Contents

Abstract

Drowsy driving is a critical issue contributing to numerous road accidents and fatalities annually, as fatigue adversely impacts a driver's reaction time, concentration, and decision-making capabilities. To mitigate these risks, a real-time drowsiness detection system based on the Eye Aspect Ratio (EAR) is proposed. Utilizing computer vision techniques, the system continuously monitors a driver's eye movements through an onboard camera. The EAR, calculated using specific eye landmarks, serves as a reliable metric to identify signs of drowsiness, such as frequent or prolonged eye closures. When drowsiness is detected, the system triggers immediate alerts, such as audible alarms or vibrations, to prompt the driver to take preventive actions. This innovative approach offers an autonomous and non-invasive solution to enhancing road safety by reducing accidents caused by fatigued driving.

Chapter 1

Introduction

Drowsy driving is a significant road safety concern, contributing to thousands of accidents and fatalities each year. As fatigue impairs a driver's reaction time, focus, and decision-making ability, detecting early signs of drowsiness is crucial in preventing accidents. Traditional methods of assessing driver alertness, such as manual checks or relying on self-reports, are often ineffective, especially in real-time situations. To address this issue, a real-time drowsiness detection system using the Eye Aspect Ratio (EAR) offers a promising solution. This system leverages computer vision techniques to monitor a driver's eye movements, providing continuous assessment of their alertness. The EAR is a metric that measures the ratio of the distances between specific eye landmarks, which helps determine if the eyes are open or closed. A decrease in EAR indicates that the eyes are closing, a sign of potential drowsiness. By integrating this system with a vehicle's onboard camera, it can autonomously track the driver's eye movements and assess their level of alertness. If the system detects signs of drowsiness, such as frequent or prolonged eye closures, it will trigger an alert, such as an audible alarm or vibration, to warn the driver and encourage them to take necessary action (e.g., pull over, rest, or stop). This real-time drowsiness detection system has the potential to significantly enhance road safety, reduce accidents, and provide an effective solution to combating drowsy driving.

1.1 Motivation

The motivation behind this project is to address the critical issue of driver drowsiness, which is a leading cause of road accidents and fatalities worldwide. With the increasing demand for transportation and prolonged driving durations, especially in traffic jams or during peak travel times, driver fatigue has become a significant concern. Existing technologies, such as autonomous driving and physiological monitoring, either lack accuracy or practicality. Hence, this study proposes a real-time drowsiness detection system based on the Eye Aspect Ratio (EAR) technique, employing image processing with tools like Raspberry Pi and Dlib functions. The goal is to enhance road safety by providing an efficient and cost-effective solution to detect and alert drivers during drowsy conditions.

1.2 Objectives

- Develop a real-time drowsiness detection system using the Eye Aspect Ratio (EAR) technique.
- Enhance road safety by reducing accidents caused by driver fatigue.
- Ensure accurate and efficient monitoring under various conditions (e.g., dim light, spectacles, microsleep).

- Provide effective alerts to drivers when drowsiness is detected.
- Offer a cost-effective solution using affordable hardware and open-source tools.

Chapter 2

Literature Survey

We studied several papers and conduct the literature survey.

Saravanaraj Sathasivam et al. proposed a drowsiness detection system based on the Eye Aspect Ratio (EAR) technique to combat road accidents caused by driver fatigue. Their methodology focuses on real-time image processing to monitor the driver's eye closures using a Raspberry Pi 4, Pi Camera, and a GPS module. The EAR is computed using six (x,y) coordinates of the eyes obtained through Dlib's pre-trained neural network. When the EAR drops below a set threshold, it signifies eye closure, and the system triggers an alert to prevent accidents. The system was tested under various conditions, including spectacles, dim lighting, and microsleep, achieving up to maximum detection accuracy. The methodology highlights the effectiveness of EAR-based detection, while also addressing limitations such as lighting challenges and errors due to spectacles. The authors suggest future enhancements, including integrating sensors for detecting distractions and physiological parameters like heart rate and alcohol levels, to improve the system's performance further.

Rupani et al. presented a real-time drowsiness detection system that calculates EAR by extracting 68 facial landmarks through Dlib's shape predictor. The system monitors prolonged eye closures, which are indicative of drowsiness, and issues alerts to the driver when the threshold is breached. The approach is robust, offering consistent performance across varying environmental conditions such as lighting changes and driver facial variations. The study demonstrated the potential of EAR-based techniques in addressing the growing problem of driver fatigue, thereby contributing to road safety improvements.

Sankar et al. proposed a hybrid approach combining EAR and Mouth Aspect Ratio (MAR) to enhance drowsiness detection accuracy. The system tracks eye blinks and yawning patterns by analyzing facial landmarks, adapting to individual variations in driver behavior. This approach improves the reliability of the detection system, making it suitable for real-world scenarios where multiple fatigue indicators may coexist. The study highlights the potential of combining multiple physiological parameters for comprehensive fatigue monitoring.

Zhang and Wang proposed a method that combines eye blink detection with machine learning techniques to detect drowsiness in drivers. By using facial feature recognition software, they measured the frequency and duration of eye blinks as indicators of fatigue. The authors employed machine learning classifiers, including Support Vector Machines (SVM) and Random Forest, to improve detection accuracy. Their approach was tested in real-time scenarios and showed promising results in identifying drowsy behavior based on eye movements.

Park, Choi, and Lee took a different approach by integrating EEG (electroencephalogram) signals with machine learning for drowsiness detection. They developed a system that analyzes brainwave patterns associated with drowsiness, using algorithms like Convolutional. Neural Networks (CNNs) to classify these patterns in real-time. Their work demonstrated the effectiveness of using physiological signals for drowsiness detection, though they highlighted the need for robust signal processing techniques to filter out noise and improve accuracy.

2.1 Problem statement

Develop a real-time drowsiness detection system using the eye aspect ratio to monitor drivers alertness.The system will analyze the driver's eye movements and alert them when signs of drowsiness are detected, enhancing road safety and reducing the risk of accidents.

2.2 Application in Societal Context

- Road Safety: Prevent accidents by detecting driver fatigue in real-time and alerting the driver.
- Public Transport: Ensure the safety of passengers by monitoring the alertness of bus and taxi drivers.
- Fleet Management: Aid companies in monitoring and managing driver fatigue in logistics and transportation services.
- Automotive Industry: Integrate with advanced driver-assistance systems (ADAS) to enhance vehicle safety features.
- Personal Vehicles: Provide a cost-effective solution for individual drivers to prevent fatigue-related accidents.
- Night Shift Operations: Useful for night shift workers or long-haul drivers who are more prone to drowsiness.

Chapter 3

Project Planning

Project planning is critical for ensuring project success by clearly defining objectives, identifying tasks, and setting timelines. A well-structured plan enables efficient resource allocation, ensuring that the right personnel, tools, and materials are available at the right time to meet project demands. It also facilitates effective risk management by anticipating potential challenges and devising strategies to mitigate them, thereby minimizing disruptions. Additionally, project planning helps maintain focus and alignment among team members, ensuring everyone understands their roles and responsibilities, which fosters collaboration and accountability. By enhancing communication, it allows for smooth coordination across departments or stakeholders, enabling quick resolution of issues and ensuring transparency.Furthermore, a comprehensive plan ensures that project milestones are achieved within budget and scope, reducing the likelihood of scope creep and cost overruns. Ultimately, project planning lays the foundation for delivering high-quality outcomes while meeting stakeholder expectations.

3.1 Gantt Chart

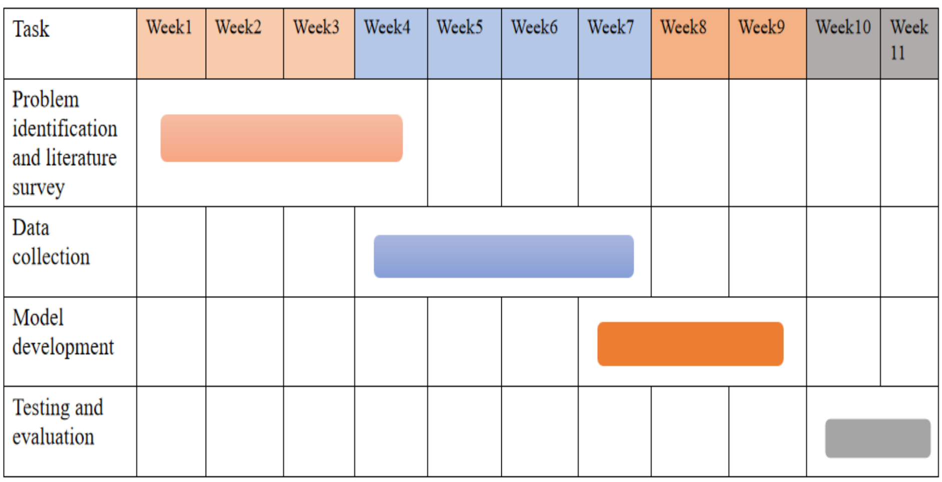

Figure 3.1: Gantt Chart

A Gantt chart is a visual project management tool that represents the timeline of a project.

It displays tasks or activities as horizontal bars along a timeline, with the length of each bar indicating the duration of a task.The Gantt chart helps project managers track progress, manage deadlines, and visualize how tasks overlap or depend on one another. It is widely used for scheduling, resource allocation, and ensuring timely completion of projects.

3.2 Work breakdown Structure

A WorkBreakdown Structure (WBS)is a project management tool that divides a project into smaller, manageable components or tasks. It organizes the work into a hierarchy, making it easier to plan, assign resources, and track progress. The WBS helps clarify the scope of the project, ensuring that all required work is identified. It also enhances communication among team members and stakeholders, assigns responsibilities, and improves time and resource management. By breaking down complex projects into manageable parts, it makes it easier to estimate costs, schedule timelines, and monitor progress

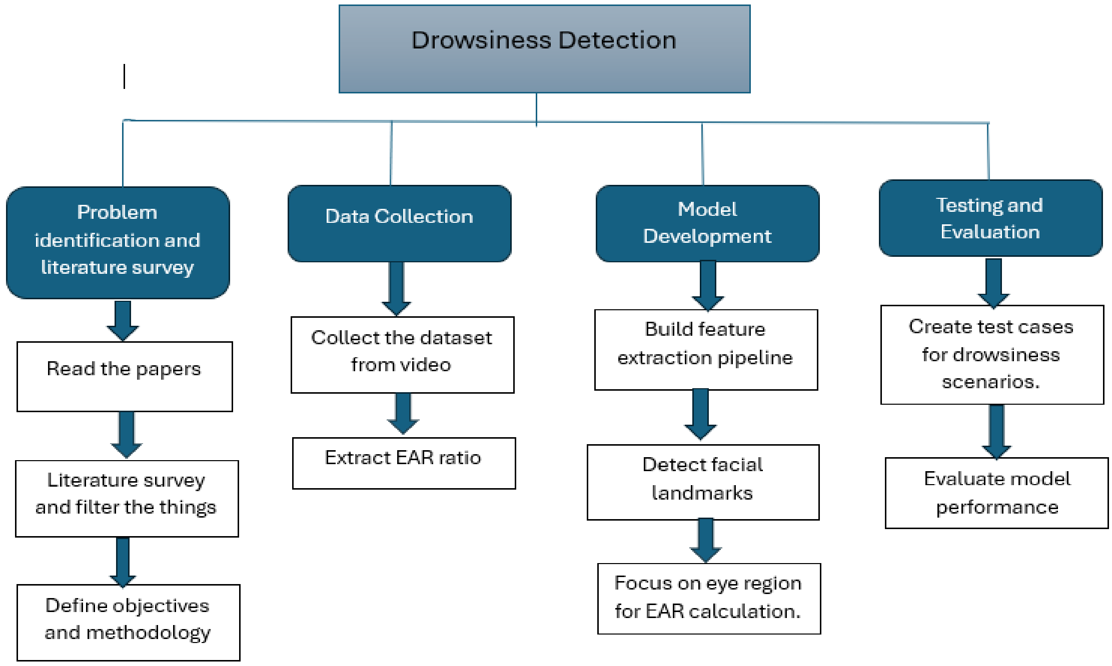

Figure 3.2: Work Breakdown Structure

Chapter 4

Methodology

4.1 Block diagram

Here we are using eye aspect ratio formula to calculate EAR ratio. Below block diagram shows the steps which are used to detect the drowsiness.

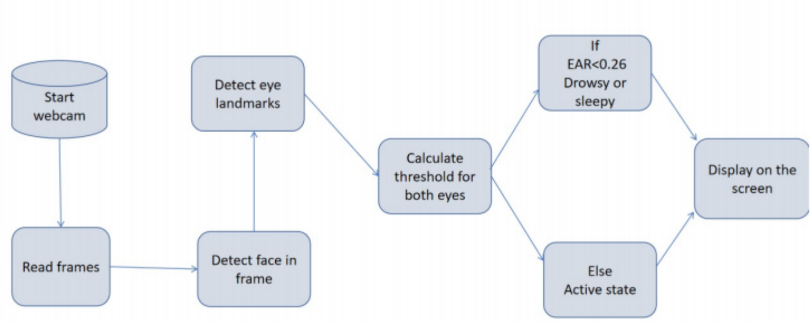

Figure 4.1: Functional Block Diagram

The Eye Aspect Ratio (EAR) helps detect drowsiness by monitoring the openness of the eyes. When a person is awake and alert, the EAR remains relatively high because the eyes are open. As the person becomes drowsy, the eyes begin to close, causing the EAR to decrease significantly. By continuously calculating and comparing the EAR to a predefined threshold (e.g., 0.26), the code identifies when the eyes are closed or nearly closed, signaling drowsiness. This real-time EAR monitoring makes it a reliable indicator for detecting drowsiness.

- Step 1:Facial Detection The system uses the dlib library's face detector to locate faces in each video frame captured by the webcam.
- Step 2:Facial Landmark Detection: It uses a pre-trained model to map specific points on the face. From these, it focuses on the eye region.
- Step 3:Eye Aspect Ratio (EAR) EAR is a measure of how open the eyes are, calculated using the distances between specific eye points Vertical distances (between top and bottom

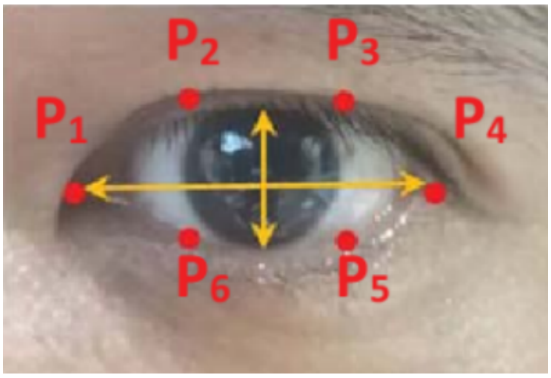

Figure 4.2: Eye Landmarks

eyelid points) and horizontal distance (between the corners of the eye) shown in figure 2. The formula for EAR calculation is : EAR = (P2 - P6) + (P3 - P5) / 2(P1 - P4)

- Step 4:Thresholding The system checks if the EAR drops below a set threshold (e.g., 0.26). If this condition persists, it concludes the user is drowsy.
- Step 5: Real-Time Monitoring The program processes each frame from the webcam in real-time, draws eye landmarks for visualization, and calculates the EAR. If drowsiness is detected, it displays a warning on the screen.

Chapter 5

Result and Discussion

5.1 Result

The drowsiness detection system utilizing the Eye Aspect Ratio (EAR) demonstrated effective classification of a user's alertness into three distinct states: active, drowsy and sleepy.

Figure 5.1: Active State

In the active state (Figure 5.1), where the EAR value remains greater then 0.26, the system accurately detected alertness with a high success rate, as the subject's eyes remained open with normal blinking.

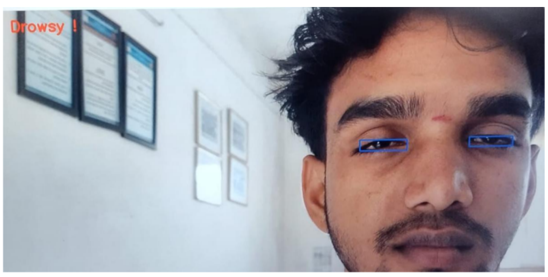

Figure 5.2: Drowsy State

In the drowsy state (Figure 5.2), characterized by an EAR value between 0.20 and 0.26, the system successfully identified the early signs of fatigue, such as prolonged blinking or slight eye closure.

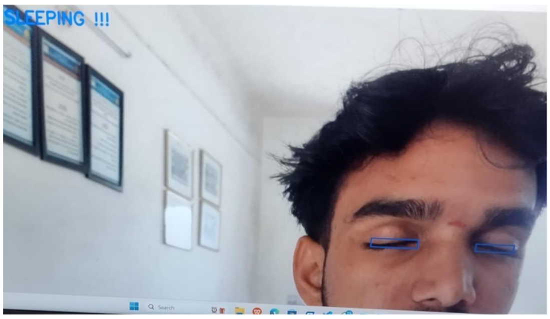

Figure 5.3: Sleepy State

The sleepy state, marked by an EAR value below 0.20, signified near-total eyelid closure, indicating a high risk of falling asleep(Figure 5.3).

5.2 Conclusion

A real-time drowsiness detection system using the Eye Aspect Ratio (EAR), efficiently detecting prolonged eye closure and alerting users. It is lightweight and practical for applications like driver safety but can be improved by refining thresholds, addressing environmental factors, and adding fatigue indicators like yawning or head movement. This creates a strong base for advanced safety systems.

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