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Intelligent Braking System Using Drowsiness Detection

Nihal Khan, Aryan Waghmare, Hasan Momin, Dhananjay Kumbhar
Students,
Mechanical Engineering,
Rizvi College of Engineering, Mumbai, India

Abstract: In recent years, driver drowsiness has been one of the main causes of traffic accidents and can lead to severe physical injuries, deaths and significant economic losses. Statistics indicate the need for a reliable driver drowsiness detection system that could alert drivers before an accident occurs. Researchers attempted to determine driver sleepiness using the following measures: (1) vehicle-based measures; (2) behavioral measures and (3) physiological measures. A detailed overview of these measures will provide insight into the current systems, the problems associated with them, and the improvements that need to be made to make the system robust. In this article, we provide an overview of these three measurements in terms of the sensors used and discuss the advantages and limitations of each. Various ways in which sleepiness has been experimentally manipulated are also discussed. We conclude that by designing a hybrid sleepiness detection system that combines non-intrusive physiological measures with other measures, it would be possible to accurately determine a driver's level of sleepiness. If an alert is sent to a driver who is considered drowsy, then several road accidents can be avoided.

A range of cars with diversified features that include anti-lock braking system (ABS), traction control system (TCS), anti-skid steering and collision warning system (CWS) are expected to be more commercially produced soon to meet consumer needs. This parallels the current trend of smart car technology and tyres of people who want to always have a comfortable and safe ride in their vehicles.

I. Introduction

Accidents currently contribute the most to loss of life. In general, accidents are caused by carelessness and ignorance, which takes the life of not only the driver, but also the people who travel with him, car accidents are very common in the modern world. According to statistics, most accidents are very common between 1:00 am and 2:00 am (early morning). Many vehicle manufacturers are intensively focusing on improvising their technologies and systems to ensure safe driving for consumers, which requires a lot of investment and thus also increases the cost of the car. In the case of heavy vehicle manufacturing, driver safety is never a primary concern. Therefore, a separate module must be built into the vehicle that can ensure the safety of the driver and thereby ensure the safety of other passengers and also the goods in the case of a heavy vehicle at a promising price. A sleep detection system is in practice in many of the latest cars that detect the driver's sleepy state, and if the driver is sleepy, he is warned by the alarm system that is pre-installed in the car. Various methods have been used in many countries, such as building curb edges and small bumps on the sides of the road to warn drivers if they cross the danger zone leading to an accident.
A driver who falls asleep at the wheel controls the vehicle, which often leads to a collision with another vehicle or stationary objects. To prevent these devastating accidents, the driver's sleepiness should be monitored. The following measures are widely used to monitor sleepiness:
(1) Vehicle-Based Measures – Several metrics, including deviations from lane position, steering wheel movement, accelerator pedal pressure, etc., are constantly monitored, and any change in these metrics that exceeds a set threshold indicates a significantly increased probability. that the driver is sleepy.
(2) Behavioral Measures - The driver's behaviour, including yawning, closing eyes, blinking, head position, etc., is monitored by a camera and the driver is alerted if any of these signs of drowsiness are detected.

II. Components

1. Arduino Nano: The Arduino Nano is a compact and versatile microcontroller board based on the Atmega328P microcontroller. It is essentially a smaller version of the popular Arduino Uno board that includes a USB interface for programming and power, as well as several digital and analog I/O pins that can be used to connect various sensors, actuators, and other electronic components. The blink rate is continuously monitored using an Arduino.

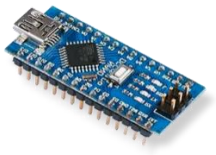

Fig. 1

2. Piezo Buzzer: In the drowsiness detection system, a piezo buzzer serves as a warning mechanism to alert the driver or operator when signs of drowsiness are detected. Here's a quick overview of how it works:

- Sensor integration: Sensors such as EEG, EMG or accelerometers monitor signs of sleepiness such as brain waves, muscle activity or changes in movement patterns.
- Data processing: Sensor data is analyzed to detect patterns indicating sleepiness, such as reduced brain activity or slower eye movements.
- Threshold detection: Thresholds are set to trigger an alert when sleepiness exceeds a certain level.
- Alert activation: When drowsiness is detected, the piezo buzzer will make a loud sound to alert the driver or operator.
- User interface: The user interface allows system configuration and feedback.
- Power management: Effective power management ensures minimal impact on the vehicle or system's energy source.

Fig. 2

3. IR Sensor: The IR sensor in the sleepiness detection system monitors changes in infrared radiation emitted by the body and detects physiological indicators such as eyelid movement or yawning. When patterns associated with drowsiness are detected, the system triggers an alert to notify the individual or relevant personnel, helping to prevent accidents caused by fatigue.

Fig. 3

4. Relay Module: In drowsiness detection systems, the relay module acts as a switch controlled by the detection system. When signs of drowsiness are detected, the relay module triggers external warning devices such as a buzzer or motor to inform the individual and prompt them to take action to prevent accidents. The relay used here is a low voltage relay. So the output was initially preset to a high value and when the output from the Arduino nano module drops to a low level, the relay turns on. Closing the relay causes the signal to reach the alarm system and the solenoid valve.

Fig. 4

5. Gear Motor: In a drowsiness detection system, a hobby/gear motor is used as a driving mechanism when the system is turned on the motor will start indicating the car is in motion as the drowsiness is detected and the buzzer will ring the motor will stop showing that that car s brake pedal is actuated automatically.

Fig. 5

6. 18650 Lithium–Ion Battery: The drowsiness detection system uses an 18650 lithium-ion battery as the power source, which provides portable and reliable power for the system components. It powers sensors, microcontrollers and warning mechanisms, ensuring continuous operation and allowing the system to operate autonomously even in situations where external power sources are unavailable or impractical.

Fig. 6

7. ADXL345: In a drowsiness detection system focused on neck movement, the ADXL345 accelerometer plays a vital role in monitoring changes in orientation and acceleration of the neck. Here is how it functions specifically for this purpose:

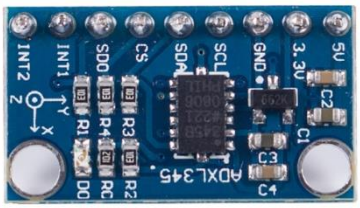

Fig. 7

- Mounting position: The ADXL345 accelerometer is securely mounted on an individual's neck or head, usually near the base of the neck or head.
- Orientation Sensing: The accelerometer measures acceleration in three axes (X, Y and Z), allowing it to detect changes in neck orientation and movement.
- Continuous monitoring: When connected to a microcontroller such as an Arduino Nano, the accelerometer continuously samples acceleration data.

- Analysis of neck movement patterns: Algorithms have been developed to analyse accelerometer data specifically for neck movement patterns associated with sleepiness, such as repeated nodding, tilting, or sudden changes in orientation.
- Detection of sleepiness indicators: By identifying abnormal or characteristic neck movement patterns, the system can infer the onset of sleepiness or fatigue.
- Alert mechanism activation: When signs of sleepiness are detected based on accelerometer data related to neck movement, the system can trigger alert mechanisms such as vibrating motors or audible alarms to alert the individual and prompt them to correct themselves.
- Feedback and settings: The system can provide real-time feedback to the user about neck movement patterns and sleepiness levels, facilitating awareness and intervention.

III. Methodology

Table 1

Scale	Description
1.	Alert
2.	Sleepy, some effort to Alert
3.	Very Sleepy, Great effort to keep alert

What did we think?

The system alerts the Person who falls asleep at the wheel thereby, avoiding accidents and saving lives. This system is useful, especially for people who travel long distances and people who are driving late at night. The circuit will be built using Arduino Nano, a switch, a Piezo buzzer, an Eye blink sensor and a Accelerometer. Whenever the driver feels sleepy and asleep the eye blink sensor detects and the buzzer turns ON with the sound of anintermediate beep. When the driver comes back to his normal State eye blink sensor senses that and the buzzer turns OFF.

We are using Arduino Nano.

The IR sensor will help in sensing the drowsiness of the driver.
If the driver is at a scale of 2 it means the driver is not fully asleep just his eyes are drowsy then it will alert the driver by ringing the buzzer for up to 4 sec so that the driver is back to alertness and stay focused.
If the driver is on a scale of 3 it means the driver has already fallen asleep.
Some conditions it will check.

1. Condition of eyes: if drowsy or fully closed, we use an IR sensor to detect the eye blink.
2. Position of Neck: if the neck is tilted while sleeping off or any other activity is performed rather than sleeping that involves tilting of neck away from the windshield.

If one of these two conditions is checked the system will take extreme effort.
The system will check if the driver is not awakened within the estimated time of the buzzer ring i.e. within 4 sec.
After 2-3 sec the car will gradually slow down and later it will stop and the buzzer will keep on ringing until the driver is awake.

IV Working Model

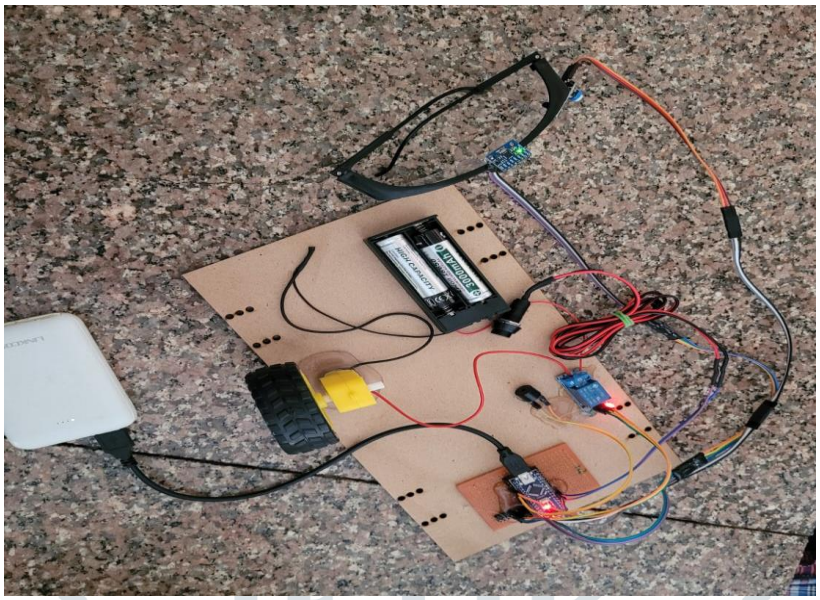

Fig. 8

V. Testing and Troubleshooting

Fig. 9

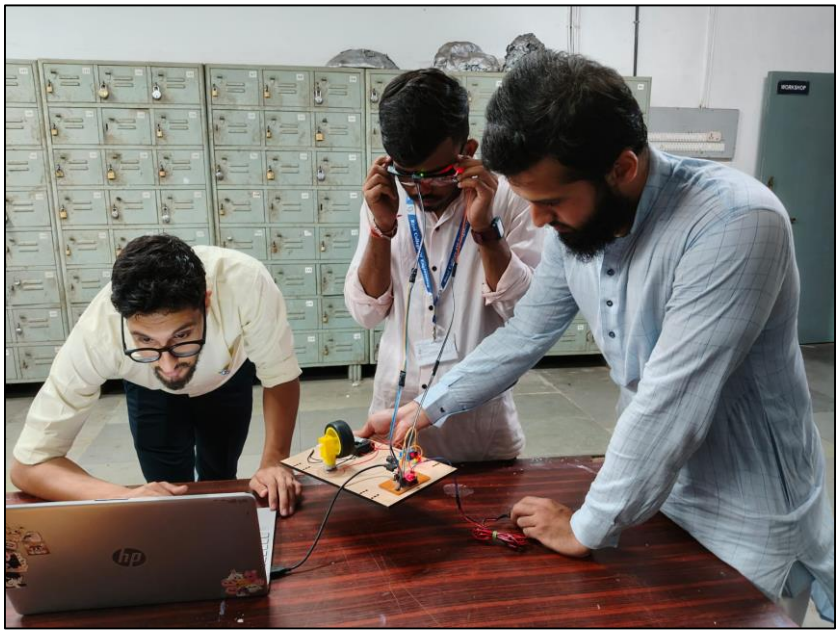

Fig. 10

VI. Results and Discussion

This system is an attempt to help decrease and/or prevent road accidents that happen due to driver's drowsiness. Using our Anti Sleep Alarm System, the drivers will benefit and be alert while driving at a low price. We believe that this project has lots of societal impact which will reduce the accidents. The goal of the system is to check the drowsiness condition of the driver. Based on the eye movements of the driver, the drowsiness is detected and according o eye blink, the alarm will be generated to alert the driver and to reduce the speed of the vehicle along with the indication of a parking light.

VII. Acknowledgement

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Working Model Video Demonstration

https://drive.google.com/file/d/1RLvWj5i3IjlfnbGkxPeTNthOeoxetjtw/view?usp=drivesdk

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