HELMET MOUNTED ADAS FOR ENCHANCED SAFETY AND AWARENESS

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College **:** *Sri Sairam College of Engineering, Bengaluru*
Branch **:** *Department of Electronics and Communication Engineering*
Guide(s) **:** *Mr. Raja G. V*
Student(S) **:** *Mr. Tharun K.*
Mr. Sakthivel G.
Mr. Pradheep M
Mr. Merbin Joshua D.

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Introduction:

The integration of Advanced Driver Assistance System (ADAS) technology within smart helmets represents a significant leap forward in motorcycle safety. These helmets are engineered to provide riders with a comprehensive suite of safety features, leveraging a combination of sensors and advanced technologies to enhance situational awareness and mitigate risks on the road. At the core of this innovation is a sophisticated microcontroller, orchestrating the seamless integration and operation of various sensors embedded within the helmet. These sensors include ultrasonic sensors for collision warning and blind spot detection, an eye blink sensor to monitor rider attentiveness, and an alcohol sensor to detect intoxication levels. The helmet's capabilities extend further with a color sensor for lane dispute warning, alerting riders to potential lane deviations or conflicts. GPS integration enables real-time location tracking and navigation assistance, while IoT connectivity facilitates remote monitoring and data transmission, enhancing overall functionality. In critical situations or emergencies, the helmet utilizes a buzzer to provide audible warnings to the rider, ensuring immediate attention to potential hazards

Objectives:

The primary objective of the proposed smart helmet system is to revolutionize motorcycle safety by integrating cutting-edge technologies to provide riders with enhanced protection, awareness, and peace of mind on the road. The project aims to achieve the following specific objectives:

- **Advanced Sensor Integration:** Integrate advanced sensors, including ultrasonic sensors for collision and blind spot detection, an eye blink sensor for rider attentiveness, an alcohol sensor for preventing impaired riding, and a color sensor for lane dispute warnings, into the smart helmet system. Optimize sensor placement and calibration to ensure accurate detection of potential dangers in real-time.

- **Comprehensive Safety Features:** Develop a comprehensive suite of safety features that leverage the capabilities of the integrated sensors to detect and mitigate potential hazards. Implement visual, audible, and digital notifications to alert the rider of impending dangers, providing a heightened level of awareness and enabling proactive risk mitigation.
- **Navigation Assistance and Connectivity:** Utilize GPS for navigation assistance, enabling riders to plan and navigate routes effectively. Leverage IoT connectivity for real-time data monitoring and communication, allowing riders to stay informed about road conditions, traffic updates, and weather alerts.
- **Seamless Integration and Management:** Incorporate a microcontroller as the central processing unit to facilitate seamless integration and efficient management of the system's functionalities. Develop software algorithms to process sensor data, generate alerts, and manage communication protocols, ensuring optimal performance and reliability.
- **User Experience Enhancement:** Prioritize user experience in the design and implementation of the smart helmet system. Design an intuitive interface for accessing and controlling safety features, minimizing rider distraction and cognitive load. Conduct usability testing and iterate on design improvements based on user feedback to enhance user satisfaction and adoption.
- **Safety Impact Evaluation:** Conduct rigorous evaluation and testing of the smart helmet system to assess its impact on motorcycle safety. Measure the effectiveness of the integrated safety features in detecting and mitigating potential dangers, reducing the risk of accidents, and enhancing rider confidence and peace of mind on the road.

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Methodology:

The methodology for developing a helmet-mounted ADAS for enhanced safety and awareness involves conducting a literature review to define requirements, designing the system architecture, and selecting appropriate hardware like sensors and GPS modules. The software is developed to include algorithms for collision avoidance, lane departure warning, and blind spot detection, integrated with a heads-up display (HUD). The system undergoes lab and field testing for validation, followed by user interface design and iterative improvements based on feedback. Safety and compliance testing ensure standards are met before deployment, monitoring, and continuous improvement. Comprehensive documentation, training, and support are provided for users, culminating in the commercial launch of the product.

Materials: Ultrasonic Sensors, Color Sensor, Alcohol sensor , Eye Blink Sensor , Arduino UNO, GPS Module.

Details:

1. **ULTRASONIC SENSOR**: An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.

2. **COLOR SENSOR:** The color sensor product family provides red, green, blue and clear (RGBC) light sensing for precise color measurement, determination, and discrimination. A SYNC input allows for greater accuracy by enabling the color sensing to be synchronized with an external event.

3. **ALCOHOL SENSOR (MQ3):** This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration.

4. **EYE BLINK SENSOR**: This Eye Blink sensor is IR based, The Variation Across the eye will vary as per eye blink . If the eye is closed means the output is high otherwise output is low. This to know the eye is closing or opening position. This output is give to logic circuit to indicate the alarm.
   This can be used for project involves controlling accident due to unconscious through Eye blink.

5. **ARDUINO UNO:** Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers

6. **GPS MODULE:** The Global Positioning System (GPS), originally Navstar GPS, is a space-based radio navigation system owned by the United States government and operated by the United States Air Force.

Conclusion:

The result of implementing the smart helmet with an Advanced Driver Assistance System (ADAS) is a significant improvement in rider safety and overall road awareness. The integration of multiple sensors such as ultrasonic sensors for collision and blind spot detection, an eye blink sensor for monitoring rider attentiveness, an alcohol sensor for preventing impaired riding, and a color sensor for lane dispute warnings has proven highly effective in mitigating potential risks on the road.
In conclusion, the smart helmet with an Advanced Driver Assistance System (ADAS) represents a pioneering advancement in motorcycle safety technology. By integrating a suite of sensors, including ultrasonic sensors for collision and blind spot detection,

an eye blink sensor for rider attentiveness, an alcohol sensor for preventing impaired riding, and a color sensor for lane dispute warnings, this system offers comprehensive protection on the road.

Comparison:

1. Flexibility: PID controllers have fixed integer orders, while fractional PID controllers offer flexibility with fractional orders, enabling precise tuning and adaptation to complex dynamics.
2. Stability: PID controllers are widely used with good stability, while fractional PID controllers may offer improved stability, particularly in systems with long time delays or non-linearities.
3. Complexity: Fractional PID controllers introduce complexity due to additional parameters, while PID controllers are simpler to implement and tune.
4. Performance: Performance depends on application and tuning; fractional PID controllers may excel in systems with non-integer order dynamics but require careful tuning.

In summary, while PID controllers are established and widely used, fractional PID controllers offer flexibility and potentially better performance in certain applications, with added complexity. The choice depends on specific motor control system requirements and characteristics

Scope for future work:

The future scope for helmet-mounted ADAS includes advancements in sensor technology, integration of machine learning and AI for better hazard prediction, and enhanced augmented reality for detailed rider information. Improved connectivity, such as vehicle-to-everything (V2X) communication, and integration with other smart wearables will further enhance safety. Battery life improvements, advanced voice control, and new safety features like automated emergency calling are expected. Customization options, compliance with global standards, and applications for commercial use, like delivery and law enforcement, will broaden the system's impact, making riding safer and smarter.

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