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Wireless Battery Charging For Electrical Vehicles

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Abstract:

This project presents the design and implementation of a Solar Wireless Electric Vehicle Charging System (SWEVCS) that enables uninterrupted electric vehicle (EV) charging through the integration of Arduino-based control systems, motor drivers, wireless power transfer coils, and renewable energy sources. The system comprises two fundamental components: a transmitting side and a receiving side. At the transmitting side, wireless power transmitting coils are coupled with solar panels and a backup battery. These components harness solar energy to generate and transmit power wirelessly to the EV. The receiving side of the SWEVCS is integrated into the electric vehicle and consists of Arduino microcontrollers interfaced with motor drivers, two electric motors, and an EV battery. Key to the system's operation is the implementation of mutual induction principles, which allow for efficient wireless power transfer from the transmitting side to the receiving side. The wireless power transfer coils, carefully positioned to maximize coupling efficiency, facilitate the transfer of electrical energy to the EV without the need for physical connectors.

This innovative system offers several advantages. First, it harnesses renewable energy from solar panels, reducing the reliance on grid electricity and contributing to a cleaner and more sustainable transportation ecosystem. Second, the wireless power transfer technology eliminates the hassle of traditional EV charging cables and connectors, making the charging process more convenient and user-friendly. Moreover, by incorporating a backup battery on the transmitting side, the SWEVCS ensures uninterrupted charging even during periods of low solar energy production.

Keywords **—**Arduino, IR Sensor, Embedded C, Solar Panel, Arduino IDE.

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I. INTRODUCTION

The rapid advancement of wireless power transfer (WPT) technology, particularly magnetic resonance, has emerged as a transformative solution, freeing individuals from the limitations of traditional wired charging systems. Building upon the foundational principles of inductive power transfer developed over the past three decades, WPT has made significant strides, achieving efficiencies exceeding 90% at kilowatt power levels. Notably, the transfer distance has expanded from mere millimetres to several hundred millimetres, making WPT increasingly attractive for various applications. This project conducts a comprehensive review of WPT technologies applicable to electric vehicle (EV) wireless charging, covering both stationary and dynamic scenarios. By integrating WPT into EVs, this research aims to address critical challenges related to charging time, range, and cost, reducing the significance of conventional battery technology in the widespread adoption of EVs. This introduction lays the groundwork for exploring the latest achievements in WPT and encourages researchers to drive further developments, fostering the concurrent growth of WPT and the broader electric vehicle landscape. Key terms include dynamic charging, inductive power transfer (IPT), safety guidelines, stationary charging, and wireless power transfer (WPT).

II. LITERATURE SURVEY

Chirag Panchal, Sascha Stegen, and Junwei Lu [1] present their research in "Static and Dynamic Wireless Electric Vehicle Charging System," which thoroughly explores both static and dynamic wireless EV charging. The analysis examines technical principles, architectures, efficiency, safety, and regulatory aspects through a systematic literature review. It identifies advancements in coil design and efficiency optimization, as well as challenges like alignment tolerance. Comparing static and dynamic systems, it evaluates factors such as power transfer efficiency and infrastructure complexity. Future directions include advancements in coil design, bidirectional power transfer, and integration with smart grids. The paper emphasizes the necessity for continued research to maximize the potential of wireless EV charging for sustainable transportation.

"An Analysis of Wireless Electric Vehicle Charging Systems [2] Static and Dynamic Perspectives," presents a detailed examination of both static and dynamic wireless electric vehicle (EV) charging systems. Authored by Sankalp Bhatnagar, Shubham Parihar, Rohan Nathiya, and Nikhil Mundra, the study delves into the technical intricacies of these charging systems, assessing their efficiency, performance, and practical applicability. Utilizing a blend of theoretical analysis and experimental validation, the paper provides insights into the operational characteristics and potential challenges associated with static and dynamic wireless EV charging. Key aspects including power transfer efficiency, alignment tolerance, and system robustness are thoroughly assessed to offer a comprehensive understanding of the charging process. These findings contribute significantly to the advancement of wireless EV charging technology and its potential impact on the future of sustainable transportation.

Partha Sarathi Subudhi and Krithiga S [3] present "Wireless Power Transfer Topologies used for Static and Dynamic Charging of EV Battery," a comprehensive study conducted at Visvesvaraya Institute of Technology, Bengaluru, India. This paper investigates wireless power transfer (WPT) topologies suitable for both static and dynamic charging of electric vehicle (EV) batteries, focusing on inductive coupling, resonant coupling, and capacitive coupling. By reviewing existing literature extensively, the authors assess the efficiency, reliability, and practicality of these WPT topologies in real-world EV charging scenarios. The findings significantly contribute to the advancement of wireless charging technology, laying the groundwork for future convenient and sustainable EV charging solutions.

Mr. Phanindar Ravi Parimi [4] presents "Dynamic Wireless Power Transfer Charging Infrastructure for Future EVs: From Experimental Track to Real Circulated Roads," a paper that explores the implementation of dynamic wireless power transfer (WPT) infrastructure for electric vehicles (EVs). The study discusses the transition from experimental track testing to real-world road demonstrations, evaluating the effectiveness and feasibility of dynamic WPT systems through experimental validations and field trials. The findings contribute to the development of a robust and reliable wireless charging infrastructure, facilitating the widespread adoption of EVs and promoting sustainable transportation solutions.

F. M. Eltoumi, M. Becherif, A. Djerdir, and H. Ramadan [5] present "The key issues of electric vehicle charging via hybrid power sources: Techno-economic viability, analysis, and recommendations." Published in Renewable and Sustainable Energy Reviews in 2021, the analysis delves into electric vehicle (EV) charging incorporating hybrid power sources, examining its techno-economic feasibility. The paper investigates the viability of this charging approach through a thorough review, pinpointing challenges and opportunities linked with EV charging via hybrid power sources. Factors like cost-effectiveness, energy efficiency, and environmental impact are considered. Valuable recommendations for enhancing the integration of hybrid power sources into EV charging infrastructure are provided, furthering the progress of sustainable transportation solutions.

III. PROPOSED SYSTEM

The proposed system is designed to revolutionize vehicle control and charging mechanisms by seamlessly integrating Bluetooth connectivity with cutting-edge wireless power transfer technology. Utilizing Bluetooth technology, the system enables wireless communication between the vehicle and the user's mobile device or a dedicated remote control. This connectivity allows drivers to remotely control various vehicle functions such as ignition, air conditioning, and navigation systems. The convenience offered by Bluetooth allows for these functions to be activated from outside the vehicle, enhancing user experience by improving comfort and saving time.

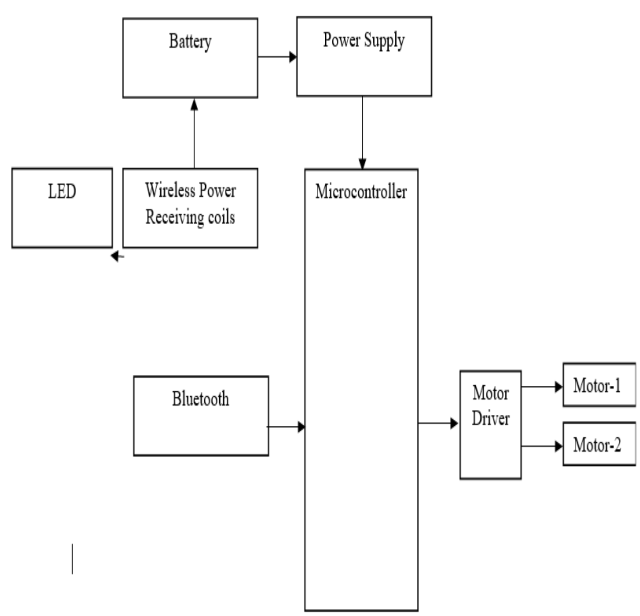
At the heart of this system lies the advanced wireless power transfer technology, which operates on the principle of resonant object coupling. This method allows for the efficient transmission of electrical power without the need for physical connectors, freeing the vehicle from the constraints of traditional wired charging systems. By leveraging resonant coupling, the system can transmit power over distances, reducing the need for manual charging and eliminating the limitations imposed by wires.

The integration of IR sensors significantly enhances the functionality and reliability of the system. By ensuring that power transfer is activated only when the vehicle is properly aligned within the charging zone, the system prevents unnecessary power wastage and contributes to the overall safety of the operation. Moreover, the system incorporates advanced encryption protocols to secure the communication between the vehicle and control devices. This protects against unauthorized access and ensures that only legitimate commands are processed.

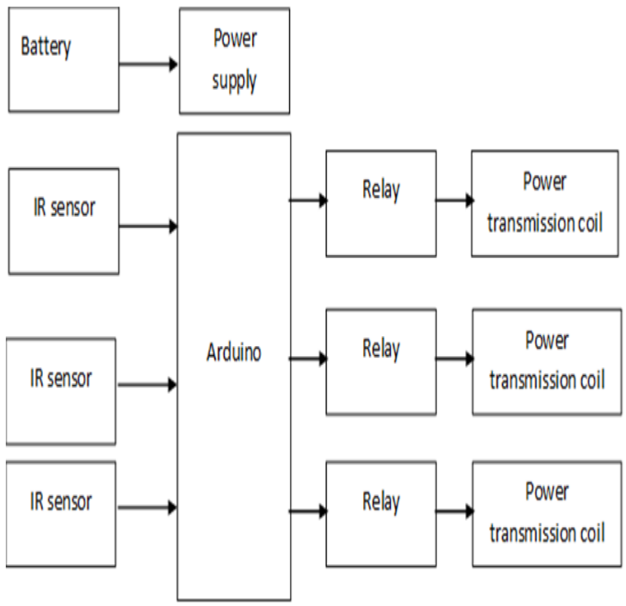
In conclusion, by combining Bluetooth vehicle control with wireless power transfer, the proposed system not only simplifies vehicle operation but also promotes efficiency, safety, and convenience. As the automotive industry progresses towards more autonomous and electrically powered vehicles, such integrated technologies are set to pave the way for smarter, more efficient vehicle systems. This system represents a significant step forward in making vehicle use and maintenance more user-friendly and environmentally sustainable.

BLOCK DIAGRAM:

Block Diagram (Electric Vehicle):



Block Diagram (Charging Station):



IV. HARDWAREDESCRIPTION

Arduino: An open-source microcontroller-based platform that is widely used for developing interactive projects. It provides an accessible way to program a variety of electronic components and has a vast community and libraries which support a wide range of sensors and devices.

Motor Driver: This device is essential when controlling motors from microcontrollers. It helps to amplify the control signals, providing the necessary power for motor operation. Motor drivers are capable of driving motors in both forward and reverse directions with variable speed control.

DC Motor: Converts direct current electrical energy into mechanical energy. It is commonly employed in projects requiring rotational motion such as robotics and small electric vehicles. DC motors are favored for their straightforward design and effective speed regulation capabilities.

Battery: Serves as a mobile power source by storing energy in chemical form and converting it back to electrical form when needed. Batteries vary widely in type, size, and capacity, ranging from small cells used in portable devices to large battery banks used for electric vehicle power or grid energy storage.

Bluetooth Module: Facilitates wireless communication between devices over short distances using radio waves. It is particularly popular in consumer electronics for creating connections between smartphones, computers, and peripherals without the need for wires.

Solar Panel: Utilizes photovoltaic cells to convert solar radiation into electricity, providing a sustainable and renewable source of energy. Solar panels are crucial for off-grid power supplies and as supplemental energy sources in residential and commercial applications to reduce dependence on fossil fuels.

Thin Film: Refers to layers of materials deposited in very thin sheets on substrates. These are used in a variety of applications including, but not limited to, solar cells, flexible displays, and advanced optics. Thin film technology is crucial for the development of electronic and energy-producing devices.

Power Supply: Converts mains AC (alternating current) to low-voltage regulated DC (direct current) power. Essential for providing stable and controlled supply of electricity to electronic devices, ensuring safety and efficiency in both industrial and consumer applications.

V.SOFTWARE DESCRIPTION

Arduino IDE:

The Arduino Integrated Development Environment (IDE) is the primary software used for designing and programming projects on Arduino boards. It is a cross-platform application, available for Windows, macOS, and Linux operating systems, which provides an accessible, user-friendly interface for coding, compiling, and uploading programs to Arduino hardware. The IDE supports the C and C++ programming languages using special rules of code structuring. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, which help to streamline the coding process. Additionally, it comes with a rich set of built-in libraries and examples that make it easier for beginners to start various types of projects. The Arduino IDE connects to the Arduino and compatible boards through USB, where it uploads sketches to the microcontroller. These capabilities make it an essential tool for hobbyists, educators, and engineers developing interactive hardware projects.

EMBEDDED C:

Embedded C is a variant of the C programming language tailored for programming microcontrollers and other embedded systems. It enables direct interaction with hardware through its support for low-level access to memory and processor-specific instructions. Embedded C is crucial for developing software that operates efficiently on devices where resources like memory and processing power are limited. It provides a blend of high-level functionality and the capability for fine-grained control of system behaviour, making it a fundamental tool in areas such as automotive electronics, consumer electronics, and industrial automation.

VI. RESULTS:

Figure: Wireless battery charging

Figure: Controlling of Vehicle

For wireless battery charging in electric vehicles, the results demonstrate successful energy transfer without physical connections, leading to streamlined operations and significantly reduced charging times. This method notably enhances convenience and safety by minimizing the handling of charging cables and plugs. Additionally, controlling the vehicle through wireless technology has shown increased precision and reliability in command execution. This integration effectively improves the overall user experience, promoting safer driving conditions and operational efficiency.

VII. CONCLUSION

To wrap up, the advancements in wireless power transfer (WPT) technology, especially through magnetic resonance, mark a significant milestone with broad implications. The progress in WPT, characterized by enhanced efficiency and extended transfer distances, offers substantial potential for revolutionizing electric vehicle (EV) charging. By addressing challenges such as charging duration, range limitations, and associated costs, WPT emerges as a transformative solution reshaping the landscape of EV adoption. This exploration not only highlights the current state-of-the-art achievements in WPT relevant to EVs but also ignites momentum for future innovations. As WPT continues to permeate various sectors such as consumer electronics, medical devices, and industrial automation, its convenience, efficiency, and sustainability herald a wireless future that transcends traditional power delivery paradigms.

VIII. FUTURE SCOPE

The future scope of wireless battery charging for electric vehicles (EVs) focuses on several key areas:

1.**Convenience and Flexibility:** Wireless charging eliminates the need for cables, integrating into everyday environments like parking spaces and roads to simplify the charging process and boost EV adoption.

2.**Enhanced Range and Continuous Charging:** Technologies that enable EVs to charge while driving could extend vehicle range and reduce the need for frequent stops, paving the way for more practical long-distance EV travel.

3. **Integration with Smart Infrastructure:** Linking wireless charging with smart grids and IoT systems can optimize charging strategies based on real-time data, enhancing energy efficiency and grid stability.

XI.REFERENCES

1. C. Cheng, F. Lu, Z. Zhou, W. Li, C. Zhu, H. Zhang, Z. Deng, X. Chen, C. C. Mi, Load-independent wireless power transfer system for multiple loads over a long distance, IEEE Transactions on PowerElectronics34(9) (2019)9279–9288. doi:10.1109/TPEL.2018.2886329.

2. J. Qu, L. He, N. Tang, C. K. Lee, Wireless power transfer using domino-resonator for 110-kv power grid online monitoring equipment, IEEE Transactions on Power Electronics 35 (11) (2020) 11380–11390. doi:10.1109/TPEL.2020.2989757.

3. L. Blain, Nz to trial world-first commercial long-range, wireless power transmission, New Atlas (Aug 2020).

4. M. Zucca, P. Squillari, U. Pogliano, A measurement system for the characterization of wireless charging stations for electric vehicles, IEEE Transactions on Instrumentation and Measurement 70 (2021)1–10. doi:10.1109/TIM.2020.3046908.

5. Triviño, J. M. González-González, J. A. Aguado, Wireless power transfer technologies applied to electric vehicles: A review, Energies 14 (6) (2021). doi:10.3390/en14061547.

6. R. González Ayestarán, G. León, M. R. Pino, P. Nepa, Wireless power transfer through simultaneous near-field focusing and far-field synthesis, IEEE Transactions on Antennas and Propagation 67 (8) (2019) 5623–5633. doi:10.1109/TAP.2019.2916677.

7. C.-H. Lin, M. Amir, M. Tariq, M. Shahvez, B. Alamri, A. Alahmadi, M. Siddiqui, A. R. Beig, Comprehensive analysis of IPT v/s CPT for wireless EV charging and effect of capacitor plate shape and foreign particle on CPT, Processes 9 (9) (2021). doi:10.3390/pr9091619.

8. L. Zhang, Y. Yang, Z. Jiang, Q. Chen, Q. Yan, Z. Wu, B. Zhang, J. Huangfu, H. Chen, Demonstration of topological wireless power transfer, Science Bulletin (2021).

9. M. A. Yousuf, T. K. Das, M. E. Khallil, N. A. A. Aziz, M. J. Rana, S. Hossain, Comparison study of inductive coupling and magnetic resonant coupling method for wireless power transmission of electric vehicles, in: 2021 2nd International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), IEEE, 2021, pp. 737–741.

10. Q.Wang, W. Che, M. Dionigi, F. Mastri, M. Mongiardo, G. Monti,Gains maximization via impedance matching networks for wireless power transfer, Progress In Electromagnetics Research 164 (2019)135–153.