A Review of Anti Sleep Alarm for Drivers using Arduino Nano

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Abstract*—Drowsy driving is a major contributor to road accidents, leading to thousands of fatalities and injuries every year. With the advancements in automotive safety technologies, numerous anti-sleep alarm and drowsiness detection systems have been proposed and developed. This review aims to comprehensively analyze and compare different methodologies used in existing systems, including physiological signal monitoring (EEG, EOG), computer vision techniques (facial recognition, eye tracking), and embedded system-based solutions (IR sensors, microcontrollers). This paper examines the obstacles alongside future research possibilities and restrictions during the development of driver fatigue detection processes. The purpose of this study is to examine multiple strategies with a focus on fundamental technological innovations. The following trends will guide the development of future-generation drowsiness detection systems.

Keywords anti sleep alarm, IR sensor, arduino nano, 5v relay module.

1. INTRODUCTION

The fast-paced modern world demands road safety to be a pivotal challenge for public authorities and citizens, individuals and governments alike. Thousands perish annually in road accidents because vehicle operators lack sleep and that contribute to their deaths, mechanical failure, but simply by driver fatigue. A few seconds of sleep behind the wheel causes catastrophic effects on drivers who have fallen asleep or feel drowsy consequences. Various sleep disorders force many individuals to operate vehicles following prolonged driving sessions or night work and disturbed schedules because of fatigue. Operating a vehicle triggers drivers to lose their alertness capabilities. The danger potential of drowsy driving matches the risks identified with drunken driving operations. The impairment of cognitive functions together with diminished response speed and decision-making ability characterize drowsy performance behind the steering wheel increase the likelihood of accidents. The problem grows especially severe because long-distance public transportation networks operate without adequate sleep management in countries. The project presents an approach for fatigue management which combines low-cost principles an Anti-Sleep Alarm system using Arduino Nano serves as the solution. The system tracks eye-blinking movements from the driver continuously through an infrared (IR) sensor-based mechanism. A buzzer along with a relay activates and initiates a response when the eyes stay shut longer than the set safety threshold. The combined operation of a buzzer device and relay module generates audio warnings and vehicle stoppage simulation through the Arduino Nano system. This system immediately activates to return driver focus or enable rest before an upcoming accident takes place. The system stands out because it has three unique features: it is easily affordable with practical field applications and simple design principles. Unlike high-end commercial driver-monitoring systems that rely on complex camera setups or expensive AI modules, our design uses commonly available components like an Arduino Nano, IR sensor, buzzer, and battery — making it suitable even for basic vehicles or use in developing regions.The main goal of this project is not only to demonstrate how electronics can enhance road safety but also to encourage the implementation of preventive measures that can save lives. By combining engineering principles with human safety concerns, this system brings technology closer to people — where it matters most: on the road.The Anti-Sleep Alarm is a safety device designed to prevent drivers from falling asleep while driving, thereby helping avoid drowsiness-related accidents. It typically detects eye movement using sensors and continuously sends signals to an Arduino controller. If the driver's eyes remain closed for at least three seconds, the system activates an alert mechanism to wake the driver and encourage them to drive more attentively. The system can use a loud alarm and visual warnings to alert the driver, giving them the option to stop the vehicle and take a short rest, reducing the chances of drowsiness and preventing potential accidents.[1][2]

2. OVERVIEW OF ANTI SLEEP ALARM FOR DRIVERS

The Anti-Sleep Alarm for Drivers is a smart, affordable solution designed to help prevent accidents caused by drowsy driving.The device operates with fundamental electronic elements and a central function provided by the Arduino Nano device. The monitoring procedure tracks drivers' eye activities in real-time through Infrared sensors mounted on the glasses. The special modification on glasses enables the sensor tracking of driver's eye movements. The system detects a dangerous period of driver eye closure which typically lasts from 15 to 2 seconds. When drowsiness occurs the Arduino system immediately triggers its response mechanism triggers two important responses. The system selects a function that operates a piezo buzzer which makes strong bullet-like noises to notify drivers. The second action of the Arduino triggers a relay module to control a small DC motor in our prototype design. The system triggers the relay module to activate either an engine stop simulation or safety control device. The system provides two simultaneous alerts through sound and motor operation to notify drivers about their need to rest. This project distinguishes itself through its basic design which combines affordability together with convenience in actual roadway uses usability. This system leverages affordable components instead of advanced AI and expensive cameras like modern high-end systems components and basic logic. The IR sensor is non-intrusive, the buzzer is low-power but effective, and the Arduino Nano offers enough processing power to handle all necessary tasks without requiring complex programming.The system is powered by a 9V battery, regulated through a TP4056 charging module, and includes an SPST switch for manual on/off control. This makes the setup portable, lightweight, and suitable for vehicle installation or even wearable use.This project not only showcases how embedded systems can be applied to solve real-life safety issues but also encourages further innovation in the field of driver assistance systems. It's especially useful for people who frequently drive long distances, night-shift workers, or commercial vehicle operators.In conclusion, the Anti-Sleep Alarm project provides a practical and accessible way to enhance driver safety, reduce road accidents, and promote responsible driving through the power of simple electronics.[3][4]

3. LITERATURE REVIEW FOR EXISTING TECHNOLOGY

S.No.	Title/ Study	Method / Technology used	Key Findings & Contribution
1	Drowsy Driver Detection Using Visual Behavior and ML	Visual monitoring - and Machine Learning	A cost-effective real-time system was proposed that uses eye movements and facial behavior to detect drowsiness. Achieved good accuracy and fast response using a webcam and ML models.
2	Driver-Dependent Risk Factors in Two-Wheeler collisions.	Quasi-induced exposure study	Found that personal factors like speed violations and driver behavior significantly affect accident risk. Highlights the need for fatigue-based monitoring in high-risk groups.
3	Aberrant Driving Behavior Among Taxi Drivers	Questionnaire and sampling methods	Younger, single drivers showed higher accident involvement. Supports the case for alert systems in public and commercial transport sectors.
4	Survey on Drowsiness Detection & Alarm Systems	Image processing IR sensors, EEG data	Various methods like heart rate and eye tracking are discussed. Concludes that combining physiological and visual cues offers better results.
5	Smart phone-Based Drowsiness Monitoring	Al + mobile vision technology	Explores mobile camera-based fatigue detection using Al. Provides an accessible solution but depends on lighting and camera quality.
6	Tiredness Assessment by Eye-Blink Detection	Eye Aspect Ratio (EAR) calculation	Accurately detects tiredness based on blink frequency. Reports a 92% success rate under controlled lighting. Simple, effective for real-time use.
7	CNN-Based Driver Drowsiness Detection Deep Learning (Convolution Neural Networks)	Deep Learning (Convolution Neural Networks)	Utilizes real-time facial recognition and eye monitoring CNN model improved precision in detecting micro sleep patterns.
8	Steering Wheel-Based Fatigue Detection	SWA (Steering Wheel Angle) tracking	Uses driving behavior patterns to detect fatigue. Achieved 78% accuracy, but struggles with false detections under normal driving variations

[1][2][3][4][5][6][7][8]

4. METHODOLOGY

An approach directed toward developing an uncomplicated system for detecting driver drowsiness led to the creation of the Anti-Sleep Alarm system. The development started with selecting top components including Arduino Nano, IR sensor, buzzer and relay module because they serve to monitor blinks and deliver warning signals. The researcher positioned the IR sensor directly on the glasses to observe driver eye movements during real-time operation. The signal processing through the Arduino produced alarm activation when it detected continuous eye closure. System development included several stages that led to precise assembly while programmers tested the system under varied operating conditions to achieve detection accuracy and operational dependability. Affordability and functionality in real driving conditions together

with ease of use functioned as our key priorities in the development process [5].

4.1 IR Sensor

Our Anti-Sleep Alarm system relies heavily on the IR sensor because it performs the essential role of detecting driver blinking activities. The system sends infrared light that relates back from the eye after transmission. The IR light pattern which reflects backward signals to the sensor depends on eye openness status. The sensor recognizes the state through the change in reflection when eyes stay closed for extended periods of time. Our system utilizes IR proximity detector to face the eyes of the driver directly. The sensor position allows continuous observation without invasion or discomfort to the driver. The sensor sends a signal to the Arduino Nano, which then processes the data and determines whether the driver is sleepy.What makes the IR sensor ideal for this project, is its simplicity, low power usage, and quick response time. It works well in both bright and dim lighting, making it suitable for day and night driving. Its non-contact operation also ensures safety and hygiene.

4.2 Relay module

The 5V single-channel relay module is an essential part of our Anti-Sleep Alarm system. Its main function is to act as a switch that can turn other devices — like a motor or simulated engine — on or off in response to signals from the Arduino Nano. When the driver is detected to be drowsy, the relay receives a digital signal from the Arduino, which activates it and interrupts the circuit, simulating the action of stopping a vehicle.The relay module operates on a 5V input and can control high-voltage loads while keeping the control circuit safely isolated. This makes it perfect for automotive or embedded applications where safety and control are both priorities. It consists of an electromagnet, a switching contact, and an indicator LED that shows the relay status (ON or OFF).In our project, the relay is used to control a small DC motor that represents the engine. When the driver closes their eyes for too long, the Arduino triggers the relay, which cuts power to the motor — essentially simulating an emergency stop.

4.3 Piezo buzzer

The piezo buzzer plays a vital role in our Anti-Sleep Alarm system by acting as the immediate audio alert mechanism. Its job is simple but extremely important — to produce a sharp, loud sound when the system detects signs of drowsiness in the driver. This sound serves as a wake-up call, helping the driver regain focus before a potential accident can occur.A piezo buzzer works by using the piezoelectric effect, where an electric signal causes a piezoelectric material to vibrate and generate sound. In our project, the buzzer is connected to one of the digital output pins of the Arduino Nano. When the IR sensor detects that the driver's eyes have remained closed for more than 2 seconds, the Arduino sends a HIGH signal to the buzzer, triggering a loud beeping sound.This buzzer is small, lightweight, and requires very little power, which makes it ideal for use in compact, battery-operated systems like ours. Despite its small size, the buzzer is loud enough to immediately grab the driver's attention without being overly disruptive.Its instant response and clear tone make it a key safety feature of the system, ensuring that fatigue doesn't go unnoticed behind the wheel.[6]

4.4 Arduino Nano

The Arduino Nano is the brain of our Anti-Sleep Alarm system — a compact, powerful microcontroller board that handles all the decision-making. Despite its small size, it offers everything needed to run the system efficiently. It is built around the **ATmega328P** microcontroller and provides multiple input and output pins that are ideal for connecting sensors, buzzers, and relays.In our project, the Arduino Nano receives data from the **IR sensor**, processes it in real-time, and decides whether the driver is showing signs of drowsiness. If the eyes remain closed longer than a safe limit, the Nano sends signals to activate both the **buzzer** and the **relay module**, triggering an alert and simulating an emergency engine cutoff.One of the main reasons we chose the Arduino Nano is its compatibility with USB programming, low power consumption, and ability to fit into small spaces — making it perfect for wearable or dashboard-mounted safety devices. It also supports a wide range of sensors and modules, which gives flexibility for future upgrades.Overall, the Arduino Nano is the core of this life-saving system, efficiently managing real-time inputs and outputs to help prevent accidents caused by driver fatigue.[7]

4.5 Glasses with IR sensor

The glasses with an IR sensor are a simple yet smart part of the Anti-Sleep Alarm system. They serve as the main interface between the driver's eyes and the technology that monitors drowsiness. These are ordinary eyeglass frames that have been modified to hold an **Infrared (IR) sensor**, positioned in a way that aligns directly with the driver's eye.The idea is to keep the sensor as close as possible to the eye without causing discomfort. When worn, the IR sensor continuously tracks whether the driver's eyes are open or closed.Infrared light transmission and reflection detection are possible for this component.[8]

4.6 SPST Switch

Our Anti-Sleep Alarm system requires an essential component which is the SPST (Single Pole Single Throw) switch. The device functions as an elementary control mechanism which regulates the entire circuit state between on and off positions. The two-terminal SPST switch completes the circuit and enables power flow or disrupts it when it is positioned accordingly. We placed the switch between the power supply containing a Lithium-ion battery with TP4056 module and the Arduino Nano to provide manual power control. A SPST switch demonstrates high efficacy as an on-off tool because it allows simple battery power conservation throughout device installation, maintenance periods and phases when the machine is inactive. A simple touch activates the system because it needs no programming or setup process. Users can just turn the device on or off with a single flick. The small component helps determine both system usability and energy conservation across the device.[9]

4.7 9V Battery

For efficient operations of the Anti-Sleep Alarm system the 9V battery functions as a portable compact power supply. The 9V battery gives continuous voltage to the Arduino Nano together with the IR sensor and buzzer and other components while eliminating the need for electric power outlet connections. The 9V battery excellence helps ensure the project functions portably thus enabling usage in wearable technologies or car integration. The project becomes suitable for situations requiring mobility on-the-go. It's lightweight, easy to install, and delivers enough power for small embedded systems like ours [6] [7] [8] [9].

5. RESULT

The Anti-Sleep Alarm system developed using the Arduino Nano and IR sensor has shown promising outcomes in real-time scenarios. Eye-blink monitoring represents the primary operation of this system which alerts drivers when drowsiness signs appear signs of drowsiness are detected prolonged testing of the integrated circuit took place across different usage conditions and environment types. Start-to-finish testing of the system proved its performance standards as well as accuracy and reliability under various conditions. Drowsy states differ from customary eye blinking in both movement speed and duration because they lead to gradual and delayed eye movements or prolonged periods with closed eyes. The eyes must stay either shut or maintain slow movements for a period more than two seconds before the system responds. The IR sensor positioned next to the drivers successfully recognized these patterns through our system eyes on a pair of modified glasses. When eyes close the sensor detects the reflection patterns of the IR beam sweeping the eyes and sends immediate data results. The Arduino Nano received data when the pre-programmed threshold of eye closure (about 2 seconds) expired. The buzzer automatically turned on at the first detection of two seconds with the eyes closed. The alert triggered by the device emitted powerful noises that alerted drivers but did not cause distress or alarm panic. The relay module would operate at the same time to create ignition cut-off effects or start motor functions that display emergency stopping operation. Emergency stop functionality testing established that the system demonstrates usefulness for vehicular emergency applications that either stop vehicles or initiate alerts to emergency responders. The system proves effective because of its simplicity and affordability unlike complex commercial drowsiness detection systems that rely on high-resolution cameras or expensive AI models, this project used minimal yet smart electronics to get the job done. It was also observed that the power consumption was low, making the system suitable for continuous use in vehicles. In real-world usage tests the system was subjected to various lighting conditions — such as day and night driving environments. The IR sensor performed consistently without being affected by ambient light, which confirmed its reliability. Also, minor variations in face angles or head movement did not significantly impact detection accuracy.User feedback collected from sample drivers and observers indicated that the system was comfortable to wear, non-intrusive, and easy to use. Drivers appreciated the immediate alert system, and many suggested it could be a valuable addition to long-distance or night-time travel routines.There were very few false alarms, and most were caused by rapid head movements or gestures that mimicked long blinks. These were addressed by fine-tuning the blink threshold and improving the sensor placement for more accurate detection.In summary, the systerm effectively fulfilled its intended purpose — to detect early signs of drowsiness and warn the driver to take correctiveaction. Its accurate detection rate, low cost, and adaptability make it a strong candidate for further development and commercial integration in automotive safety systems [10].

5.FUTURE SCOPE

While the current version of the Anti-Sleep Alarm system using Arduino Nano performs its core function effectively — detecting drowsiness and alerting the driver — there is plenty of potential for enhancing and expanding this project in the future.One of the most promising directions is the integration of Artificial Intelligence (AI) and Machine Learning (ML**)** to improve accuracy AI-based models possess the capability to detect advanced behavioral patterns including facial expressions as well as yawn frequency and head nodding movements that signal driver drowsiness. The system uses head nodding as an additional early warning method for detecting driver drowsiness. The updated system will generate fewer mistakes and show improved adaptation abilities for various drivers and driving situations. Odd features would enhance after incorporating GPS and GSM modules into the system. The system would enable it to deliver instant alerts together with precise location data toward family members or emergency response personnel. Safety measures would strengthen through the addition of extra security features triggered during detected drowsy events. One advanced upgrade of the device will add body temperature sensors alongside pulse rate monitors to monitor drivers' overall physical condition. The system would achieve better decision-making power through the integration of multiple assessment criteria. A live monitoring system with settings customization can be accessible through mobile app interfaces for users to use. Users can make custom changes to the system and view their recorded drowsiness events through the review section. The gathered information enables drivers to develop improved habits which can be assessed in the future development of this system. The system can be installed either in public transport vehicles or commercial fleets or within automotive dashboards by producers. General adoption of the Anti-Sleep Alarm system becomes practical because users find it affordable and easy to operate. The Anti-Sleep Alarm can expand from its basic form to develop into a complete driver assistance system contributing meaningfully to road safety [10] [11].

6. CONCLUSION

Modern life at high speed has created increasing challenges for road safety because of rising incidents involving driver fatigue. Road safety has turned into an escalating concern since driver fatigue produces more traffic incidents. Our Anti-Sleep Alarm system based on Arduino Nano functions as a practical solution which delivers low-cost effective solutions to prevent this problem. The device provides an efficient prevention system for stopping such occurrences. The system designers created a straightforward design which demonstrated ample power to spot drowsiness through eye-blink detection using IR sensors. The system tested an IR sensor to monitor eye blinks while undergoing device maintenance and this work produced consistent results. The device displayed reliable performance in detecting prereqes of sleep onset and also initiated emergency alerts timely. The device activates prompt alert mechanisms consisting of noise alarms and engine simulation shut downs. An instant feedback system represents the line between road safety and hazardous traffic circumstances during a journey the road. The main importance of this project system comes from its capability for broad implementation. The basic setup of this system uses available parts without advanced technology making it suitable for mass implementation. This system has value particularly in regions along with industrial areas which cannot support sophisticated driver-monitoring systems. The system stands out by providing effective service at affordable costs. It’s wearable, user-friendly, and easy to integrate into a variety of vehicles. Whether it's long-distance truck drivers, late-night commuters, or fleet vehicles, this kind of safety feature can bring real change.In conclusion, this project is more than just a tech experiment — it’s a small but significant step toward smarter, safer roads. With further enhancements, like AI-based data processing or integration into mobile apps, this system can evolve into a full-fledged safety companion for drivers. It proves that even with basic components and a clear vision, meaningful innovations can be made to save lives and improve driving conditions for everyone [10] [11].

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