Driver Drowsiness Alarming System

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Abstract

These days, one of the biggest issues is traffic accidents. The three main causes of traffic accidents are intoxication, fatigue, and reckless driving. . In a driving environment, it is necessary that fatigue detection is performed in a non-intrusive way, and that the driver is not bothered with alarms when he or she is not drowsy. This explains why there are more incidents relating to transportation each year, particularly those involving cars. Being tired while driving lowers one's level of activity. The construction of a fatigue detection and warning system for vehicle safety and accident prevention is the aim of this project. Machine vision principles allow us to recognize patterns in eye movements, fatigue, and other phenomena. By looking directly into a driver's eyes and using a camera to record their eye movements, it has been possible to determine whether they are sleepy or exhausted. We conclude that by creating a hybrid drowsiness detection system that combines non-intrusive physiological measures with other measures, one could accurately determine a driver's level of drowsiness. Many car crashes might be avoided if a driver who is deemed to be sleepy gets an alert.

Introduction

The greatest number of accidents are caused by tired drivers. The term “drowsy” is synonymous with sleepy, which simply means an inclination to fall asleep [1]. According to National Highway Traffic Safety Administration (NHTSA), the police and hospital reports identified that 100,000 car accidents and over 1,500 deaths were caused due to drowsiness of drivers each year [2]. Recent statistics estimate that annually 1,200 deaths and 76,000 injuries can be attributed to fatigue related crashes [3]. Detecting drowsiness improves driver safety and lowers the number of auto accidents. A 30% to 40% increase in accidents is attributed to fatigued drivers, according to several studies. More sophisticated solutions can now be implemented in daily life thanks to technological advancements. Not only does this improve worker safety, but it also lessens employee fatigue at work. The use of vision-based systems is growing in popularity and has various applications these days.

An individual's face, eye position, and pattern of blinking are all considered in the process of drowsiness detection. A "shape predictor containing 68-facelandmarks" is used in the analysis of facial image data. A webcam pointing straight at the driver's face and tracking eye movement has been used to identify fatigue. In this project, the eyes' blinking pattern will be the focus. To do this, an image processing algorithm that the researcher developed will analyse the full-face image and use it to determine the location of the eyes. When the eyes' position is established, the system is meant to identify drowsiness and ascertain whether the eyes are open or closed. A specific amount of time spent with closed eyes will trigger the alarm.

One of the biggest challenges in accident-avoidance systems is the development of technologies that can identify or prevent driver fatigue. Techniques to mitigate the effects of drowsiness on drivers must be developed because of the danger it poses on the road. Driver fatigue and distraction may cause a driver to become less attentive when operating a motor vehicle, leading to driver inattention. When someone's focus is diverted from the task of driving, it is known as driver distraction. The research presented in this manuscript aims towards the detection of driver drowsiness by non-invasively acquiring chest movement with impulse radio ultra-wideband (IR-UWB) radar. Impulse radio ultra-wideband (IR-UWB) radar is an evolving technology [4].

Road safety is seriously threatened by drivers who operate motor vehicles while intoxicated. An estimated $12.5 billion in financial losses, 71,000 injuries, and 1,550 fatalities are attributed to sleepy driving each year. Although it is difficult to pinpoint the exact number of incidents involving sleep-deprived drivers, the National Highway Traffic Safety Administration (NHTSA) notes that the reported numbers are probably conservative. Driver drowsiness detection (DDD) systems, which can monitor drivers for signs of fatigue and provide timely warnings to avert collisions, are a product of technological advancements. Extended eye closure, erratic lane changes, and frequent yawning are common indicators of sleepy driving.

Literature review

In this paper, an eye state detection with eye blinking strategy was proposed as a means to detect drowsiness." The image is first converted to a dim image, and the Harris corner identification technique is applied to identify corners on both sides and at the eye's curve. After the dots are drawn, the mid-point will be connected to the lower dot by a straight line that is drawn between the top two dots and the mid-point. The procedure is the same for every image, and the distance 'd' between the top and bottom is computed to ascertain the state of each eye. In the end, the eye state's purpose is determined by the measured distance "d”.

In 2012, a plan that acknowledges tiredness was put forth. A webcam with a resolution of 640x480 is used to identify eye flickers continuously. Every eye squint is measured in relation to a mean value that is unique for every casing. Every flicker has a standard mean value that the framework considers, and if the educational exceeds this incentive for a particular measure of consecutive edges, an alert is triggered. The support vector machine algorithm is the suggested tactic. The authors report an accuracy of 99%. Under current circumstances, the framework runs significantly at 640x480 resolution. Since the eye squinting estimates from an aggregate measure of edges are used to screen languor, the framework in this computation needs to store information about the past edges.

Many methods have been employed in the relevant literature for face detection itself. Knowledge-based techniques aim to extract and utilize human knowledge about the aspects of a normal face, including their interrelationships, to identify faces in an image. The aim of feature-invariant techniques is to identify structural characteristics of the face—such as the eyes, nose, mouth, hairline, and eyebrows—that remain consistent across different angles, lighting conditions, and positions to identify faces. To extract such features, edge detectors are typically used. A camera trained on the driver's face provided the video. Face characteristics, weights, heights, and the threshold for facial colors are among the features included in the Haar-based classifier.

A Python library for handling arrays is called NUMPY-NumPy. Moreover, it contains functions for matrices, the Fourier transform, and linear algebra. An open-source library called SCIPY-SciPy for

Python is used to solve mathematical, scientific, engineering, and technical challenges. It offers a large selection of advanced Python commands that enable users to work with and view data. SciPy is based on the NumPy extension for Python. IMUTILS: An assortment of handy routines for performing fundamental image processing operations like scaling, rotation, translation, skeletonization, and displaying are called Imutils. OpenCV with Python 2.7 and Python make it simpler to use Matplotlib pictures. DLIB: This is a facial detector for landmarks that uses pre-trained models to predict the location of 68 coordinates (x, y) that map the facial points on a face.

Methodology

Facial Landmark Identification: After locating the face, the system proceeds to identify and track specific facial points, such as eye and mouth corners, through facial landmark detection. This stage relies on a pre-trained facial landmark detector from the dlib library, accurately pinpointing 68 (x, y)-coordinates corresponding to facial features.

Algorithm for Drowsiness Detection: The identified facial landmarks play a crucial role in determining the eye aspect ratio (EAR), a widely accepted metric for detecting drowsiness. EAR is calculated by evaluating the ratio between the horizontal distance of the outer eye corners and the vertical distance from the eyebrows to the lower eye region. A lower EAR value signals a higher probability of drowsiness.

Integration of Euclidean Geometry: To refine drowsiness detection accuracy, Euclidean geometry is integrated into the algorithm. Calculations based on Euclidean geometry help determine the distance between the eye corners and eyebrows, contributing to a more precise EAR calculation. We also employ PERCLOS, which stands for "the percentage of eyelid closure over the pupil over time" and represents gradual eyelid closures as opposed to blinks. The system as a whole is utilized to gauge Perclos, and depending on the scoring of Perclos, the beep begins to alarm [2].

Activation of the Alarm System: Upon detecting signs of drowsiness, an alarm system is activated to alert the individual. This system employs the alarm.wav module, producing an audible alarm sound that notifies the user about their potential drowsy state.

Real-time Implementation: The entire methodology is implemented in real-time, ensuring continuous monitoring of the user's drowsiness status. This real-time feature guarantees prompt detection and intervention, mitigating the risk of drowsy driving or other hazardous situations.

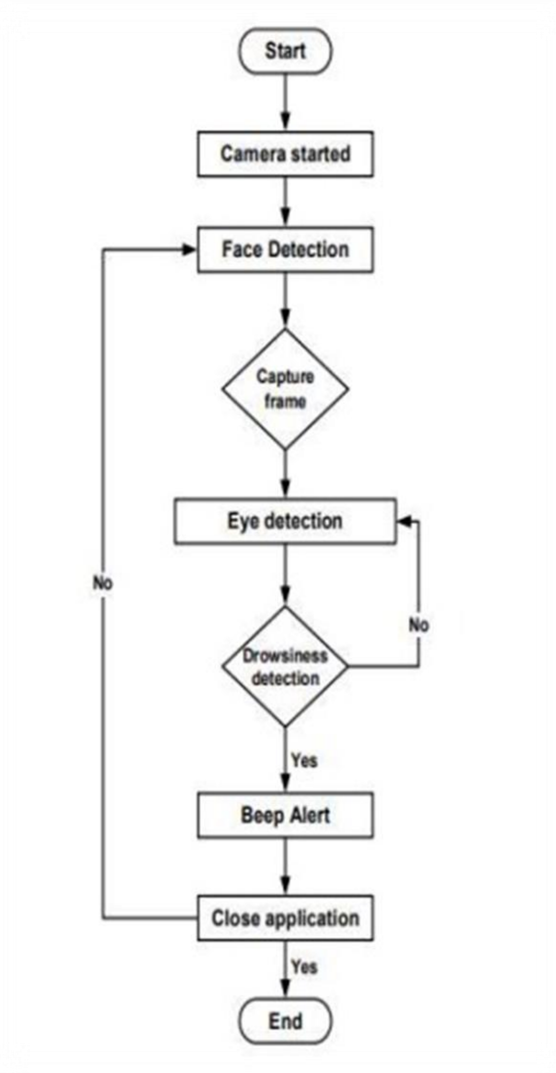


Fig 2: Process of Operations

A flowchart detailing the operation of a driver drowsiness detection system with an alarm mechanism is depicted in the image provided. The following steps are taken by the system to function:

1. Frame of capture: It usually does this by using a front-facing camera mounted on the dashboard or steering wheel to take a picture of the driver's face.
2. Face Detection: By utilizing a face detection algorithm, the system locates and separates the driver's face from the rest of the picture, allowing for targeted examination.

3. Sight Recognition: The eyes of the driver are located using an eye detection algorithm, which enables the system to track eye movements and identify prolonged eye closure.

4. Detection of Drowsiness: The system determines that the driver is sleepy if their eyes stay closed for a set amount of time. It is possible to adjust the drowsiness detection threshold to suit different drivers and driving situations.

5. Alert: The system notifies the driver by sounding an alarm if it detects drowsiness. To rouse the driver and keep them from falling asleep, the alarm can be visual, auditory, or haptic.

Drowsiness Detection with Multiple Sensors:

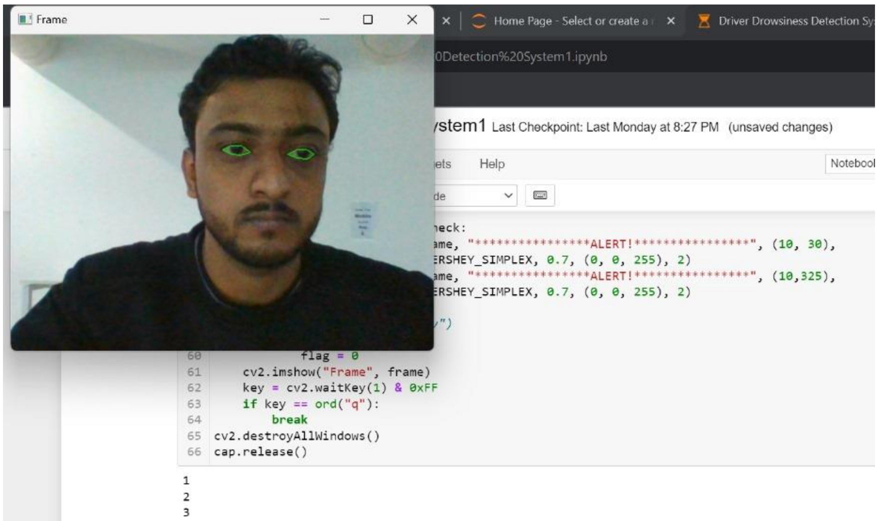
The flowchart presents a branch where the system investigates the use of multiple sensors, such as electroencephalography (EEG) devices or infrared sensors, for drowsiness detection. This diversification improves the accuracy of the system, especially under difficult circumstances like low light or darkness.

Automotive Safety System Integration:

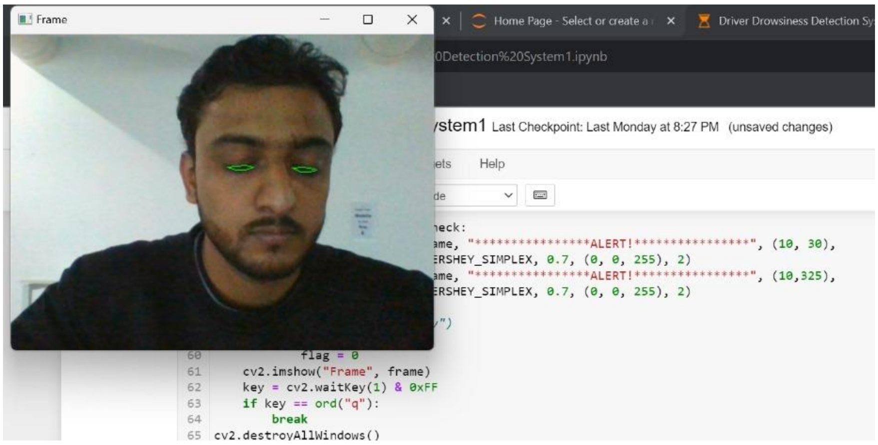
Moreover, the system can be integrated with current car safety features like adaptive cruise control (ACC) and lane departure warning systems (LDWS). By disabling the adaptive cruise control feature if drowsiness is detected, for example, this integration provides an extra layer of accident prevention. All things considered, the driver drowsiness detection system, when combined with an alarm mechanism, shows great promise as a technology that could drastically lower the number of drowsy driving accidents.

Outcome

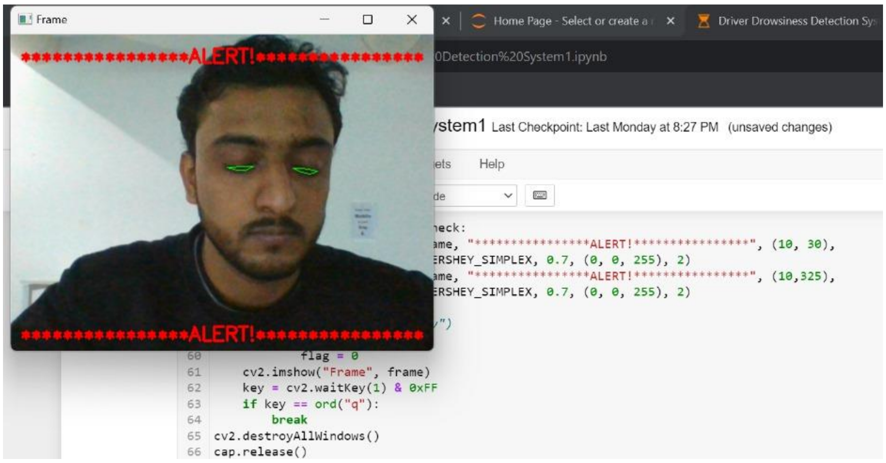
1. Normal State: - There is no alert or alarm when the user's eyes are open.



2. Alarm Activation: – The alarm sounds after the user shuts their eyes for four to five seconds.



3. Alert Mechanism: - A beeping sound is produced when the alarm is triggered.



These actions demonstrate how the project works: it keeps the user in a normal state when the eyes are closed, but it sounds an alarm using a unique alert mechanism when the eyes are closed.

Result Analysis

The primary approach for image feature detection relies on extracting facial landmarks, a subset of the shape predictor problem. These landmarks, encompassing areas like the eyes, nose, and mouth, define the subject's facial shape. The dlib library includes a facial-landmark detector that identifies 68 coordinates (a, b).

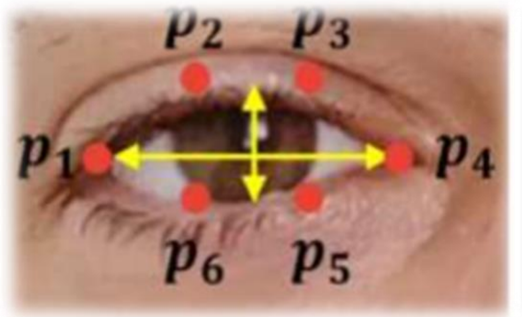


Fig3: Open eyes

For open eyes, the coordinates a1, a2, a3, a4, a5, and a6 contribute to calculating the Eye Aspect Ratio (EAR), approximately 0.24 as shown in Figure 3. In contrast, closed eyes exhibit an EAR of around 0.15, illustrated in Figure 4.

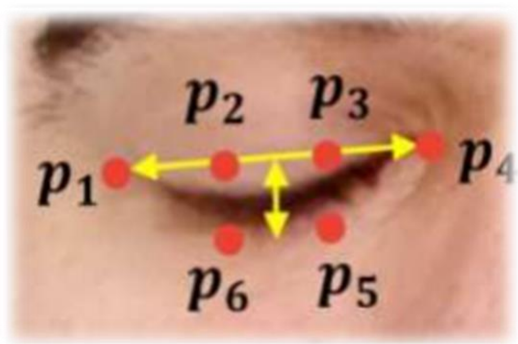


Fig4: closed eyes

A comprehensive test was conducted ten times, varying parameters such as surrounding light, different drivers, and alarm sensitivity. The accuracy test evaluated using the formula CR = (C/A) X 100%, where CR represents the correct rate, C is the number of successful tests, and A is the total number of tests, resulted in an 80% accuracy rate. Among the ten tests, eight ran successfully, while two failed due to poor lighting conditions at night. The project's accuracy is notably influenced by light conditions during the experiment, with brightness being a critical factor. Therefore, the average accuracy of our project is 80%, showcasing its effectiveness despite variations in lighting conditions. Invasive sensors can be used in virtual or controlled environments, but in real-world circumstances, they require driver commitment and compliance as well as the possibility of driver discomfort and privacy issues [4]. Any driver sleepiness detection system must take into account practical considerations including pervasiveness, aesthetics, economic viability, and user acceptance. Future research could focus on the significant application of deep learning techniques for more accurate drowsiness detection [7].

The project's focus on image feature detection, particularly when utilising facial landmarks and the dlib library, has demonstrated success in distinguishing between open and closed eyes. Based on precise coordinates associated with open and closed eyes, the Eye Aspect Ratio (EAR) calculation offers reliability as a metric for assessing eye state. The experiment demonstrated an astounding 80% accuracy rate in a range of scenarios, including variations in illumination, drivers, and alarm sensitivity. Surprisingly, eight out of ten tests showed that the project was successful; the two failures were ascribed to challenging night time lighting.

The results show how accurate the project is in real-world scenarios and how much environmental factors, especially brightness, influence it. The project is a promising option for applications such as driver monitoring systems because of its emphasis on evaluating different parameters, which enhances its adaptability. Despite occasional glitches, the system's overall effectiveness shows promise for increased safety and reliability, especially in scenarios where eye status monitoring is critical, such as preventing drunk driving.

Conclusion

The importance of eye blink detection in real-time drowsy driver identification has been emphasized in this paper's thorough review of drowsiness detection techniques. Detecting drowsiness from images of the driver is a complex problem that even commercial automotive brands struggle with [5]. The suggested system analyses blinking patterns and detects drowsiness by using the effective and economical Euclidean distance ratio technique. The system is able to process images, generate alarms, detect drowsiness in real-time, and capture facial features with accuracy thanks to the integration of libraries such as SciPy, Imutils, Simple Audio, dlib, and cv2. This system's installation could greatly lower the number of accidents caused by fatigue, improving traffic safety and averting fatalities. . In the real time drowsy driver identification using eye blink detection if the parameters exceed a certain limit warning signals can be mounted on the vehicle to warn the driver of drowsiness [6].

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