Driver Drowsiness Analysis Journal Using Image Analysis

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Abstract- *Driver fatigue and drowsiness are two of the most common causes of car accidents. In this paper, we address a method for detecting and alerting drivers who are drowsy. The aim is to reduce the number of accidents caused by driver fatigue and, as a result, improve transportation safety. As an indication of driver exhaustion, several different body and face movements are used.*

Keywords- component: Drowsiness monitoring, face tracking, eye detection

I. INTRODUCTION

A severe road accident occurs every minute in the country, according to the Ministry of Road Transport and Highways, and 16 people are killed on the roads every hour. Every day in India, about 1200 road accidents occur.

Driver fatigue is thought to be a major cause of road accidents in the region, accounting for up to 20% of serious crashes. Driver exhaustion is classified as one of the most dangerous factors in the government's Road Safety Strategy.

When a person operating a motor vehicle is too tired to remain alert, it is referred to as "drowsy driving." As a consequence, the driver's reflexes may be sluggish, his vigilance may be poor, and his reasoning may be impaired. In the worst-case scenario, the driver could fall asleep behind the wheel.

Drivers should keep an eye on the road at all times so that they can respond quickly to unexpected events. As a result, devices to track, identify, and warn a driver of his or her poor psychophysical condition are required, which could significantly reduce the number of fatigue-related motor vehicle accidents. The majority of conventional drowsiness detection methods are focused on behavioral aspects, while some are intrusive and can distract drivers, while others require costly sensors. As a result, we offer a lightweight, real-time Drowsiness detection framework for drivers, which was developed and implemented using Python 3.6 and supporting libraries.

Using image recognition techniques, the device records the videos and identifies the driver's face in - frame. The device can recognize facial landmarks and calculate the Eye Aspect Ratio (EAR) and Eye Closure Ratio (ECR) to detect driver drowsiness using an adaptive threshold based on visual data.

It is presented in order to minimize the number of accidents caused by driver fatigue by alerting the driver when signs of drowsiness are observed, thereby improving transportation safety.

The following is a breakdown of the paper's structure: The related work on detecting driver fatigue is summarized in section II. The method of approaching the paper's goal is defined in Section III. The experimental findings are presented in section IV, and the conclusion and possible research are presented in section VI.

II. RELATED WORK

The field of Image processing for purposes of retrieving relevant information is a vast domain in itself with applications in defense, healthcare, space exploration etc. Some of the examples are Magnetic Resonance Imaging (MRI) in healthcare, search and rescue, prevention of Terrorism and illegal activities through surveillance for defense, and capturing images with mars rover to analyze atmosphere soil type, terrain for space exploration etc.

We use the concept of image processing to determine whether driver is in suitable driving conditions. Similar systems have been proposed that analyze driver video feed and determines drowsiness through camera and similar setup. The setup required for such systems are invasive and require tiresome installation. The system we propose is different from preexisting systems in terms of the interface and its low resource consuming nature. What we propose is that instead of supplying a camera and other required setup, we provide easy solutions that can be integrated with a cell phone camera, webcams connected to smart cars, and similar interfaces. This is a step towards reducing e-waste and introduce green technology.

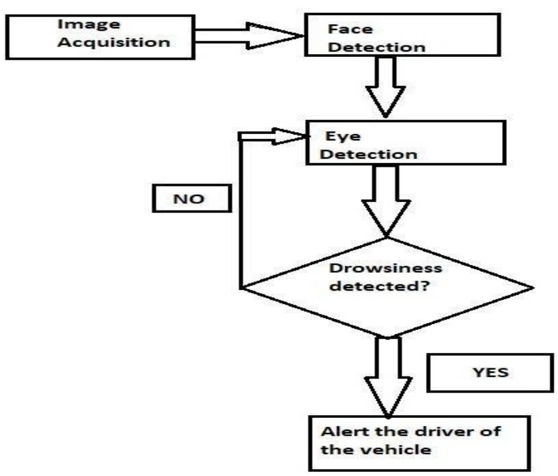
III. PROPOSED APPROACH

Many methods have been used to contribute to the research work on driver inattention detection drowsiness. Face detection accuracy is one of the most important criteria in a vision-based fatigue detection system, as it determines the accuracy of the entire process.

The working of this system can be divided into these parts:

a. Detecting or localizing the face (Face Detection).
b. Predicting the landmarks of important regions in the detected face (Eye Detection and Face Tracking).
c. Sleep (closed eyes)Detection

The overall system diagram is shown in the figure below. The details of each step will be further explained in the following subsections.



The proposed algorithm uses eye closure as a marker to detect drowsiness in a driver. With a small number of test cases, the device is tested on a range of subjects. In 85 percent of cases, it correctly detects faces and the requisite facial features, and it is divided into six states, as detailed in the following sections.

A. Image acquisition

If we're given an image, the motive of face detection is to spot all image regions with a face, regardless of their position or lighting. Faces are non-rigid and vary greatly in scale, shape, color, and texture, making this a difficult problem to solve. In computer vision, tracking visual objects may be a major issue. Human-computer interaction, behavior recognition, robotics, and surveillance are only some of the areas where it may be used. Given the initial state of the target in the previous frame, visual object tracking calculates the target location in - frame of the image series. Since processing is impossible without an image, image acquisition is typically the first step in the workflow series. The picture we get is totally unprocessed, and it's the product of whatever hardware we used to make it, which can be useful for having a consistent baseline to work with. Real-time image acquisition is performed in this method. This involves retrieving photos from a source that captures images automatically. Real-time image acquisition generates a list of files that are automatically processed and queued for later processing. The images captured are stored according to their time-stamps. Once we obtain the different frames of the images, further processing on the image is performed to reveal the facial features. First component is to detect the eyes and evaluate the eye movement.

Following image acquisition, the device creates a facial landmark chart, which is used to measure the Eye Aspect Ratio (EAR).A threshold value is fed into the system programmed to allow it to track the driver while on the road.

B. Facial landmark recognition

The position/location of the eyes will be identified after the face has been detected. The primary goal of finding the eyes is to use them as a check to ensure that the position of the eye in the face has been correctly identified. Since both eyes blink at the same time, only the right eye will be controlled to detect eye blinking during this process. The eye will be classified as open or closed depending on its current condition. An eye blink occurs when the state of the eye changes from closed to open. If the eye stays closed for a certain amount of time (in our case, 2 seconds), the eye will be detected as closed. The aim of this project is to monitor closed eyes and notify the driver with a buzzer if closed eyes are detected. This would be accomplished by mounting a camera ahead of the driver and using OpenCV to continually capture real-time video. While skin detection techniques can detect almost all skin-colored pixels and reject all undesirable background pixels, some noisy pixels will remain. Morphological operations are used to remove the noise from the image. The aim is to produce a picture with a skin area that is free of noise.

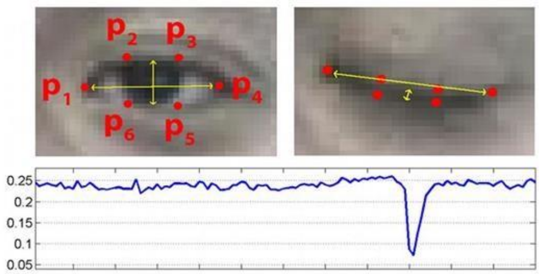
C. Eye Detection

The next step in the system is to detect the location of eyes. Locating the eyes and tracking its movement i.e. opening and closing of eyes helps us to confirm that the person is drowsy or not. To detect the eyes, eye-map based on chrominance component is built.

Based on the paper, Real-Time Eye Blink Detection using Facial Landmarks, we can then derive an equation that reflects this relation called the eye aspect ratio (EAR):

$$EAR = \left(||p2 - p6|| + ||p3 - p5||\right) \div 2||p1 - p4||$$

The eye map highlights the eyes regions. Then by using proper threshold, we can convert the eye map image to a black and white image. This new image includes the eyes in white while the rest is all black.



Top-left: A visualization of eye landmarks when then the eye is open. Top-right: Eye landmarks when the eye is closed. Bottom: Plotting the eye aspect ratio over time. The dip in the eye aspect ratio indicates a blink[3]

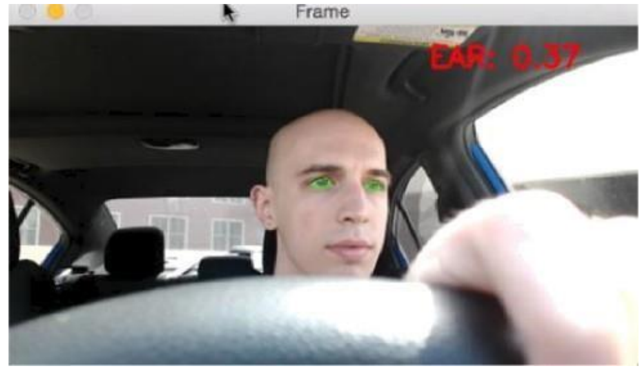
D. ***Warning System Design***

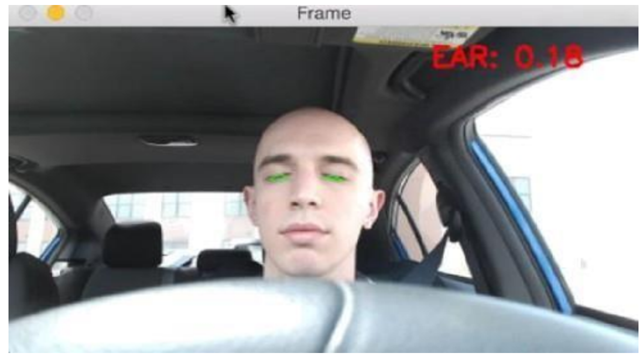
We set the time and number of eye blinks in a certain period of time in the warning system. We configured the warning system to notify the driver if he or she blinks repeatedly in that short period of time

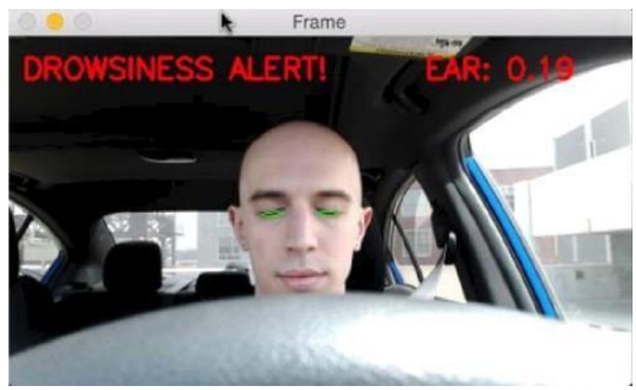
IV. EXPERIMENTAL EVALUATION

Datasets & Setup

A prototype device that includes a camera and a laptop with an Intel Core i5 processor running at 2.5 GHz and 8GB of memory. To collect the video data recorded by the vehicle camera, we use ten volunteers. Each volunteer takes turns simulating drowsy and awake driving states. Each video lasts one hour. To create the software, we used Python 3.6, OpenCV3.4, Dlib, and Pygame Python Modules.







V. LIMITATIONS AND FUTURE SCOPE

The system's primary goal is to prevent fatigue-related road accidents. We have created a driver drowsiness detection system based on eye and facial features in this paper. When the drowsiness conditions are met, the system will automatically warn the driver. Image processing is a noninvasive and cost-effective method of detecting drowsiness. Images taken under a variety of conditions, such as different light reflections and directional lighting, can be used. With adequate lighting, the device can reliably detect drowsiness in individuals. When the lighting is dim, the device fails to detect skin. This programmed can be tweaked to detect sleepiness in students in a classroom or at a meeting, for example.

VI. CONCLUSIONS

The proposed system uses the OpenCV module to scan images and Dlib to create facial landmarks, which are then cross-referenced with threshold values to detect eye twitch for driver drowsiness. The system's efficiency was tested for different subjects (individuals) wearing spectacles, without spectacles, without moustache, and with moustache in various lighting conditions. This device primarily senses the driver's eyes and face. During monitoring, the device is very good at detecting whether the driver's eyes are closed for a certain amount of time (in our case, 2 seconds) and alerting the driver with a buzzer tone. If the driver shuts his eyes for an extended period of time, the machine warns him that he/she might have fallen asleep. Since separate Haarclassifiers are used for the eyes, blinking has been observed at a very high rate. The average positive and negative alerts were calculated using the most recent 100 frames. Drivers without glasses were able to track the blinking of their eyes more accurately.

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