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## Design and Implementation of an Arduino-Based Black Box System for Enhanced Monitoring and Safety in Electric Vehicles (EVs)

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Abstract: Electric vehicles (EVs) are gaining widespread adoption due to their environmental benefits, improved efficiency, and lower operating costs. However, challenges such as battery management and charging infrastructure persist. To address these issues, black box systems can monitor operational parameters of EVs, including battery health, energy consumption, speed, and GPS location, ensuring safety and enabling predictive maintenance. This study explores the design and implementation of an Arduinobased black box system integrated with the EV's CAN bus, collecting real-time data from sensors monitoring battery voltage, current, temperature, motor speed, and acceleration. The recorded data is stored locally and wirelessly transmitted to a remote server, facilitating IoT-based diagnostics and remote monitoring. Motivated by increasing EV fire incidents due to battery thermal issues, this research aims to enhance EV safety and reliability through effective data recording and monitoring. Additionally, IoT integration enables remote troubleshooting and system updates, optimizing performance and infrastructure planning by providing valuable data to manufacturers and policymakers. The methodology involves identifying key system requirements, interfacing Arduino with the EV's CAN bus, integrating sensors, and implementing wireless data transmission, followed by rigorous testing under simulated and real-world conditions to ensure reliability and accuracy. With robust thermal management strategies, this black box system can prevent thermal runaway incidents, fostering public confidence in EV technology and promoting its broader adoption.

Keywords: Electric Vehicles (EVs), Black Box System, Arduino Integration, IoT Monitoring, EV Diagnostics

