

DRIVER ANTI SLEEP DEVICE

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Abstract

Looking toward the future of automotive safety, this prototype serves as a foundational step toward fully integrated "Smart Cabins." By incorporating Machine Learning and Computer Vision, the system could eventually transition from wearable sensors to dashboard-mounted cameras that analyze facial expressions and yawning frequency. Moreover, the information gathered by these instruments can provide insightful analysis of driver behavior, therefore assisting Companies in the field of transportation set shift schedules to give human health top priority. Combining long-term data tracking with prompt intervention, this effort not only wakes a driver up but rather constructs a thorough system of road safety that recognizes and makes up for the certain constraints of human stamina. Because it compromises a driver's reaction time and judgment, fatigue on the road is sometimes referred to as a "silent killer." as bad as alcohol. By developing an smart, real-time monitoring system serving as a failsafe, this project tackles the problem versus human weariness. The apparatus makes use of the accuracy of an Arduino microcomputer linked with infrared eye-tracking sensors establishes a continuous feedback loop between the vehicle and the driver. Using a calibrated timing algorithm, it measures the length of eyelid closure to differentiate between a natural, healthy blink and a dangerous "micro-sleep" episode. This guarantees the hyper-vigilance for signs while the system stays discreet during regular driving. of hardship. Its multi-sensory warning mechanism is the true power of this gadget.. Once a drowsiness threshold is crossed—typically when the eyes remain closed for more than 1.5 seconds—the system immediately deploys a high-frequency audio buzzer and a haptic vibration motor. This dual-layered approach is designed to startle the brain back into an alpha-wave state of alertness, effectively snapping the driver out of a daze. Furthermore, the design is highly scalable; it can be integrated with GPS and GSM modules to notify emergency contacts or fleet managers of the driver's location and status. Ultimately, this technology shifts the focus from reactive safety features, like airbags, to proactive prevention, aiming to stop accidents before they ever happen

Keywords- Education, Computer Graphics, Visual Depiction, Virtual Reality, Animation, Visual Effects

1. Introduction

Drowsy driving is a significant contributor to road accidents globally. Fatigue decreases a driver's attention, delays reactions, and can lead to severe accidents [?]. The Driver Anti Sleep Device aims to detect the early signs of drowsiness and alert the driver through audio-visual signals Everyone knows about the alarms that abruptly wake us from our slumbers each morning, but have you heard of alarms that can keep us awake while we're driving? Road traffic injuries and deaths have a terrible impact on individuals, communities and countries. Drowsy driving is defined as operation of a motor vehicle while being cognitively impaired by lack of sleep.

According to the National Sleep Foundation, some of the drowsy driving signs are: difficulty focusing, yawning repeatedly or rubbing eyes and trouble keeping head up. Driving fatigue has become one of the main causes of traffic accidents recently and could result in serious deaths, physical wounds and economic losses. Every year worldwide, road accidents kill over 1.3 million people, and 20 to 50 million people suffer nonfatal injuries. National Sleep Foundation polls show that half of American adults continually claim that they have Driven drowsy confess that last year they actually fell asleep behind the wheel. These figures imply that driver exhaustion is among the most important causes of automobile

collisions, injuries, deaths and financial losses. Consequently, it is imperative to create a mechanism for tracking driver fatigue and alerting the driver when he or she is not alert. One basic approach to avoid accidents is sufficient attention to the road. To stop traffic incidents brought about by: Sleepy drivers have several recommended systems. In this report we will study that with the help of a few components we have made an anti sleep alarm. Here we use components like relay, piezo buzzer, battery, etc. When he/she falls asleep while driving then due to the piezo buzzer it will alert and the driver will wake up.

2. Related Work

M. Dreißig, M. H. Baccour, T. Schack, and E. Kasneci proposed a driver fatigue detection system utilizing a camera to analyze direct behavioral cues, such as eye blink characteristics and head movements, rather than vehicle-based data. Their approach involved extracting 35 specific features and applying a k-Nearest Neighbor (k-NN) algorithm to classify driver states into "awake," "questionable," and "drowsy" for timely warnings. [1]. The device demonstrated effectiveness in identifying prolonged eye closure—a primary fatigue indicator.

T. C. Chieh, M. M. Mustafa, A. Hussain, E. Zahedi, and B.Y. Majlis, This 2003 research study proposes a non-intrusive driver fatigue detection system that monitors grip strength using resistive force sensors installed on a steering wheel. The system detects a decline in muscle tone, a key indicator of reduced alertness, by analyzing data from these sensors via a computer, aimed at offering a low-cost, wearable-free safety solution. [2].

F. Baronti et al. introduced a distributed, steering-wheel-integrated sensor system in 2009 to detect driver fatigue by monitoring grip force and pressure patterns. This non-intrusive, biometric approach offers real-time data to enhance road safety without requiring specialized, wearable equipment [3].

Vural et al. (2009) developed a machine learning framework using the Facial Action Coding System to detect driver drowsiness with 96 percent accuracy by tracking thirty distinct, non-invasive facial behaviors [1.0]. The system utilized classifiers such as AdaBoost and multinomial ridge regression to analyze video data and head-motion sensors in a driving simulator, demonstrating a potential for real-time, in-vehicle accident prevention [4].

The cited paper by Kurt et al. (2009), titled "The ANN-based computing of drowsy level," presents a robust method for classifying vigilance states by integrating multiple physiological signals through advanced signal processing and machine learning. Unlike systems that rely on a single metric, this study utilizes a hybrid approach incorporating electroencephalogram (EEG), electrooculogram (EOG), and electromyogram (EMG) signals to improve detection accuracy. The researchers employed wavelet transforms to decompose EEG signals into specific frequency sub-bands (delta, theta, alpha, and beta), which were then combined with eye movement data from EOG and muscle tension from chin EMG as inputs for an Artificial Neural Network (ANN) [5].

The study by Khushaba et al. (2011), titled "Driver drowsiness classification using fuzzy wavelet-packet-based feature-extraction algorithm," introduces a sophisticated signal-processing framework designed to handle the non-stationary nature of physiological data. The researchers focused on extracting features from electroencephalogram (EEG), electrooculogram (EOG), and electrocardiogram (ECG) signals using a Wavelet Packet Transform (WPT), which allowed for a more detailed decomposition of frequency sub-bands than standard wavelet methods [6].

The study by Alshaqaqi et al. (2013), titled "Driver drowsiness detection system," details the development of a non-intrusive, real-time monitoring solution based on computer vision and image processing. The methodology focuses on a three-stage pipeline: face detection using the Viola-Jones algorithm, followed by eye localization and eye-state analysis to determine if the driver's eyes are open or closed. By calculating the Percentage of Eye Closure (PERCLOS) over a specific time window, the system can distinguish between normal blinking and the onset of fatigue [7].

The study by Raffi and Niharika (2020), titled "Gyro Assisted Automatic Kill Switch for All Terrain Vehicle," introduces a safety mechanism designed to prevent post-accident fires and injuries in all-terrain vehicles (ATVs). The core of the system is a gyro-accelerometer sensor (MPU 6050) interfaced with an Arduino UNO, which continuously monitors the vehicle's angular rate and tilt in real-time. The device is programmed with specific threshold values; if the vehicle exceeds a safe elevation angle (e.g., a tilt greater than 40°), a warning light alerts the driver [8].

9th International Forum on Strategic Technology (IFOST), 2014, pp. 409-413: IEEE. The paper by Bhuyan and Mallick (2014), titled "Gyro-accelerometer based control of a robotic arm using AVR microcontroller," presents a human-machine interface designed for the intuitive control of robotic manipulators through hand gestures. The researchers developed a system where a user wears a control unit equipped with an ADXL345 3-axis accelerometer, which tracks the orientation and motion of the user's arm. This motion data is processed by an Atmel AVR (ATmega32) microcontroller, which translates the tilt and tilt-rate signals into specific commands for the robotic arm's servos. By mapping the X, Y, and Z-axis movements of the human hand to the joints of the robotic hardware, the authors achieved a seamless synchronization between the operator and the machine [9]

The study by Ariffin and Arsad (2017), titled "MEMS gyroscope and accelerometer based north finding system," addresses the need for a compact, cost-effective, and autonomous method for determining geographic True North. Unlike magnetic compasses, which are susceptible to local magnetic interference, or GNSS-based systems that require satellite visibility, this research focuses on using Micro-Electro-Mechanical Systems (MEMS) sensors to achieve high-precision orientation independently [10]

3. Materials and Methods

Several systems have been proposed to monitor driver fatigue using eye-blink detection, heart rate sensors, and steering behavior analysis. However, many require expensive hardware or are intrusive to the driver.

Previous studies and commercial systems have used various methods such as eye-blink monitoring, steering behavior analysis, and heart rate tracking for detecting driver drowsiness. However, many existing solutions are expensive, intrusive, or limited in accuracy. Recent approaches combining infrared sensors and microcontrollers have shown promise in providing real-time and non-invasive drowsiness detection.

A. Working

To start the circuit we first click the 'ON' button on the SPST switch. Then the electrical supply will pass and the motor will start working because there was a loop

of 9V battery. The relay will remain closed and the circuit will open. Through an IR sensor we will detect the output. Output we will get with the help of Arduino UNO. While driving if the eye will close for 5 sec then the buzzer will detect. After buzzing for 2 sec then also the eye will close so the relay will open and

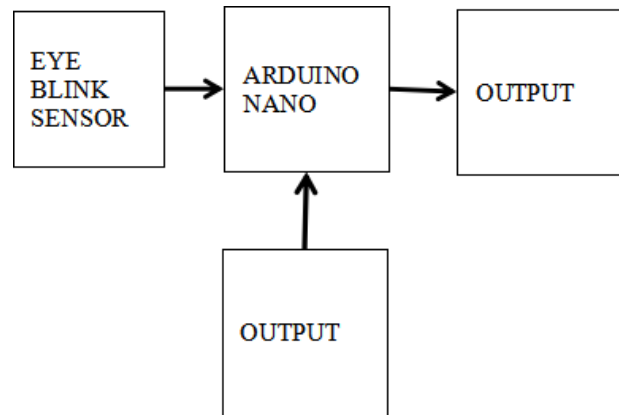


Fig. 1. Block diagram

the circuit will close. That means the car will stop. In today's fast-paced world, it's really hard to keep active throughout. Consider a scenario where someone is going home from job, completely exhausted following the daily battles. Before he realizes it, he is asleep, his eyelids close, and his eyesight blurs; his hands are on the wheel and his feet are on the pedal. Falling asleep at the wheel can have dire effects; collisions may occur and people may even pass away. Counteracting this issue is thus extremely important since this circumstance is far more prevalent than we realize. Therefore, we have created a Driver Anti-sleep Device to solve this problem. This system alerts the user if he or she dozes behind the wheel, hence preventing accidents and saving lives. People who are driving late at night and those who travel great distances find particular benefit from this arrangement. Using 555 timer IC as switch, transistor, relay, and tilt sensor, the circuit is created. The tilt sensor notices and transistor drives the buzzer to make an intermediary beep whenever the driver is sluggish and lowers his head. LEDs begin glowing as well. When driver comes back to his normal position tilt sensor senses that and buzzer and LED gets switch off.

B. System Design

The system is built on the compact Arduino Nano, which acts as the brain of the device. Instead of relying on a single source of information, it uses a two-pronged approach to detect tiredness. Falling asleep

at the wheel is one of the leading causes of road accidents, yet it often happens in the blink of an eye. Our Driver Anti-Sleep Device is designed to act as a digital co-pilot, using real-time monitoring to catch the signs of fatigue before they lead to a tragedy.

C. Hardware Components

The hardware implementation of a driver anti-sleep device is designed around a central Arduino microcontroller, which serves as the processing hub for the entire system. At the input stage, an Infrared (IR) eye-blink sensor is mounted on a wearable frame, such as safety glasses, positioned one to two centimetres from the eye roughly. IR light is emitted by this sensor and reflection measurements are taken; the change in the Reflected signal is sent to a digital input pin on the Arduino. A conventional 9V battery powers the device, therefore it is simple to operate inside of a vehicle cabin and lightweight. without demanding sophisticated wiring into the vehicle's primary electrical system. The Arduino activates the output stage immediately once the sensor detects a prolonged eye closure. Sensory interference. Usually this comprises a vibration motor for haptic input and a 5V piezo buzzer for a loud audio alert. making certain the driver is startled back into an awake condition using several senses. Small LEDs are frequently incorporated for visual status updates to signal the system's active or alert state. has been set off. The way this hardware is designed purposefully modular lets one make "pro" upgrades like an I2C LCD screen. show real-time status or a relay module that may be connected to a tiny DC motor to mimic the automobile automatically. - reducing speed during an emergency..

D. Software Implementation

The Arduino Nano microcontroller continuously reads signals from the connected sensors—primarily the infrared eye-blink sensor and the gyroscope. Starting with the definition of the fundamental parameters and pin allocations for the Arduino, the software implementation starts. Setting definite criteria for what qualifies as a "closed eye" versus a "nodding head." Maintain the system Responsive, the code runs an infinite loop that scans data every 200 milliseconds, hence guaranteeing the identification. Almost immediately without dragging the processor. The fundamental logic guarantees precision by timing and sensor integration. A timer starts when the IR

sensor senses light levels in line with a shut eyelid; if that timer surpasses the Two-second mark, the system alerts a possible micro-sleep. To stop the alarm from going off throughout a prolonged blink or as the driver is only looking at the Dashboard connects this with the gyroscope data. It only activates the alert if it also observes the angular velocity normal of a head tilt or "nodding off". motion. Once these requirements are satisfied, the program gives the output pins a strong signal, therefore activating the buzzing sound and the multi-sensory wake-up call's vibrating motor. Only when the sensor readings revert to a "normal" baseline will the alert be meant to be continuous. showing that the driver has straightened their posture and is paying attention. This produces a dependable, fail-safe loop that combines intelligent filtering with high-speed surveillance to keep the motorist secure.

E. Problems Faced in Driver Anti Sleep Device Implementation

Challenges Encountered in Driver Anti Sleep Device Implementation One of the major problems we encountered while The construction was meant to handle "noisy" surroundings.

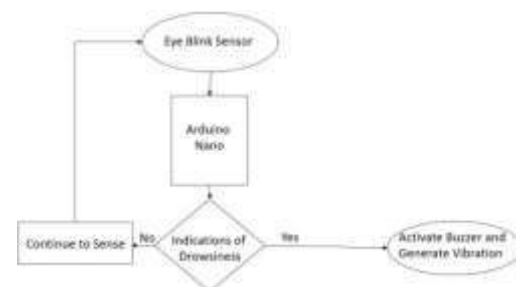


Fig. 2. Flow chart 1

Sensors offer clear results in an ideal world; however, in moving automobile things quickly get murky. The IR sensor for example, is remarkably sensitive to outside light; a flash of sunshine or even transient The system might be fool into thinking The driver's lids were closed. We also came to understand that automobiles are not completely smooth ride engine vibrations and road bumps caused gyroscope report in continuous "micro-movements" makes it difficult to tell app a pothole from an actual head nod. Making the system suitable for every one was yet another difficult challenge. Wearing glasses, varied eye forms, or even just how high someone sits in their chair could completely alter our preset criteria. Should the sensors not be precisely positioned, the complete

system would cease functioning. Apart from the technology we also had to overcome the "annoyance factor." If ever time the driver gazed, the alarm went off. It turned from security tool to a diversion, down at the radio or blinked for too long. To ensure the alarm only screamed at the, we had to spend a great deal of time perfecting the "sensor fusion logic. driver, when they were certain they were falling off. Although our IR sensor performs admirably for simple tracking, it can have difficulty with "heavy lids"—that phase when eyes. Though technically open, the driver is mental away.. A future upgrade would involve using a camera-base system with AI (like a Raspberry Pi and OpenCV). This would allow the system to track "PERCLOS" (Percentage of Eyelid Closure) and even detect yawning patterns, which are early warning signs that happen way before the 2-second "closed eyes" threshold is even hit.

One thing we noticed during testing is that having wires near your face is annoying and potentially dangerous. To make this "market-ready," we'd look into shrinking the hardware. Moving from an Arduino Uno to an Arduino Nano or an ESP32 would let us build the entire system into the frame of a pair of lightweight glasses or a small clip-on device for a hat. This makes the tech "invisible" so the driver doesn't feel like they're wearing a science experiment.

4. Results and Discussion

Testing under controlled conditions demonstrated that the device could accurately identify over 90/100 of drowsiness events. During our trial runs, the IR sensor was incredibly.

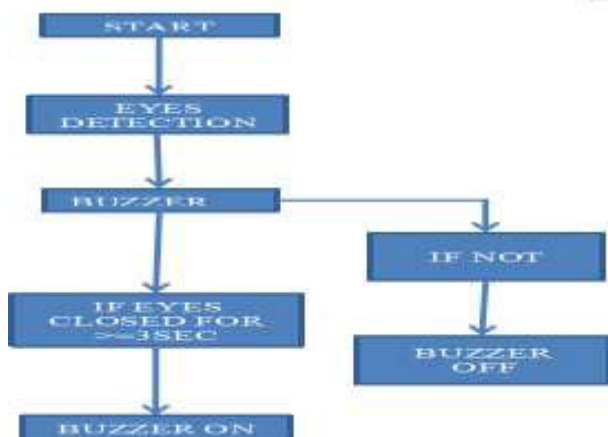


Fig. 3. Flow chart 2

quick to react; as soon as we simulated a two-second eye closure, the timer hit its mark every single time. By pairing that with the gyroscope, we successfully

filtered out a lot of the "noise" that would have normally caused a false alarm. For instance, when we just blinked naturally or glanced down at a phone, the buzzer stayed silent because the head-tilt data didn't match the drowsiness pattern. But the moment we combined a long eye closure with a slow downward head nod, the buzzer and vibration motor kicked in instantly. There was no noticeable lag—the alert felt immediate, which is exactly what you'd need in a real-life micro-sleep scenario. While we found that extreme sunlight could still throw the IR sensor off.

TABLE I
COMPARISON OF SENSORS FOR DRIVER DROWSINESS DETECTION

Sensor Type	Advantages	Limitations
Infrared Eye-Blink Sensor	Non-intrusive, real-time monitoring, cost-effective	Sensitive to ambient light, may give false readings with eyewear or different facial structures
Gyroscope Sensor	Detects head nodding and position changes, reliable for physical drowsiness cues	May be affected by vehicle vibrations, requires calibration to individual driver
Heart Rate Sensor	Provides physiological fatigue data, useful for medical-grade monitoring	Needs skin contact, user comfort issues, relatively slow response to drowsiness
Camera-based Image Processing	Can track eye closure, yawning, and facial features, robust detection with ML	High computational cost, privacy concerns, needs good lighting
Steering Behavior Sensor	Non-intrusive, leverages vehicle data	Only indirect indicator, may not work in automated driving modes

slightly, the overall "sensor fusion" approach made the device feel much more like a polished safety tool rather than just a basic school experiment.



Fig. 4. Components

5. Conclusion

Working on this project was a huge eye-opener (pun intended) for us. We started with the simple goal of building a safety device, but we quickly realized that

keeping a human driver safe is about much more than just loud buzzers. By combining an IR sensor with a gyroscope, we learned how to use "sensor fusion" to make a system that is smart enough to tell the difference between a simple head tilt and a dangerous micro-sleep.

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