen.

References

[1]. E. Turkyilmaz, A. Akgul, E. Bostanci, and M. S. Güzel, "Detection of Light Sleep Periods Using an Accelerometer Based Alarm System".

[2]. A. Ahmad, A. Sharma, A. Singh, S. Chatterjee, and A. Paul, "Microcontroller

Based Anti Sleep Alarm System," in International Journal of Computer Sciences and Engineering, vol. 8, special issue 1, Feb. 2020, e-ISSN: 2347-2693. [Online]. Available: www.ijcseonline.org

[3]. B. O. Dincer, A. Sevim, and A. Eleyan, "Image Processing Based Anti-Sleep Alarm System for Drowsy Drivers," in Proceedings of the Fifth International Conference on Technological Advances in Electrical, Electronics and Computer Engineering (TAEECE2018), Turkey, 2018.

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