Driver Drowsiness Detection System

Introduction

The Driver Drowsiness Detection System is a project that seeks to reduce the number of road accidents caused by fatigue and drowsiness of the driver in real time. Fatigue is one of the leading causes of accidents and this system will help to warn the driver before he or she becomes unconscious at the wheel. This project uses image processing, machine learning and computer vision to track the face of a driver and check for signs of drowsiness.

Objective

The main purpose of the system is to minimize the number of road accidents due to the fatigue of drivers. This is enabled by constant live feed from a webcam or camera that focuses on the driver's face. The model then recognizing the position of the eyes and the mouth. The model can look for abnormal detections such as some symptoms of fatigue, for instance, when the eyes are shut for a long time or yawning.

This is prompted via an alarm to notify the driver in case of drowsiness. Detection System is a project aimed at enhancing road safety by identifying signs of driver fatigue and drowsiness in real time.

Methodology

The system uses the following techniques and tools to achieve its objectives:

1. Face Detection

The first operation that is performed is face detection of the driver in the captured video stream. The system uses the Haar Cascade Classifier, which is a ready-made model in OpenCV to detect the face area.

2. Facial Landmark Detection

The eyes and mouth in a face are detected by the dlib library. These landmarks are important while assessing the state of the driver. The system employs the shape_predictor_68_face_landmarks model, which marks 68 facial landmarks.

3. EAR stands for Eye Aspect Ratio Calculation

The EAR is a mathematical formula which is used to calculate the openness of the eyes. It is calculated by distances between certain landmarks of the eye. If the EAR goes below a threshold for a fixed time, then the system considers the driver as sleepy.

4. Mouth Aspect Ratio Calculation

The MAR quantifies the degree of openness of the mouth to identify yawning, which is a typical indication of fatigue. Like the EAR, the MAR is calculated based on distances between particular mouth points of interest.

5. Alert System

If the EAR stays below the threshold or the MAR goes beyond the yawning threshold consecutively, the system raises an alarm. This can be in the form of an audible signal, a vibration signal or a visual signal.

Implementation

The project is implemented in Python and uses several libraries, including:

- OpenCV: To use in image processing and face detection.
- dlib: In the case of facial landmark detection.
- scipy: In order to compute distances between the facial landmarks.
- pygame: For playing audio alerts.

Process Flow

1. The system is able to record frames from the webcam in real time.
2. The face and the facial landmarks are detected from each frame.
3. The EAR and MAR are derived from the detected landmarks.
4. The system determines whether the EAR or the MAR goes beyond the thresholds for a certain period of time.
5. If a drowsiness state is identified, then the system raises an alarm.

Challenges

- Lighting Conditions: The performance of the system is contingent with adequate lighting. Low light condition poses a problem in the identification of faces and landmarks.
- Obstructions: Sunglasses or covering part of the face also makes it difficult to identify the person.
- Hardware Dependency: The system requires a good quality webcam for it to be able to produce accurate results.

Future Enhancements

1. Infrared Cameras: Infrared cameras as ways of increasing efficiency in conditions of limited visibility.
2. Mobile Integration: The creation of a mobile app version for use in personal cars.
3. Improved Algorithms: Applying deep learning models for better detection of objects in real-time environment.

Conclusion

This system can be considered as a positive step towards improving road safety due to fatigue. Though the current implementation gives accurate results in perfect environment, more enhancements are needed to make the system more robust in real world situations. As the hardware and machine learning progresses this system could become a standard feature in vehicles and prevent accidents and save lives.