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# IOT BASED AVOID FIRE ACCIDENT IN EV VEHICLE WITH MULTIPLE FAULT DETECTION AND BATTERY MANAGEMENT SYSTEM USING AI

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**ABSTRACT:** The rapid growth of electric vehicles (EVs) demands innovative safety measures to address potential fire accidents arising from faults in the vehicle's electrical systems, particularly in the battery management system. In this study, we propose an internet of things (IoT)-enabled solution designed to prevent fire accidents in EVs through comprehensive fault detection and intelligent battery management utilizing artificial intelligence (AI) techniques. A sophisticated fault detection system is implemented to identify multiple fault types, including short circuits, overcharging, and thermal anomalies. This proactive approach ensures the timely detection of potential issues, reducing the risk of fire accidents. The system is designed to provide accurate and timely predictions, enabling maintenance teams to address potential issues before they lead to critical failures.

***Index Terms*** **- IOT, AI, Circuits, Electric Vehicle.**

**INTRODUCTION:** The advent of electric vehicles (EVs) marks a significant milestone in the automotive industry, offering promises of cleaner and more sustainable transportation. However, alongside the benefits of EV adoption come new challenges, particularly in ensuring safety and reliability. Among the foremost concerns are fire accidents and the effective management of EV batteries, both of which have garnered considerable attention from stakeholders, researchers, and the public alike. The transition to electric mobility presents unique safety considerations, notably due to the high-energy density and complex nature of lithium-ion batteries powering these vehicles. Despite advancements in battery technology, incidents involving EV fires have raised concerns about their safety and the adequacy of existing prevention and management strategies. The intricate interplay of factors such as battery chemistry, thermal management, and vehicle design underscores the need for innovative solutions to address these challenges comprehensively.

In response to these concerns, this paper proposes an innovative approach leveraging the convergence of the Internet of Things (IoT) and Artificial Intelligence (AI) to mitigate fire risks and enhance battery monitoring in EVs. By harnessing IoT-enabled sensors and AI algorithms, our solution aims to proactively detect and

mitigate potential hazards in EV battery systems, thereby improving overall safety and reliability. The integration of IoT technologies enables real-time monitoring of various parameters within the EV ecosystem, including battery temperature, voltage, and current. These data streams are fed into AI- driven analytics engines capable of identifying patterns indicative of potential faults or anomalies in the battery management system. Furthermore, the introduction of EVs and the occurrence of fire incidents involving these vehicles have attracted considerable media attention, shaping public perceptions and regulatory discourse. Addressing these concerns not only requires technical innovation but also effective communication and stakeholder engagement to build trust and confidence in EV safety.

LITERATURE SURVEY

This paper explores off-board chargers for electric vehicles (EVs), focusing on AC-DC and DC-DC power stages connecting the power network to the EV battery. Off-board chargers, essential for DC fast and ultra-fast charging, significantly reduce EV volume and weight. Leveraging IoT and Power Factor Correction (PFC), we assess their advantages like enhanced charging capacity monitoring, while acknowledging limitations such as a restricted maximum charging rate (2022).

In "A Data-Driven Approach for Optimizing the EV Charging Stations Network" (2020), sparse electric vehicle trajectory data poses challenges. To address this, a context-aware tensor collaborative decomposition method is proposed. This method effectively recovers

missing data, providing precise analysis for optimizing charging station networks. Leveraging data mining and tensor construction yields exact results despite occasional missing values.

Advancements in battery monitoring systems, particularly those utilizing wireless communication, are crucial for addressing performance degradation and energy supply issues in electric vehicles (EVs). IoT-based solutions enable remote monitoring of EV battery systems, ensuring optimal performance. These systems find applications beyond EVs, including uninterruptible power supply (UPS) management. Additionally, GPS satellites enhance wireless monitoring capabilities for precise location tracking. Wireless systems are robust, thanks to their insensitivity to image details, making them reliable across various environments (2018).

**PROPOSED SYSTEM**

**BATTERY MANAGEMENT**

The battery voltage and temperature monitoring system is designed to monitor and manage the electrical parameters
of batteries used in various applications, such as renewable energy systems, electric vehicles, and portable devices. This module provides real-time data on battery voltage and temperature, enabling efficient management, maintenance, and safety measures.

**CONTROL FLOW MANAGEMENT SENSOR DATA ACQUISITION:**

The system continuously acquires data from various sensors placed strategically within the EV. Temperature sensors monitor the temperature of critical components such as the battery pack, motor, and power electronics.

**DATA PROCESSING AND ANALYSIS:**

The acquired sensor data is processed and analyzed in real-time by the onboard microcontroller or processing unit. Algorithms analyze temperature trends, smoke levels, and flame presence to identify potential fire hazards or faults.

**FAULT DETECTION:**

In parallel with fire detection, the system monitors for other faults or abnormalities in the vehicle electrical and mechanical systems. Voltage and current sensors detect fluctuations or anomalies in the power distribution system. Diagnostic algorithms analyze sensor data to identify potential faults in components such as the battery management system, charging system, or motor controller.

**User Dashboard:**

Establish predefined thresholds for battery performance metrics and temperature levels. Define threshold values for voltage deviations, levels, degradation, and temperature limits beyond which alerts should be triggered. Connect the user and the hardware to alert the user.

## MODEL BUILDING

### IOT INTEGRATION

Integrating IoT technology into EVs offers a robust solution for enhancing safety and efficiency. Through strategically placed sensors and AI-powered analytics, real-time data on critical parameters like temperature and voltage can be collected and analyzed. This enables early detection of potential fire hazards and faults, allowing for proactive measures to be taken. Additionally, advanced battery management systems ensure optimal performance and longevity of the battery pack. With remote monitoring and control capabilities, stakeholders can swiftly respond to emerging issues, ensuring EVs remain safe and reliable on the road. This integrated approach represents a significant advancement in EV technology, promising safer and more efficient transportation for all.

### ARCHITECTURE

The architecture for an IoT-based system to prevent fire accidents, detect faults, and manage batteries in EVs with AI involves several layers. First, sensors placed in the vehicle monitor temperature, voltage, and other parameters, sending data to an IoT gateway for transmission. In the cloud or a server, this data undergoes analysis by AI algorithms, which can predict fire risks and detect faults in components like the battery pack or motor. Users can access vehicle status and receive alerts through a simple interface, allowing for remote control and proactive maintenance. This integrated approach ensures safer and more reliable EV operation, minimizing risks while maximizing efficiency.

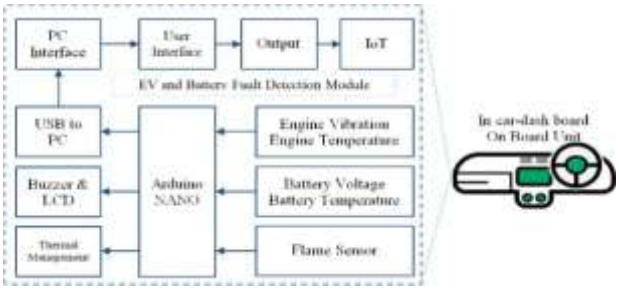


figure 1

### EVALUATION AND ACCURACY

The evaluation of an IoT-based system for preventing fire accidents and managing faults in EVs with AI involves assessing its ability to detect hazards accurately and promptly, optimize battery usage effectively, and provide reliable alerts to users. Key metrics include the system's accuracy in detecting potential risks, its responsiveness in triggering preventive measures, and its success in prolonging battery life. Additionally, factors like user satisfaction and system reliability play vital roles in determining its effectiveness.

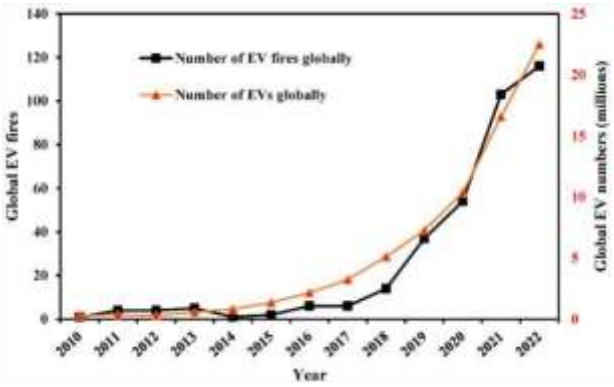


figure 2

## CONCLUSION

In conclusion, the IoT-based system for preventing fire accidents in electric vehicles (EVs) through fault detection and intelligent battery management using AI is a significant advancement in automotive safety. By leveraging IoT sensors and AI algorithms, the system offers proactive monitoring and timely intervention to mitigate potential hazards. With sophisticated fault detection mechanisms and intelligent battery management, it detects issues early and optimizes battery usage while minimizing fire risks. Real-time monitoring and continuous model improvement ensure the system's effectiveness and reliability. Overall, this system represents a holistic approach to enhancing EV safety, promising safer transportation for all.

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