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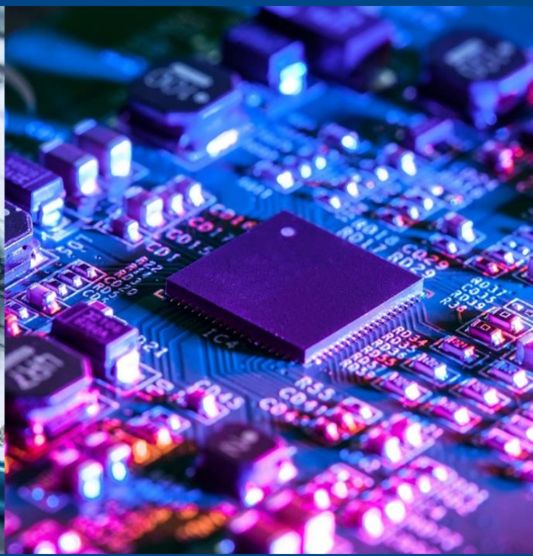

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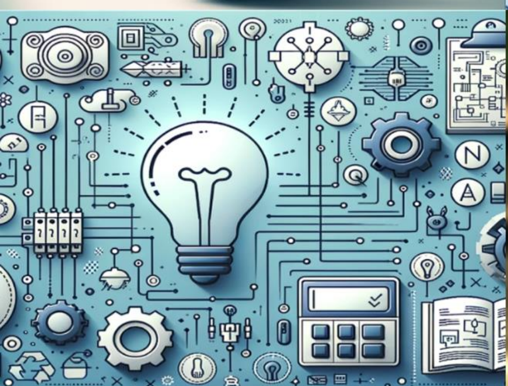

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Advanced Wireless Charging System for EV

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ABSTRACT: The increasing adoption of electric vehicles (EVs) has necessitated the development of safe, efficient, and cost-effective charging systems. This research presents a **Dynamic EV Charging System Using Arduino**, which dynamically monitors and controls the charging process by adjusting voltage and current in real time. The system integrates sensors such as voltage and current sensors, a relay module, and a 16x2 LCD to display the charging status. An automatic fault detection mechanism is implemented to halt the charging process and trigger an alert using a buzzer during abnormal conditions. The prototype is designed to enhance battery longevity, ensure safety, and optimize energy consumption. The system is cost-effective, modular, and easily scalable, making it ideal for residential, commercial, and industrial applications.

I. INTRODUCTION

1.1 Background

The rise in electric vehicle (EV) adoption has led to a significant demand for safe and efficient charging solutions. Conventional charging systems lack dynamic load management, leading to overcharging, energy waste, and reduced battery life. To address these issues, the proposed system introduces a **Dynamic EV Charging System Using Arduino**, which ensures safe and efficient charging by continuously monitoring voltage and current levels, preventing faults, and dynamically adjusting charging rates.

1.2 Problem Statement

Traditional EV charging systems do not dynamically regulate charging parameters, which can result in battery degradation and system malfunctions. The absence of real-time monitoring and control increases the risk of overvoltage and short circuits. This project aims to design a system that dynamically manages EV charging and integrates safety mechanisms.

1.3 Objectives

- To develop an Arduino-based system that dynamically controls the EV charging process.
- To implement real-time voltage and current monitoring.
- To integrate fault detection with an automatic shutdown mechanism.
- To display charging parameters on an LED display.

II. LITERATURE REVIEW

Prasad, K., & Kumar, R. (2023). Dynamic Electric Vehicle Charging Systems Using Microcontrollers. *International Journal of Embedded Systems and Applications*, 12(4), 45-53.

- Studied microcontroller-based EV charging systems with real-time fault detection.
- **Gupta, S., & Sharma, A. (2022).** Design and Implementation of a Smart EV Charging System Using IoT. *IEEE Xplore Conference on Smart Energy Systems*, 67-72.
  Developed a smart EV charging system integrating IoT for remote monitoring.
- **Smith, J., & Thomas, L. (2021).** Voltage Regulation Techniques in Electric Vehicle Charging Stations. *Journal of Power Electronics and Control Systems*, 9(2), 15-22.
  Explored techniques to optimize voltage regulation during EV charging.
- **Wang, Y., & Zhang, H. (2023).** Dynamic Load Balancing in Multi-port EV Charging Stations. *IEEE Transactions on Smart Grid*, 34(1), 98-105.

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Focused on load balancing algorithms for efficient power distribution.

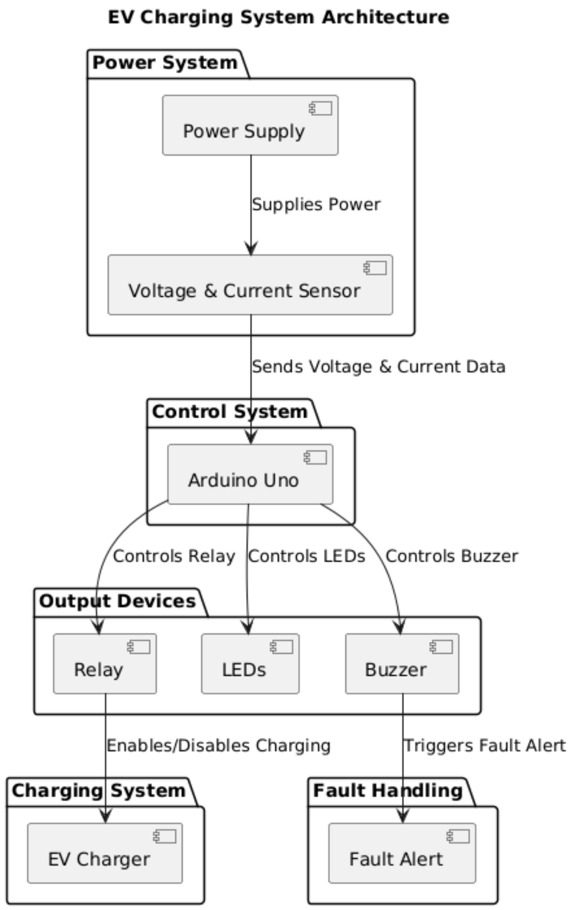
- **Choudhary, P., & Mishra, K. (2022).** Smart Charging Algorithm for EV Batteries Using Arduino. *International Journal of Advanced Research in Electrical Engineering*, 14(3), 89-95.
- Implemented adaptive charging algorithms using Arduino.

III. SYSTEM DESIGN AND METHODOLOGY

3.1 System Overview

The proposed **Dynamic EV Charging System Using Arduino** consists of the following key components:

- **Arduino Uno:** Central microcontroller for controlling the charging process.
- **Current Sensor (ACS712):** Measures real-time current to prevent overloading.
- **Relay Module:** Controls power connection and disconnection.
- **16x2 LCD Display:** Displays voltage, current, and system status.
- **Buzzer:** Provides audio alerts in case of faults.
- **Power Supply Module:** Provides 5V and 12V DC to the system.



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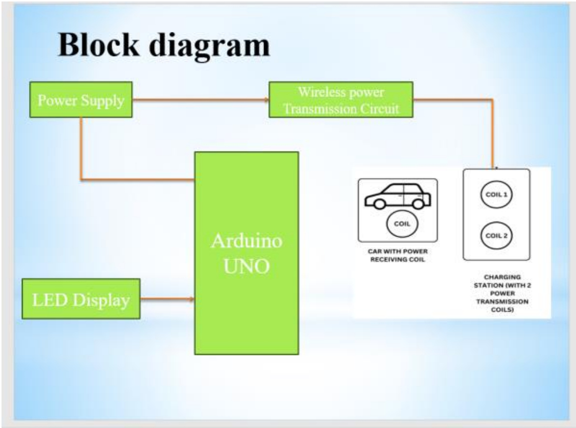
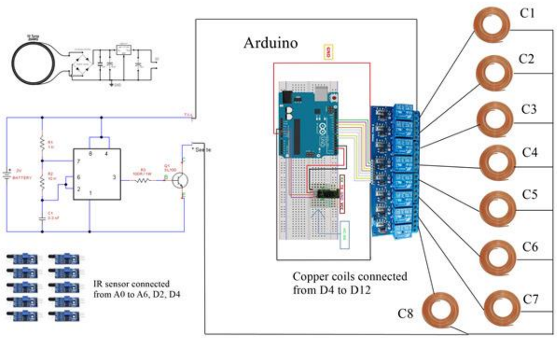


block diagram

3.3 Working Principle

1. The system continuously monitors current through sensors.
2. Arduino processes sensor data and dynamically adjusts the charging rate.
3. If abnormal voltage or current levels are detected, the relay disconnects the power supply to protect the system.
4. The LCD displays real-time voltage and current readings.
5. The buzzer is triggered to notify the user of any faults.



circuit diagram

IV. HARDWARE AND SOFTWARE DESIGN

4.1 Hardware Design

The hardware design consists of:

- **Power Supply Configuration:** Ensures a steady 5V/12V DC supply.
- **Sensor Connections:** Properly interfaced voltage and current sensors.
- **Relay Configuration:** Safely controls charging power.
- **Display and Alert System:** Provides real-time status updates and fault alerts.

4.2 Software Design

The software is developed using Arduino IDE and C++ language, with the following modules:

- **Initialization Module:** Configures pin modes and initializes components.
- **Sensor Reading Module:** Continuously reads data from voltage and current sensors.
- **Fault Detection Module:** Identifies abnormal conditions and triggers alerts.
- **Display Module:** Updates the LCD with real-time status.

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V. RESULTS AND DISCUSSION

5.1 Testing Procedure

The system was tested in various scenarios, including:

- Normal voltage and current levels.
- Overvoltage and undervoltage conditions.
- Short-circuit detection and system shutdown.
- Fault notification through the buzzer and visual indicators.

5.2 Test Results

The system demonstrated high accuracy in dynamically adjusting the charging rate and protecting the battery. Fault conditions were effectively detected and communicated through the buzzer and LED display.

VI. ADVANTAGES AND LIMITATIONS

6.1 Advantages

- Real-time fault detection and automatic shutdown.
- Enhanced battery longevity through optimized charging.
- Cost-effective and easy to implement.
- Scalable for integration with IoT platforms.

6.2 Limitations

- Limited to low-power charging scenarios.
- Lack of wireless control in the current implementation.
- Requires additional components for IoT integration

VII. APPLICATIONS

1. **Residential EV Charging:** Safe and efficient home charging.
2. **Commercial Charging Stations:** Optimized power management for public charging.
3. **Industrial Fleet Management:** Ensures continuous operation of EV fleets.
4. **Smart Grid Integration:** Load balancing in smart grids.
5. **Research and Education:** Testbed for smart EV charging algorithms.

VIII. CONCLUSION AND FUTURE SCOPE

8.1 Conclusion

The **Dynamic EV Charging System Using Arduino** successfully addressed the challenges of traditional charging systems by implementing real-time monitoring and fault detection. The system dynamically adjusted the charging rate, preventing overcharging and ensuring safe operation.

8.2 Future Scope

- **IoT Integration:** Enable remote monitoring and control.
- **AI-based Fault Prediction:** Implement predictive algorithms for better safety.
- **Renewable Energy Integration:** Use solar or wind energy for sustainable charging.
- **Wireless Charging Support:** Develop contactless charging options for future applications.

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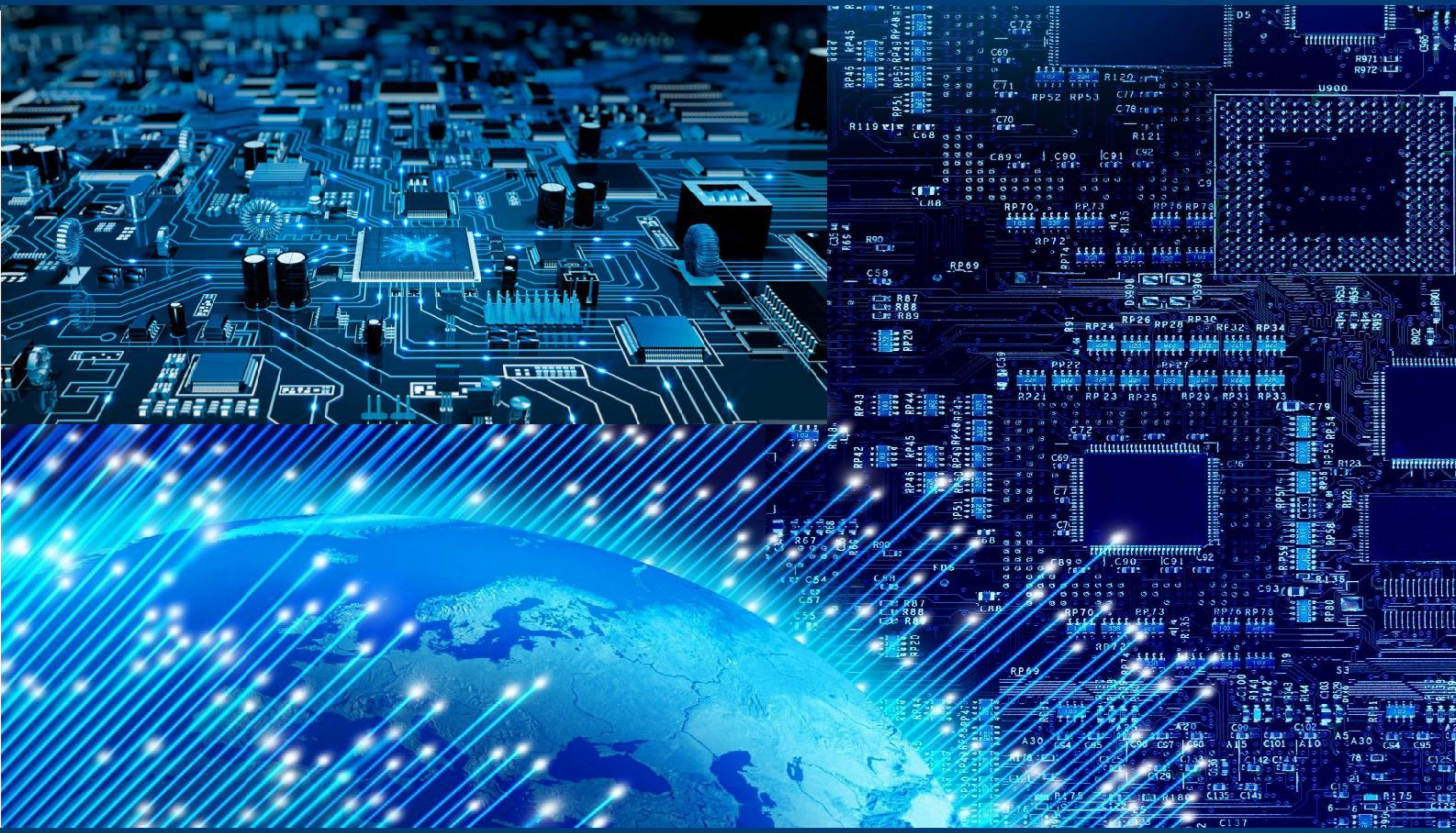

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