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# Driver drowsiness detection system

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**ABSTRACT:** Driver drowsiness is a critical factor contributing to road accidents worldwide. Every year, drivers who do not take regular breaks when driving long distances run a high risk of becoming drowsy, a state which they often fail to recognize early enough according to the experts, thus increasing the amounts of deaths and fatalities globally. In recent years, considerable attention has been given to the development of driver drowsiness detection systems aimed at preventing accidents caused by fatigue-induced impairment. The system put in place deals with automatic driver drowsiness detection based on visual information.

**KEYWORDS:** Drowsiness, facial predictors, landmarks, eye aspect ratio, mouth aspect ratio, Arduino UNO

## I. INTRODUCTION

An essential component of the body, the face communicates a great deal of information. The facial expressions of a fatigued driver differ from those of a normal state, such as the frequency of blinking and yawning. Conventional strategies for overcoming sleepiness, such as drinking coffee, or opening windows, only work momentarily and do not deal with the root cause.

Even with improvements in infrastructure and vehicle technology, fatigue-related incidents continue to be a significant problem. The severity of the issue is highlighted by statistics from agencies such as the National Highway Traffic Safety Administration (NHTSA), which reports that each year sleepy driving is a contributing factor in tens of thousands of incidents. Applications for vision-based systems are becoming increasingly common in the transportation, industrial, and security domains. Understanding how critical it is to reduce this risk, scientists have concentrated on creative ways to identify and stop driver fatigue.

Therefore, we present a system that, without requiring the drivers to wear gadgets on their bodies, uses video images to determine their state of weariness, including yawning and blinking. We created a brand-new face region identification technique based on sixty-eight essential features. Next, we assess the drivers' condition using these facial regions. We can use the eye and mouth to inform the driver with a fatigue warning.

## II. LITERATURE SURVEY

JayD. Fuletra and Dulari Bosamiya (1) has banded several drowsiness discovery approaches, we concluded that different ways will be. Applicable depending on the circumstances. Although EEG- grounded results are effective, it isn't practicable for motorists to wear electrodes. The approach grounded on Artificial Neural Networks is straightforward, but neurons are the very best option, if we want a better outgrowth. One of the most popular strategies among experimenters is image processing.

Vahid Kazemi and Sullivan Josephine, (6) in their paper banded about. The 300 faces in the wild challenge which is aimed to examine different datasets of images for facial milestones identification.

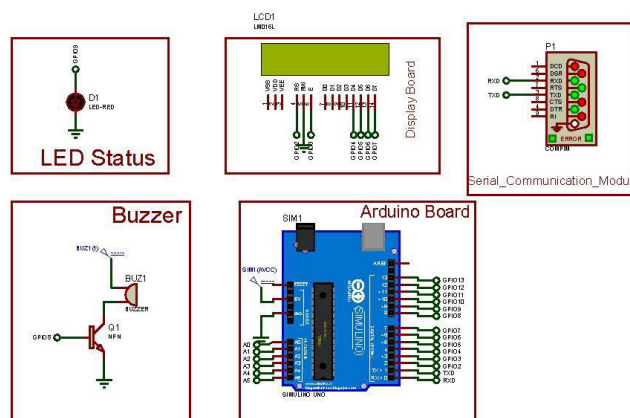
Tereza Soukupova and Jan Cech (7) in their paper enforced the facial landmark discovery to describe eye blinks in real time through training their machine with different datasets with the help of a SVM classifier.

### III. METHODOLOGY

The proposed technique is primarily based on eye blinking and yawning of driver which can be behavioral measures. The aim of this project is to detect closed eyes or opened mouth. This is done by placing a camera or recording device in front of the driver and capturing real time video continuously using openCV and Dlib. The application is executed in python and Arduino IDE.

#### 1. Component description

- **Arduino UNO:** This is a microcontroller board based on the ATmega328P chip. It features digital input/output pins, analog inputs, PWM outputs, and other essential features for interacting with the physical world. The Arduino Uno is highly versatile, making it suitable for a wide range of projects, from simple blinking LED experiments to complex robotic systems. Its open-source nature and extensive community support mean there are countless resources, tutorials, and libraries available to help you get started and expand your skills.
- **Buzzer:** A buzzer is an electromechanical component that generates sound when an electric current is passed through it. It typically consists of a coil of wire and a diaphragm, which vibrates to produce sound waves. Buzzer modules often include a built-in oscillator circuit, making them easy to control with an Arduino. By adjusting the frequency and duration of the electrical signals sent to the buzzer, you can create different tones, melodies, or alarm sounds for your projects.
- **LED:** LEDs (Light Emitting Diodes) are semiconductor devices that emit light when current flows through them. They come in various colors, sizes, and shapes, including standard through-hole LEDs and surface-mount (SMD) LEDs. LEDs are polarized, meaning they have a positive (+) and negative (-) lead, and they require a current-limiting resistor to prevent damage when connected to a voltage source. LEDs are commonly used for status indicators, visual feedback, decorative lighting, and even illumination in projects.
- **LCD Display:** LCD (Liquid Crystal Display) modules provide a convenient way to display text, numbers, and graphics in your projects. They consist of a liquid crystal layer sandwiched between two transparent electrodes and a polarizing filter. LCD displays require backlighting for visibility and often come with built-in driver circuitry to simplify interfacing with microcontrollers like the Arduino. Character LCDs display fixed-size characters arranged in rows and columns, while graphical LCDs offer more flexibility for displaying custom graphics and icons.



#### 2. Software Used:

- **OpenCV:** open-source computer vision is the Swiss army knife of computer vision. It has a wide range of modules that can help us help with computer vision problems. The most useful part of openCV is architecture and memory

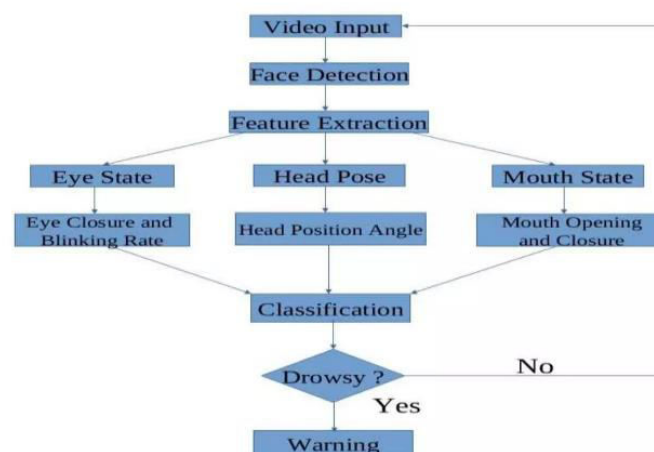


Management. It provides you with a framework in which you can work with images and video in any way you want. OpenCV libraries and functions are highly optimised and can be used for real image and video processing. Function is used by authors for real time image processing of live video feed from camera.

- **Dlib:** A modern C++ toolkit containing machine learning algorithms and tools for concreting complex software in C++ to solve real world problems. It is used in both industry and academia in a wide range of domains including robotics, embedded devices, mobile phones, and large high performance computer environment. Open-source Dlib library is used for by author for implementing of CNN (neural networks). Highly optimised pre-planned facial space predictor and detectors functions are used by authors for detection of facial landmarks.
- **Python:** It is an object-oriented programming language. It is ideally designed for rapid prototyping of complex applications. It has interfaces to operating systems calls and libraries and is extensible to C or C++ . Python is used in artificial intelligence, nature language generation, neural networks, and other advanced fields of computer science. It has a deep focus on core readability. Author uses it due to their cross-platform compatibility as main coding language for algorithm. OpenCV and Dlib libraries are integrated in python interpreter for using readymade optimized function.
- **Arduino IDE:** The Arduino IDE offers a streamlined environment for developing projects with Arduino microcontroller boards. It includes a text editor for writing code in the Arduino programming language, which is based on C and C++. The IDE also integrates a compiler to translate the written code into machine language that the microcontroller can understand.

Additionally, the IDE provides tools for uploading the compiled code to the Arduino board via a USB connection, enabling users to evaluate their programs in real-world applications. It supports a wide range of Arduino boards and shields, allowing developers to leverage various hardware features for their projects. Overall, the Arduino IDE simplifies the process of programming and prototyping electronic devices, making it a popular choice among hobbyists, students, and professionals.

#### IV. FLOW CHART



#### V. WORKING

The working of this project is a three-step procedure:

##### 1. Face, eye detection:

In this step face is detected using dlib library. The shape predictor that is implemented in dlib library is used to find facial landmarks. The predictor gives 68 landmarks points that can be applied to localized regions of face such as eyes,

eyebrows, nose, ear, and mouth. Figure 1 shows the facial landmarks that will be detected by dlib. Thus, we apply facial landmarks detection for eyes and mouth for moving further.

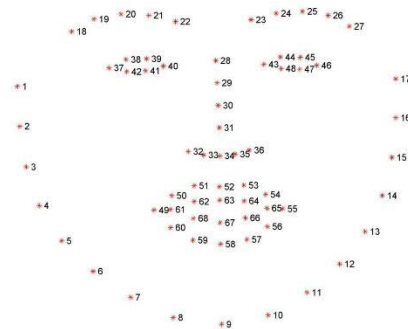


Figure 1: landmarks as depicted by Dlib facial predictor

**2. Eye closure detection:**

Each eye is characterized by 6 coordinates in figure 2. We will use the eye aspect ratio (EAR) which shows the relation between width and height of coordinates.

The distance between vertical eye landmarks is taken in numerator and the distance between horizontal eye landmarks are calculated in denominator using Euclidean distance formula.

The Eye Aspect ratio is,

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Where P1, P4 are endpoints of an eye, P2 and P3 are upper eyelid points , P6 and P5 are lower eyelid points. This ratio of eye landmark distance can be used with demand whether a person is blinking or not.



Figure 2: landmarks on closed and open eyes

**3. Open mouth detection:**

Mouth is categorized with the help of twenty coordinate as shown in figure 3. Using these coordinates the distance between lip is calculated that is equal to the difference between top lip and bottom left. This lip distance is used to determine whether the driver’s mouth is open if the lift distance is greater than a threshold amount the subject is given an alert accordingly for yawning.

The mouth Aspect ratio is,

$$MAR = \frac{\|p_2 - p_8\| + \|p_3 - p_7\| + \|p_4 - p_6\|}{2\|p_1 - p_5\|}$$

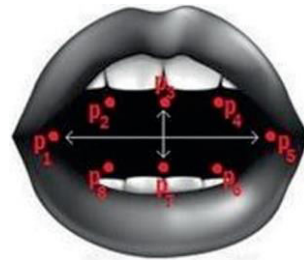


Figure 3: landmarks of mouth

## VI. CONCLUSION

To reduce the number of road accidents resulting from driver fatigue, it is of great importance to introduce to the automotive industry a system that would effectively detect the first signs of fatigue and notify the driver. In this paper, we presented the conception and implementation of a system for detecting driver drowsiness based on vision that aims to warn the driver if he is in drowsy state. The use of openCV is more suitable for this application based on the design of the proposed work because it means the relevant requirements such as cost, power, and size. Face, eyes, and mouth can be easily detected by this technology, and these are captured using a camera the technology can detect whether the eyes and mouth were open or closed during monitoring. A warning signal will be issued if the eyes has been closed for an extended period or if learning is deducted

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