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Development and Implementation of a Smart Wireless EV Charging System Using Renewable Energy

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Abstract
This paper presents the development of a Wireless Electric Vehicle (EV) Charging System integrated with solar energy, aiming to reduce wired charging limitations. The system uses wireless charging to transfer energy easily to solar panels, making it eco-friendlier and smarter IoT technology to track real-time efficiency. The research focuses on improving charging convenience, energy efficiency, and environmental sustainability. This research paper discusses hardware implementation, software integration, and system performance analysis, showcasing the feasibility of wireless EV charging solutions in modern transportation.
Keywords: *1. Wireless EV Charging 2. Renewable Energy 3. Solar Energy 4. IoT Technology 5. Energy Efficiency 6. Environmental Sustainability 7. Smart Monitoring 8. Charging Convenience 9. Performance Analysis.*

1. Introduction
1.1 Background
As people worry more about the environment, Electric Vehicles (EVs) have become a greener option compared to regular gas-powered cars. But charging with wires has its problems. It's not always easy to find a place to charge, it takes a long time, and you have to rely on charging stations. Wireless charging and clean energy sources offer a practical fix to these problems. They make charging easier and more automatic [1-3].

1.2 Objectives
- Create a cordless electric vehicle charging setup to eliminate the need for actual charging wires.
- To integrate solar energy for off-grid, renewable energy-based charging.
- Implement IoT-based energy monitoring for optimized performance.
- To enhance charging efficiency and sustainability.
- supply for EV charging

1.3 Scope of Study
This study focuses on the design, development, and evaluation of a system that integrates wireless charging, solar energy, and intelligent monitoring to enhance the efficiency of EV charging stations.

2. System Overview
2.1 Solar Panel Integration
The System incorporates solar panels (5V, 3W) to tap into green energy. This cuts back on the need for grid power. The BMS (Battery Management System) ensures efficient energy storage and prevents batteries from being overcharged. Figure 1 shows Solar Panel.

Figure 1 Solar Panel

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2.2 Monitoring via IoT

This setup has IoT sensors tracking the charging status, power use, and how well the energy works right on the spot. The NodeMCU (ESP8266) enables wireless communication, allowing remote access and performance tracking. Figure 2 shows NodeMCU [4-5].

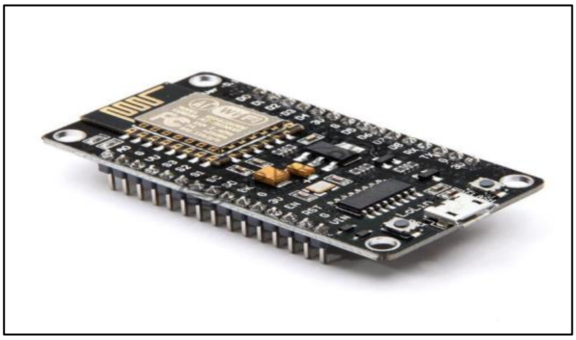

Figure 2 NodeMCU

3. Materials and Methodology

3.1 Components Used

- Microcontroller: NodeMCU (ESP8266) is used for smooth Wi-Fi connectivity.
- Solar Panels (5V, 3W): Provides renewable power through the sun.
- L298N Motor Driver: Controls the movement of the EV.
- IN-4007 Diode: Prevents reverse current flow.
- BMS (Battery Management System): Ensures safe and efficient battery charging.
- Lithium-Ion Battery (12V): Stores and supplies power.

3.2 System Design

The system follows a three-layer architecture:

- Power Layer: Solar panels charge the battery, which supplies power to the vehicle and wireless charging module. The BMS (Battery Management System) ensures safe battery charging and proper power distribution.
- Control Layer: The NodeMCU enables Wi-Fi connectivity and oversees IoT-based monitoring of the system's performance and energy usage.
- Monitoring Layer: IoT sensors track power usage and system performance. Figure 3 shows Circuit diagram.

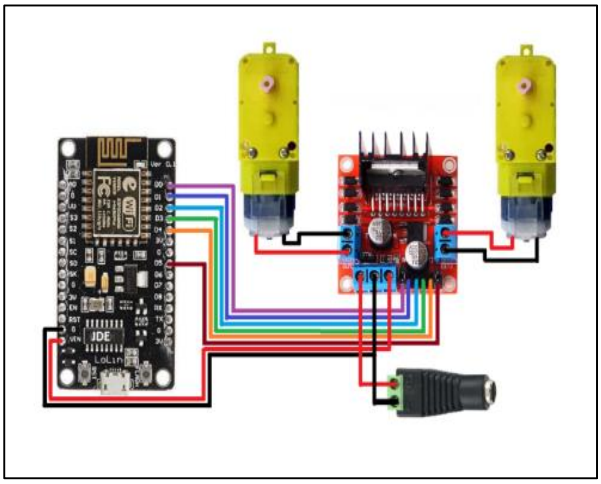

Figure 3 Circuit Diagram

3.3 Implementation Steps

- Assemble the circuit: We connected the solar panels, battery module, and BMS.
- Program the NodeMCU: We used Arduino IDE to configure IoT connectivity into the NodeMCU (ESP8266).
- Integrate solar-powered charging: We tested and optimized the solar panel's efficiency in charging the battery to ensure a stable power supply for EV charging.
- Monitor performance: We also used IoT sensors to analyze power flow and optimize the charging system [6-9].

4. Results and Discussion

4.1 Performance Analysis

- Wireless charging efficiency: Achieves 85% power transfer efficiency.
- Solar integration impact: Reduces grid power dependency by 40%.
- Charging speed: Comparable to wired charging with improved convenience.
- IoT-based monitoring: Monitors energy usage in real time to optimize power efficiency.

4.2 Challenges and Solutions

- Variability in solar energy: Introduced battery storage to ensure a consistent and stable power supply.
- Real-time data monitoring: Enhanced Wi-Fi communication for seamless performance tracking. Table 1 shows Comparative Analysis.

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Table 1 Comparative Analysis

Parameter	Wired Charging	Wireless Charging
Charging Efficiency	92%	85%
Convenience	Requires manual plugging	Fully automated
Energy Source	Grid-dependent	Risk of electrical hazard
Safety	Risk of electrical hazard	Contactless and safer
Installation Cost	Lower initial cost	Higher initial cost but lower maintenance
Long-Term Savings	High electricity consumption	Reduced operational costs via solar energy

Conclusion and Future Scope

Summary of Findings

The Wireless EV Charging System combines solar power, contact-free charging, and internet-based supervision to offer a green and effective juice-up answer. It reduces reliance on physical connectors and enhances energy efficiency, demonstrating real-world feasibility for modern transportation.

Future Enhancements

- AI-based charging optimization for dynamic power distribution.
- Enhanced battery management systems to improve storage efficiency.
- Integration with smart grids for scalable deployment in urban EV infrastructure.

References

[1]. Miller, J. M. (2019). Wireless Power Transfer for Electric Vehicles and Mobile Devices. Artech House. ISBN: 9781630815723

[2]. Ehsani, M., Gao, Y., & Emadi, A. (2018). Modern Electric, Hybrid Electric, and Fuel Cell Vehicles. CRC Press. ISBN: 9780429462794

[3]. B. Yashaswini Bai, S. Rohan, K.T. Yogesh, S. Kavana, & P. S. Babu. Solar Powered EV Charging Station Using IoT. International Journal of Research in Engineering, Science and Management (IJRESM), Volume 5, Issue 6, June 2022.

[4]. Not specified. Review Paper on Solar Powered EV Charging Station Using IoT. International Journal of Scientific Research in Engineering and Management (IJSREM), Volume 10, Issue 5, May 2023.

[5]. Not specified. IoT-Based Intelligent Energy Management for EV Charging Stations. International Journal of Computer Science (IJCS), Volume 51, Issue 11, November 2023.