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# SOFTWARE REQUIREMENTS SPECIFICATION

***for***

Driver Drowsiness Detection System

(using OpenCV and Dlib)

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## Introduction

### Purpose

### The purpose of the Driver Drowsiness Detection System is to enhance road safety by developing an intelligent system capable of monitoring a driver's alertness during vehicle operation. This system uses computer vision techniques to detect signs of drowsiness or distraction in real-time.

### Intended Audience and Reading Suggestions

### This system is intended for a wide range of stakeholders, including developers, vehicle manufacturers, regulatory authorities, and drivers. Developers can refer to this system's documentation for technical details, while vehicle manufacturers can assess its integration possibilities. Regulatory authorities can use it as a reference for safety standards, and drivers can understand how the system enhances their safety.

### Project Scope

### The project scope covers the complete design and implementation of the Driver Drowsiness Detection System. It includes:

### Video frame capture from an in-vehicle camera.

### Facial landmark detection using the dlib library.

### Real-time analysis of eye and mouth aspect ratios for drowsiness detection.

### Activation of visual and auditory warnings when drowsiness or distraction is detected.

### Presentation of a real-time video feed with visual overlays.

### References

<https://www.researchgate.net/publication/371292920_Driver_Drowsiness_Detection>

<https://www.researchgate.net/publication/333664318_Driver_Drowsiness_Detection_System>

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## Overall Description

### Project Perspective

The Driver Drowsiness Detection System is a standalone application that operates within a moving vehicle. It continually assesses the driver's level of alertness and attentiveness to reduce the risk of accidents caused by drowsy or distracted driving.

### Project Functions

The primary functions of the system include:

* Acquiring video frames from an in-vehicle camera.
* Utilizing the dlib library to identify facial landmarks.
* Calculating eye and mouth aspect ratios for drowsiness and distraction detection.
* Issuing visual and auditory warnings when signs of drowsiness or distraction are detected.
* Displaying a real-time video feed with overlaid regions of interest for monitoring.

### User Classes and Characteristics

System users fall into two categories:

* **Drivers**: Individuals operating the vehicle.
* **Passengers**: Individuals traveling in the vehicle.

Users are expected to have basic computer literacy and should be aware of the system's purpose and functionality.

### Operating Environment

The system operates in a vehicle equipped with:

* A functioning camera capable of capturing clear video frames.
* A computer or processing unit with adequate computational resources to run the required detection algorithms.
* Suitable lighting conditions within the vehicle for accurate facial landmark detection.

### Design and Implementation Constraints

Key constraints include:

* **Facial Landmark Detection**: The system's accuracy relies on precise facial landmark detection, which can be affected by variations in lighting conditions and the driver's position.
* **Real-time Processing**: To issue timely warnings, the system must process video frames in real-time.

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### User Documentation

Comprehensive user documentation will be provided separately. It will include installation instructions, usage guidelines, troubleshooting steps, and safety recommendations.

### Assumptions and Dependencies

The system operates under the following assumptions:

* The in-vehicle camera functions properly and provides a clear video feed.
* All required software libraries and dependencies (e.g., dlib, OpenCV) are available and compatible with the system.

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## External Interface Requirements

### User Interfaces

Users interact with the system through a graphical user interface (GUI), which displays real-time video and warning messages. The GUI aims to be intuitive, with clear indicators of the driver's status.

### Hardware Interfaces

The system interfaces with the following hardware components:

* + 1. Camera or Webcam
* **Description**: The system requires a camera or webcam to capture hand gestures for recognition.
* Compatibility: The camera or webcam should be compatible with the system's software for gesture recognition.

### Software Interfaces

The system relies on several software libraries and APIs, including:

* **Dlib**: Utilized for facial landmark detection.
* **OpenCV**: Used for image processing and video frame capture.
* **Pygame:** Employed for audio playback of warning alarms.

### Communications Interfaces

The project does not require external communication interfaces since it operates as a standalone application within the user's computer environment. It does not communicate with external systems or network services.

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**4.System Features**

**4.1 Facial Landmark Detection**

The system uses advanced computer vision techniques and the dlib library to detect facial landmarks accurately. These landmarks include key points around the eyes, nose, and mouth, which are crucial for assessing drowsiness and distraction.

**4.2 Eye Aspect Ratio Calculation**

To gauge drowsiness, the system calculates the Eye Aspect Ratio (EAR) by measuring the relative positions of key eye landmarks. EAR provides insights into the driver's eye behavior, helping detect signs of closed or partially closed eyes.

**4.3 Mouth Aspect Ratio Calculation**

The system computes the Mouth Aspect Ratio (MAR) by analyzing the positioning of mouth landmarks. MAR helps identify yawning or other mouth-related signs of fatigue.

**4.4 Real-time Feedback**

Real-time feedback is a critical feature of the system. It continuously analyzes video frames and updates the

driver on their alertness level through visual cues, such as contour drawings around the eyes and mouth, and text-based warnings overlaid on the video feed.

**4.5 Warning Alarms**

When the system detects drowsiness or distraction beyond predefined thresholds, it triggers audible warning alarms. These alarms are designed to alert the driver and prompt them to regain full attention to the road.

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## Non-functional Requirements

### Performance Requirements

The system is expected to:

* Process video frames at a minimum rate of 20 frames per second to ensure timely detection.
* Maintain a low-latency response for real-time feedback.
* Avoid false positives and false negatives in drowsiness and distraction detection.

### Safety Requirements

Safety considerations include:

* Ensuring that the system's warnings and alarms do not create undue distraction to the driver.
* Implementing measures to prevent false alarms, which could lead to unnecessary stress for the driver.

### Security Requirements

Security aspects focus on:

* Protecting user privacy by not storing or transmitting personal data.
* Ensuring that the system cannot be easily tampered with or disabled by unauthorized individuals.

### Software Quality Attributes

Key software quality attributes include:

* Robustness: The system should perform reliably under various lighting and environmental conditions.
* Ease of Installation: Users should be able to install and set up the system with minimal effort.
* User-friendliness: The user interface should be intuitive and easy for drivers and passengers to understand.

### 5.5 Business Rules

The system does not involve specific business rules as it primarily serves a safety and driver assistance purpose.