Automated Rider Companion

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Motorcycle riders face high risks due to limited visibility and awareness, which can lead to collisions. The ARC Helmet (Automated Rider Companion) improves rider safety by providing real-time situational awareness through an integrated wearable system combining sensors, visual cues, and haptic feedback. An ESP32 microcontroller processes data from four ultrasonic sensors mounted around the helmet to detect obstacles in front, behind, and to the sides. Each sensor measures distances by emitting ultrasonic pulses and calculating echo return times. A WS2812 LED strip along the visor displays directional alerts corresponding to sensor detection, while vibration motors embedded in the padding provide tactile feedback. An accelerometer monitors sudden movements to detect abrupt changes in velocity. Testing involved measuring detection distances using a vehicle or object along a controlled pathway and verifying LED and vibration feedback. Results confirmed the system consistently detected obstacles within range and accurately conveyed direction through visual and tactile alerts. The ARC Helmet demonstrates that integrating sensor fusion, microcontroller processing, and multimodal feedback can effectively improve rider awareness and safety, providing a reliable layer of protection in dynamic environments.

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