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IoT Based Low-Cost Smart EV Motor Fault Detection Using ESP32

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Abstract: *The operational integrity of Electric Vehicle (EV) propulsion systems is paramount for the advancement of sustainable transportation. Sudden motor malfunctions, especially during high-speed transit, present severe safety hazards and logistical inefficiencies. Conventional maintenance models, typically reactive or rigidly scheduled, often fail to address incipient faults effectively, leading to avoidable downtime. This study introduces a comprehensive IoT-enabled framework designed for the predictive maintenance of EV motors. The proposed architecture leverages the ESP32 microcontroller to orchestrate a multi-sensor array, comprising accelerometers for vibration profiling, Hall Effect sensors for current signature analysis, and thermal probes for temperature monitoring. By adopting a synergistic mechatronic approach, the system processes sensor data in real-time, utilizing threshold logic and Root Mean Square (RMS) computation to identify early signs of degradation. Telemetry data is relayed via Wi-Fi to the Blynk IoT interface, affording drivers immediate visualization and alert capabilities. Empirical validation confirms the system's efficacy in detecting anomalies in current and vibration metrics with minimal latency, establishing a cost-effective paradigm for enhancing vehicle reliability*

Keywords: Electric Vehicle; Predictive Maintenance; IoT; ESP32; Vibration Analysis; Motor Current Signature Analysis

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