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Design and Implementation of an IoT-Based Smart Helmet and Bike Integrated Safety Monitoring System for Motorcycle Riders

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Abstract: *The rapid increase in motorcycle-related accidents has highlighted the need for intelligent safety solutions that can actively monitor rider behavior and vehicle conditions in real time. This paper presents the design and implementation of an IoT-based smart helmet and bike integrated safety monitoring system aimed at enhancing the safety of two-wheeler riders. The proposed system consists of two coordinated units: a smart helmet unit and a bike-mounted control unit. The helmet unit incorporates sensors to detect helmet usage, alcohol consumption, and abnormal head movement, while the bike unit monitors critical parameters such as stand position, oil level, obstacle proximity, and vehicle stability. A PIC18F4520 microcontroller acts as the central processing unit, integrating sensor data and making real-time safety decisions. Wireless communication between the helmet and bike units is achieved using RF technology, while GSM and GPS modules enable emergency alert transmission with precise location details. In unsafe conditions, such as alcohol detection or absence of helmet usage, the system restricts bike ignition, thereby enforcing safety compliance. In the event of an accident, automatic alerts are sent to predefined emergency contacts, reducing response time and potential injury severity. Experimental evaluation of the prototype demonstrates reliable communication, accurate sensor detection, and timely alert generation. The proposed system offers a cost-effective, scalable, and practical IoT-based solution to significantly improve motorcycle rider safety and reduce accident-related risks*

Keywords: IoT, Smart Helmet, Bike Rider Safety, Accident Detection, Alcohol Sensor, PIC Microcontroller, GSM, GPS, Wireless Communication

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