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# **IOT based motor performance analysis system for electrical vehicle**

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**ABSTRACT:** Electric Vehicles (EVs) are emerging as a key solution for sustainable transportation due to their high efficiency and low environmental impact. The performance and reliability of electric motors play a critical role in the overall efficiency, safety, and lifespan of EVs. This paper presents an IoT-based Motor Performance Analysis System designed to continuously monitor and analyze critical motor parameters such as voltage, current, speed (RPM), temperature, and power consumption. The system integrates sensors, a microcontroller, wireless communication, and cloud-based analytics to provide real-time monitoring and predictive maintenance insights. The proposed approach enables early fault detection, reduces downtime, improves energy efficiency, and supports remote diagnostics. Experimental analysis demonstrates that the system effectively enhances motor performance monitoring and supports data-driven maintenance strategies for electric vehicles.

**KEYWORDS:** Internet of Things (IoT), Electric Vehicle, Motor Performance Monitoring, Predictive Maintenance, Cloud Computing, Smart Transportation

This paper proposes an IoT-based motor performance analysis system specifically designed for electric vehicles. The system continuously monitors key motor parameters and uploads the data to a cloud platform for storage and analysis. By leveraging IoT technology, the proposed system aims to improve motor reliability, reduce maintenance costs, and enhance overall EV performance.

## **I. INTRODUCTION**

The rapid growth of electric vehicles has significantly transformed the transportation sector by reducing dependency on fossil fuels and minimizing greenhouse gas emissions. At the core of an EV lies the electric motor, which converts electrical energy into mechanical energy to drive the vehicle. The performance of this motor directly affects vehicle efficiency, safety, and reliability. Any degradation or fault in motor operation can lead to reduced efficiency, increased energy consumption, or even system failure.

Traditional motor monitoring techniques rely on periodic manual inspection or standalone diagnostic tools, which are often insufficient for real-time fault detection. With the advancement of the Internet of Things (IoT), it has become possible to implement continuous monitoring systems that collect, transmit, and analyze data in real time. IoT-based monitoring systems enable predictive maintenance, remote supervision, and intelligent decision-making.

This paper proposes an IoT-based motor performance analysis system specifically designed for electric vehicles. The system continuously monitors key motor parameters and uploads the data to a cloud platform for storage and analysis. By leveraging IoT technology, the proposed system aims to improve motor reliability, reduce maintenance costs, and enhance overall EV performance.

## **II. SURVEY AND SPECIFICATION**

Recent studies show that IoT-based motor monitoring systems are widely used to improve performance, efficiency, and reliability of electric vehicle motors. Existing systems focus on monitoring parameters such as voltage, current, temperature, and speed using sensors and cloud platforms. However, many solutions lack real-time fault detection and

integrated predictive maintenance.

The proposed system uses voltage, current, temperature, and RPM sensors interfaced with a microcontroller (ESP32/Arduino) to collect motor data. The monitored data is transmitted wirelessly to a cloud platform for real-time analysis and alerts. This system ensures efficient motor operation, early fault detection, and reduced maintenance cost for electric vehicles.

### III. LITERATURE SURVEY

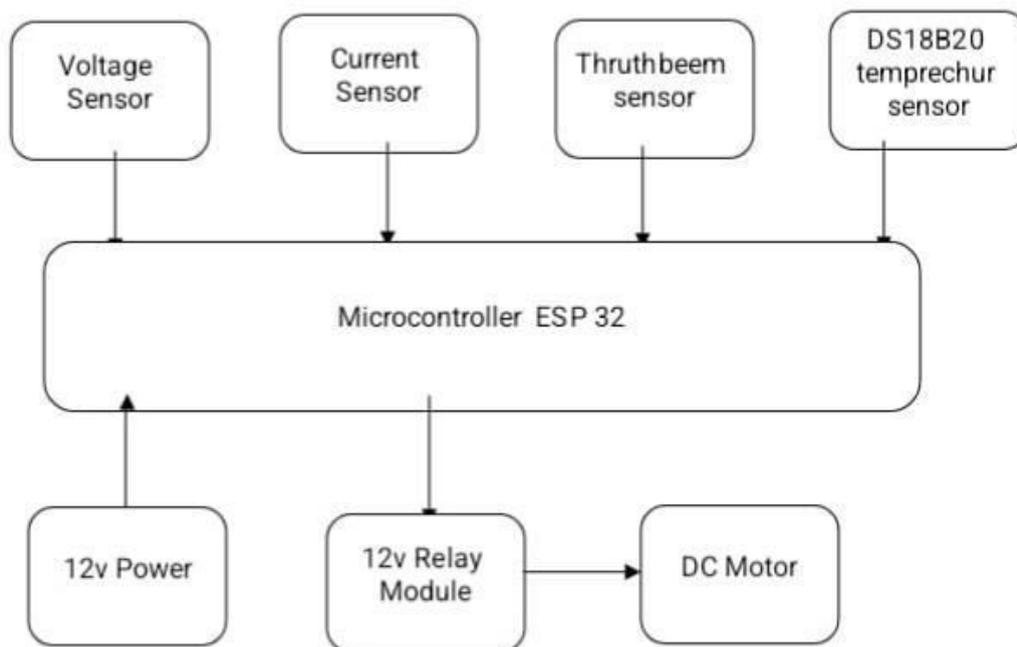
Several researchers have explored motor monitoring and diagnostic systems for electric vehicles and industrial applications. Conventional approaches include vibration analysis, thermal monitoring, and current signature analysis. While effective, these methods often require expensive equipment and are limited to offline analysis.

Recent studies have introduced IoT-based monitoring solutions using microcontrollers and cloud platforms. These systems provide real-time data visualization and remote access. Some research focuses on predictive maintenance using machine learning algorithms, while others emphasize energy efficiency optimization. However, many existing systems lack integration of multiple motor parameters or are not specifically tailored for EV applications.

The proposed system addresses these limitations by integrating voltage, current, speed, and temperature monitoring into a single IoT-enabled framework suitable for electric vehicles.

### System Design Discussion And Methodology

#### A. System Architecture



### IV. HARDWARE COMPONENTS

#### 4.1 VOLTAGE SENSOR

The voltage sensor measures the supply voltage of the motor and ensures it operates within safe limits. Abnormal voltage levels may indicate power electronics faults or battery issues.

#### 4.2 CURRENT SENSOR

The current sensor monitors motor current to detect overload conditions, short circuits, or abnormal operating states. Current analysis is essential for estimating power consumption and efficiency.

#### 4.3 TEMPERATURE SENSOR

Temperature sensors are used to monitor motor winding and casing temperatures. Excessive heat can lead to insulation failure and reduced motor lifespan.

#### 4.4 SPEED SENSOR (RPM)

The speed sensor measures motor rotational speed, which is crucial for performance evaluation and control accuracy.

#### 4.5 MICROCONTROLLER UNIT

A microcontroller such as ESP32 or Arduino processes sensor data and manages communication with the cloud server.

### V. SOFTWARE AND COMMUNICATION

The software architecture includes embedded firmware, cloud services, and a user interface. Sensor data is sampled and processed by the microcontroller, then transmitted via Wi-Fi to the cloud platform using standard IoT protocols such as MQTT or HTTP.

The cloud platform stores the data and performs analytics to identify trends, anomalies, and performance degradation. A web or mobile dashboard allows users to visualize real-time and historical data.

### VI. RESULTS AND ANALYSIS

The system was tested on an electric motor under various load conditions. Parameters such as voltage, current, temperature, and RPM were monitored in real time. The results showed accurate data acquisition and reliable transmission to the cloud platform. Temperature and current trends were analyzed to identify overload conditions. The system successfully generated alerts when parameters exceeded predefined thresholds, demonstrating its effectiveness for predictive maintenance.

### VII. APPLICATIONS AND PRACTICAL CONSIDERATIONS

Electric vehicles (two-wheelers, three-wheelers, cars)  
Industrial motor monitoring  
Smart transportation systems  
Predictive maintenance platforms

### VIII. CONCLUSION AND FUTURE WORK

This paper presented an IoT-based motor performance analysis system for electric vehicles. By integrating multiple sensors, a microcontroller, and cloud-based analytics, the system enables real-time monitoring and predictive maintenance. The proposed solution enhances motor reliability, improves energy efficiency, and reduces downtime. Future work may include integration of machine learning algorithms for advanced fault prediction and optimization.

### IX. ACKNOWLEDGMENT

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