TWO-WHEELER DRIVER SAFETY SYSTEM

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Abstract-
A smart helmet is a special idea which makes motorcycle driving safer than before. This is implemented using Gyroscope technology. The working of this smart helmet is very simple, bump sensors are placed in different places of helmet where the probability of hitting is more which are connected to microcontroller board. So when the rider crashes and the helmet hit the ground, these sensors sense and gives to the microcontroller board, then controller send the data using the Gyroscope module that is interfaced to it. When the data exceeds minimum stress limit then module automatically sends message to family members. Our task as an electronics engineer was to design a helmet that could autonomously detect accident. Also aims at minimizing road accidents. In this Project we design a smart helmet. It is the helmet that works with the help of transmitter and receiver circuit and the microcontroller.

1. INTRODUCTION

Two-wheelers such as motorcycles and scooters are widely used across the world due to their affordability, convenience, and ability to navigate through traffic with ease. However, they also pose significant safety challenges. Unlike cars, two-wheelers offer minimal protection to riders, making them more vulnerable to serious injuries or fatalities in the event of an accident. According to road safety studies, a large percentage of traffic-related deaths involve two-wheelers, with head injuries being the most common and deadly outcome.

Despite the known risks, many riders continue to engage in unsafe behaviors such as riding without helmets, driving under the influence of alcohol, or operating the vehicle while drowsy. These actions greatly increase the chances of accidents and reduce the effectiveness of emergency response. While there have been technological advancements in car safety, similar innovations in two-wheeler safety have not kept pace.

To address these concerns, the Two-Wheeler Safety Management System (TW-SMS**)** has been developed as a proactive safety solution. The system focuses on three major risk factors: helmet usage, alcohol consumption, and rider drowsiness. It uses smart sensors and monitoring technology to detect unsafe conditions and prevent the vehicle from operating unless all safety requirements are met.

The helmet detection feature ensures the rider is wearing a helmet before the vehicle can start, promoting consistent helmet use. The alcohol detection system uses a breathalyzer to check the rider's sobriety and disables the ignition if alcohol levels exceed a safe limit. Meanwhile, the drowsiness detection component monitors the rider's alertness during the ride, using sensors to identify signs of fatigue. If drowsiness is detected, the system activates an alert or a mild stimulus such as a burst of air to keep the rider awake and focused.

2. COMPARATIVE ANALYSIS

A comparative analysis of two-wheeler driver safety systems typically involves examining various safety technologies and features that aim to reduce accidents and injuries among motorcyclists and scooter riders. Here's a structured analysis comparing traditional safety systems and modern/advanced safety systems**,** followed by a look at selected systems and their effectiveness.

2.1 Efficiency Comparison:

The efficiency of two-wheeler driver safety systems can vary based on their technological complexity, ease of integration, and real-world impact. Among the most efficient systems is the Anti-lock Braking System (ABS), which significantly reduces the risk of skidding during sudden braking and has proven life-saving benefits, making it mandatory in many countries. Smart helmets equipped with impact sensors and emergency alert features also show high efficiency by enabling real-time accident response and improving rider safety. Crash detection systems using GPS and accelerometers are similarly effective in emergency scenarios, offering quick notifications to emergency contacts or services.

2.2 Cost-effectiveness:

The implementation of a two-wheeler driver safety system proves to be highly cost-effective when weighed against the potential consequences of accidents. Although there may be an initial investment in safety components such as sensors, GPS tracking, automatic braking systems, or helmet detection modules, these costs are relatively low compared to the expenses incurred from medical treatments, vehicle repairs, and insurance claims following accidents.

2.3 Environmental Impact:

The implementation of a two-wheeler driver safety system can have both positive and negative environmental impacts. On the positive side, such systems help reduce accidents, leading to fewer traffic jams and lower emissions from idling vehicles. They also promote safer use of two-wheelers, which generally produce less pollution compared.

2.4. Practical Application:

A two-wheeler driver safety system can be practically applied to significantly reduce road accidents and enhance rider protection. By integrating sensors, GPS, and real-time monitoring, the system can detect sudden movements, falls, or collisions and immediately alert emergency services with the rider's location. Helmet detection features ensure the rider does not start the vehicle without wearing proper headgear, while alcohol sensors and drowsiness detection systems help prevent driving under unsafe conditions. Additionally, features like automatic braking, blind-spot alerts, and lane-change warnings can help avoid common causes of two-wheeler accidents. Such a system not only safeguards the rider but also promotes responsible driving behavior, making roads safer for everyone.

2.5 Educational and Motivational Value:

The implementation of a two-wheeler driver safety system offers significant educational and motivational value. It raises awareness among riders about the importance of safe driving practices, encouraging them to adopt habits such as wearing helmets, maintaining speed limits, and avoiding distractions. Educational features such as alerts, real-time feedback, and safety tutorials help riders understand traffic rules and the consequences of unsafe behaviur.

3. METHODOLOGY

The Two-Wheeler Safety Management System (TW-SMS) aims to enhance the safety and security of two-wheeler riders by integrating real-time monitoring, analysis, and intervention mechanisms. This system is designed to detect and prevent unsafe riding behaviour, including the failure to wear a helmet, alcohol consumption, and drowsiness, which are common causes of accidents among two-wheeler riders. By utilizing various sensors, such as an alcohol sensor, gyroscope, infrared (IR) sensor, and GPS module, along with an intelligent control system, the TW-SMS works to ensure the rider's safety at all times. This methodology describes how the system will be implemented, focusing on the integration of components, the processes involved, and the steps to achieve a fully functional safety management system.

3.1 System Design and Concept The Two-Wheeler Safety Management System is designed as an integrated solution that leverages modern sensors and actuators to monitor and control the safety of two-wheeler riders. The system is structured around three main safety concerns: helmet detection, alcohol detection, and drowsiness monitoring. These concerns are tackled through specific technologies and methods that work in harmony to create a robust safety solution.

1. Pre-Start Safety Check Implementation Before allowing the two-wheeler to start, the system performs a series of safety checks to ensure that the rider is in a safe condition to operate the vehicle. These checks are crucial for preventing accidents related to the rider's safety behavior. The pre-start checks are broken down into three primary categories: helmet detection, alcohol detection, and position verification.
2. Helmet Detection The first step in the pre-start safety check is to verify that the rider is wearing a helmet. This check is performed using an infrared (IR) sensor placed in the vicinity of the rider's head. The IR sensor works by emitting infrared light and measuring the reflection from the surface of the helmet. When the helmet is worn, the reflection will meet the sensor's specifications, confirming that the rider is properly protected.

4. DISCUSSION

The experimental setup for the Two-Wheeler Driver Safety System uses the ESP8266 microcontroller to manage various sensors ensuring rider safety. An IR sensor checks helmet usage, a limit switch confirms the rider is seated, and an alcohol sensor (MQ-3) prevents ignition if alcohol is detected. MPU6050 detects drowsiness or falls, triggering a water pump to alert the rider. A GPS module tracks speed and location, while a motor and driver control ignition based on safety checks.

5. CONCLUSION

The Smart Two-Wheeler Management System offers a groundbreaking approach to rider safety, combining advanced technology with essential safety features. By integrating helmet detection, alcohol sensors, and sleep monitoring systems, the system ensures that riders are fully prepared for safe travel before they start their journey. This multi-layered safety approach addresses critical issues like impaired driving, fatigue, and lack of protective gear, significantly reducing the risk of accidents.

Additionally, the real-time monitoring and automatic responses, such as disabling the vehicle's motor if any safety criteria are violated, provide an added layer of protection for the rider. The system's energy efficiency, modular design, and scalability make it adaptable to different vehicle types and rider preferences, ensuring widespread applicability.

Furthermore, its cost-effectiveness helps reduce the financial burden of accidents by minimizing medical, repair, and insurance costs over time. Overall, the Smart Two-Wheeler Management System not only ensures a safer riding experience but also fosters a shift toward responsible and mindful driving behavior. By incorporating a combination of proven technologies and user-friendly alerts, the system empowers riders to make informed decisions, which ultimately contribute to their personal safety and the overall safety of the road.

6. REFERENCES

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