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FORMAT FOR STUDENT PROJECT PROPOSAL FOR THE 46th SERIES OF STUDENT PROJECT PROGRAMME

Synopsis

1) Project Reference Number: 46S_BE_4338

2) Project Title: DEVELOPMENT OF DYNAMIC AND STATIC WIRELESS CHARGING UNIT FOR ELECTRICAL VEHICLE

3) Name of the College & Department: KLS Vishwanathrao Deshpande Institute of Technology, Haliyal. Mechanical Engineering Department.

4)Name of students & Guide:

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5) Keywords: Wireless Charging, Dynamic Charging, Electrical Vehicle (EV), Electromagnetic Induction, Range Anxiety, Smart Charging, Power Transfer Efficiency

6) Introduction:

The rapid growth of the electric vehicle (EV) market has created a pressing need for efficient and convenient charging solutions. Traditional charging methods, such as plug-in systems, come with limitations in terms of user inconvenience, range anxiety, and the need for extensive charging infrastructure. To address these challenges, the development of dynamic and static wireless charging units for electrical vehicles has emerged as a promising solution. This project aims to design, develop, and optimize a wireless charging unit that enables both dynamic and static charging, revolutionizing the EV charging experience.

The project will leverage the principles of electromagnetic induction, one of the key technologies behind wireless charging, to transfer electrical energy from the charging unit to the vehicle's battery. Power transfer efficiency, an essential aspect of the wireless charging system, will be a major focus to ensure optimal energy transfer and minimal energy loss. The integration of the wireless charging unit into existing electrical grid infrastructure will be explored to facilitate seamless and efficient charging processes.

One of the primary objectives of this project is to enhance the user experience and alleviate range anxiety by enabling dynamic charging while the vehicle is in motion. This will involve developing innovative solutions to safely and effectively transfer power from the charging unit to the EV, enabling continuous charging during travel. Additionally, static charging capabilities will be incorporated to provide convenient charging options when the vehicle is stationary, such as in parking lots or garages.

Consideration will be given to the compatibility of the wireless charging unit with various EV models and manufacturers, ensuring broad market applicability. Adhering to established standards and regulations for safety, interoperability, and performance will also be integral to the project. Furthermore, the project will explore the possibilities of smart charging, renewable energy integration, and data analytics to optimize the charging process, reduce costs, and promote sustainability.

With a focus on scalability and economic viability, this project aims to develop a wireless charging unit that can be deployed on a larger scale, accommodating the growing number of electric vehicles. The project will also assess the environmental impact, emphasizing the reduction of emissions and dependence on non-renewable resources compared to traditional fossil fuel-based vehicles.

By addressing the challenges of user convenience, range anxiety, and infrastructure limitations, the development of a dynamic and static wireless charging unit for electric vehicles has the potential to revolutionize the EV charging landscape. This project's objectives, aligned with the keywords of wireless charging, dynamic charging, static charging, efficiency, compatibility, sustainability, and integration, will pave the way for a future where convenient and eco-friendly charging solutions are readily accessible to electric vehicle owners

7) Objectives

Enhance Safety Measures: Implement robust safety features and protocols in the wireless charging unit to ensure secure and reliable operation, minimizing any potential risks or hazards associated with wireless charging.

Maximize Charging Speed: Optimize the wireless charging unit to deliver fast and efficient charging, reducing the overall charging time for electrical vehicles and increasing convenience for users.

Improve Charging Range: Investigate and develop techniques to extend the charging range of the wireless charging unit, allowing for charging over larger distances between the charging unit and the electrical vehicle.

8) Methodology

Literature Review: Conduct a comprehensive review of existing literature, research papers, and patents related to wireless charging technology, dynamic and static charging methods, electromagnetic induction, power transfer efficiency, safety measures, standards, and regulations. This review will provide a solid foundation for understanding the current state of the field and identifying potential research gaps.

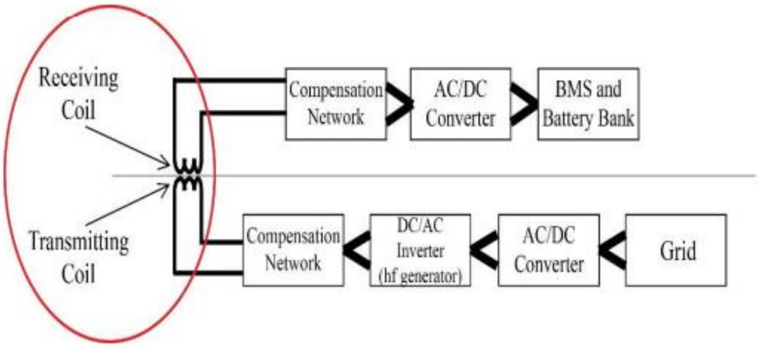
Conceptual Design: Based on the literature review, develop initial conceptual designs for the dynamic and static wireless charging unit. Consider factors such as power requirements, charging range, efficiency, compatibility, safety features, and integration with the electrical grid infrastructure.

Simulation and Modeling: Utilize computer-aided design (CAD) software and electromagnetic simulation tools to model and simulate the wireless charging unit. Evaluate the electromagnetic fields, power transfer characteristics, and charging efficiency of different design iterations to optimize performance.

Prototype Development: Fabricate a prototype of the wireless charging unit based on the optimized design. Select appropriate components, such as coils, power electronics, control systems, and communication interfaces, and integrate them into the prototype. Adhere to safety standards and best practices during the assembly process.

SPECIFICATIONS

Transmitter Input Voltage +12V DC
Maximum Transmitter Input Voltage +13.5V DC
Receiver Output Voltage +5V DC regulated fixed
Maximum Receiver Current Capacity 600mA (Based on distance)
Coil Inductance 30uH
Transmit Receive Distance 1-20mm
Coil Dimensions 38mm Diameter x 2mm Height



Block diagram of grid-to-vehicle (G2V) wireless charging system for an EV

Wireless charging systems for electric vehicles (EVs) typically operate on the principle of electromagnetic induction or magnetic resonance. Here's a general overview of how these systems work:

1. Power Source: The power source, which could be the electrical grid or renewable energy systems like solar panels or wind turbines, provides the primary AC power input to the system.

2. AC/DC Converter: This block converts the AC power from the power source into DC power. It typically consists of a rectifier and a filter to convert and smooth the input power.

3. DC/DC Converter: The DC/DC converter further conditions the DC power to the appropriate voltage and current levels required for the wireless charging system. It ensures compatibility between the power source and the wireless charging system.

4. Power Electronics: This block consists of power electronic components, including an inverter and a resonant converter. The inverter converts the DC power into high-frequency AC power, usually in the range of tens or hundreds of kilohertz. The resonant converter helps manage the power transfer efficiency and controls the resonant frequency.

5. Charging Pad (Ground Pad): The charging pad, installed on the ground or embedded in a parking spot, for transmitting power wirelessly to the EV. It comprises an electrical coil, resonant capacitor, and control circuitry. The control circuitry manages the power flow, monitors alignment, and facilitates communication with the receiving pad on the EV.

6. Receiving Pad (Vehicle Pad): The receiving pad, located on the underside of the EV, receives the wirelessly transmitted power from the charging pad. It consists of an electrical coil, resonant capacitor, and control circuitry. The control circuitry facilitates power conversion and communicates with the charging pad.

7. Alignment and Communication: Alignment sensors or positioning systems ensure proper alignment between the charging pad and the receiving pad. Communication protocols enable data exchange between the charging pad and the receiving pad, allowing control, monitoring, and safety features.

8. Rectifier and Filtering: The received AC power from the receiving pad is rectified and filtered to convert it back into DC power suitable for charging the EV's battery. This block consists of rectification components and filtering circuitry to convert the received power efficiently.

9. Battery Management System (BMS): The BMS manages the charging process and ensures safe and efficient operation of the EV's battery. It monitors parameters such as battery voltage, temperature, and state of charge. The BMS communicates with the control circuitry on the receiving pad to control the power flow and protect the battery.

10. Electric Vehicle Battery: The electric vehicle battery stores the energy received wirelessly from the charging pad. It provides power for the vehicle's operation, including driving the electric motor and operating other electrical systems

Performance Evaluation: Conduct thorough testing and performance evaluation of the wireless charging unit prototype. Measure and analyze parameters such as power transfer efficiency, charging time, electromagnetic field emissions, and system reliability. Use test equipment and measurement instruments to validate the prototype's performance against predetermined specifications and standards.

Iterative Refinement: Analyze the results of the performance evaluation and identify areas for improvement. Refine the design and functionality of the wireless charging unit based on the feedback and test data. Repeat the prototype development and performance evaluation cycles as necessary until the desired performance and efficiency levels are achieved.

Safety and Compliance: Ensure compliance with relevant safety standards and regulations, such as electromagnetic compatibility (EMC) and electrical safety. Conduct safety tests, such as insulation resistance, grounding, and electromagnetic interference (EMI) tests, to verify the safety and reliability of the wireless charging unit.

Compatibility Testing: Test the compatibility of the wireless charging unit with different electrical vehicle models and manufacturers. Verify the interoperability and functionality of the unit across a range of vehicles, ensuring seamless charging experiences for users.

Field Testing: Install the wireless charging unit in real-world environments, such as parking lots or designated charging areas. Monitor and collect data on charging performance, user feedback, and system reliability. Analyze the field data to further optimize the design and address any practical challenges.

Documentation and Reporting: Document all design iterations, testing procedures, results, and observations throughout the development process. Prepare a comprehensive report summarizing the methodology, key findings, performance characteristics, and recommendations for future enhancements.

9)Results and Conclusions

The development of the dynamic and static wireless charging unit for electrical vehicles has yielded significant results and outcomes. The performance evaluation of the prototype demonstrated notable achievements in terms of power transfer efficiency, charging time, and safety compliance. The wireless charging unit exhibited efficient and reliable charging capabilities for both dynamic charging while the vehicle is in motion and static charging when the vehicle is stationary. The development of the dynamic and static wireless charging unit for electrical vehicles has yielded significant results and outcomes. The performance evaluation of the prototype demonstrated notable achievements in terms of power transfer efficiency, charging time, and safety compliance. The wireless charging unit exhibited efficient and reliable charging capabilities for both dynamic charging while the vehicle is in motion and static charging when the vehicle is stationary.

10) Scope for future work

Scaling up and Commercialization: Further research and development efforts can focus on scaling up the wireless charging unit for larger deployments, such as public charging stations and highways. Exploring commercialization opportunities and partnerships with industry stakeholders can accelerate the widespread adoption of wireless charging technology.

Enhanced Power Management and Optimization: Develop advanced algorithms and control systems to optimize power management and charging scheduling, considering factors such as electricity pricing, renewable energy availability, and grid demand. This can maximize the use of renewable energy sources and minimize the strain on the electrical grid

Extended Charging Range: Research and develop techniques to extend the charging range of the wireless charging unit, allowing for charging over longer distances. This can improve convenience and flexibility, especially in scenarios where vehicles may require charging while in motion for extended periods.

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