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Review on Dynamic Wireless Charging of Electric Vehicle

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ABSTRACT:

This paper presents a With electric vehicles, smaller batteries, longer driving ranges, and more extended operation, dynamic charging is a possible alternative. Identifying cars and maximizing power transmission are essential for success. This article presents a technique that makes use of current technologies to accurately identify cars and regulate charging intervals for effective power delivery. Additionally, a lab-based method for rapid testing is shown. These methods don't require additional hardware or sophisticated communication, and they have been shown to be successful in simulations and real-world testing.

Keywords: Electric vehicles, Power transmission, Vehicle identification, Lab-based testing

INTRODUCTION:

A grid-connected charging device placed on or integrated into the vehicle path allows for the wireless (inductive) recharging of an energy storage unit while the vehicle is in motion. This technique is known as dynamic (in-motion) charging. Without a doubt, the most common usage of these systems is the dynamic charging of electric vehicles (EVs), which includes trucks, buses, and passenger cars. This technology has the potential to be "game-changing." The worldwide need to lower greenhouse gas emissions and rely less on fossil fuels has led to a notable acceleration of the electrification of transportation in recent years. Dynamic wireless charging, a ground-breaking technology that offers a fresh method of charging medium-power and fast electric vehicles (EVs) while they are in motion, appears as part of this revolutionary change. Dynamic wireless charging solutions, in contrast to traditional stationary charging techniques, provide the possibility to EVs can be effortlessly recharged while traveling, which helps to overcome some of the drawbacks of conventional charging infrastructure. The recurring use of the same travel route by one or more vehicles is a prerequisite for the viability of dynamic charging, as it enables ongoing use of the same charging infrastructure. With dynamic charging, driving range restrictions are removed, onboard battery size can be lowered by up to 75%, and charging convenience and safety are increased.

METHODOLOGY:

A novel approach to evaluating the long-term viability and possible effects of a dynamic wireless power transfer (DWPT) highway on the electrical grid is presented in this research. The method requires multiple steps, beginning with the application of a Monte Carlo method to convert historical traffic flow (HTF) data into electric vehicle traffic flow (EV-TF) data. This conversion is an essential step in modifying current traffic patterns to meet the unique needs of traffic involving electric vehicles (EVs).

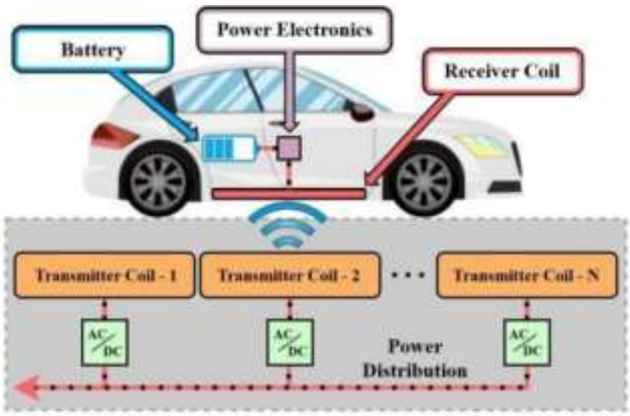

Figure 1.1: DWPT roadway power infrastructure.

The authors perform a thorough DWPT simulation for a 1-mile and a 10-mile roadway in order to assess the effects of EV traffic on the power distribution grid. The simulations consider different densities of EVs traveling across the road, and the IEEE 33-Bus power distribution system is used to examine if the DWPT roadway—which for the seamless integration of DWC into existing infrastructures.

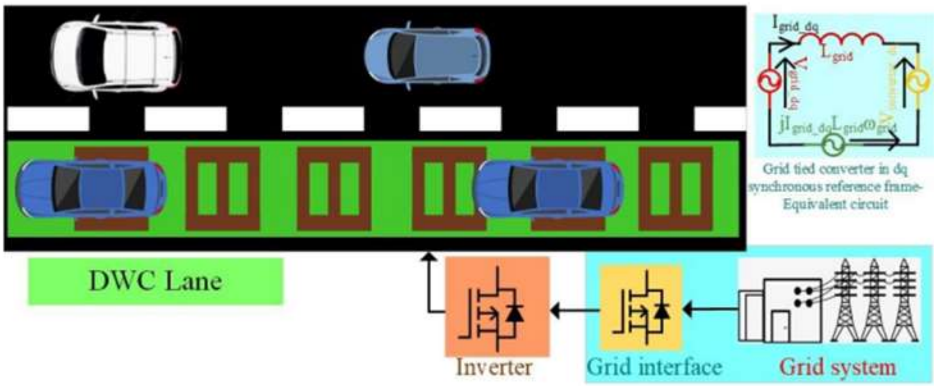

Figure 1.2: Grid-tied DWC System

The paper's authors present a thorough method for assessing and simulating the dynamic wireless charging system for electric cars (D-WCSEV). Building on earlier work cited in references [20] and [56], they create a mathematical model for the D-WCSEV dynamic model. Fig. 12 clarifies the charging coupler design considerations and the operating frequency selection, with further information derived from sources [65] and [66]. Especially, the authors amalgamate the primary and secondary coils form an innovative impedance, Zr, as shown graphically in Fig. 12. Equations (16) through (21) explain how important parameters that are necessary to determine the system's efficiency are derived, and this provides a solid basis for the efficiency analysis that follows..

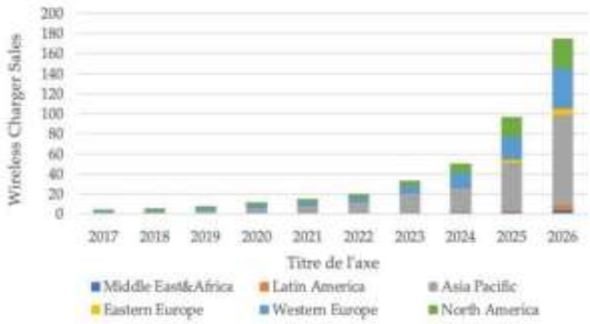

Fig 1.2: Classification of the wireless charger number by region for 2017-2026.2.

Within the framework of the Parallel Inverter and Parallel Buck Converter (PIPBC) scheme, the study presents a systematic methodology centered on the design and implementation of a Double-Sided LCC (Lumped Capacitance and Coil) Topology for Dynamic Wireless Power Transfer (DWPT). This novel method highlights the need of optimizing the dynamic wireless power transfer system by integrating the parallel operation of an inverter and buck converter with a double-sided LCC architecture. The parallel arrangement improves the effectiveness and versatility of the system, providing a viable path for efficient dynamic wireless power transmission, particularly for applications requiring on-the-go power replenishment, such as charging electric vehicles.

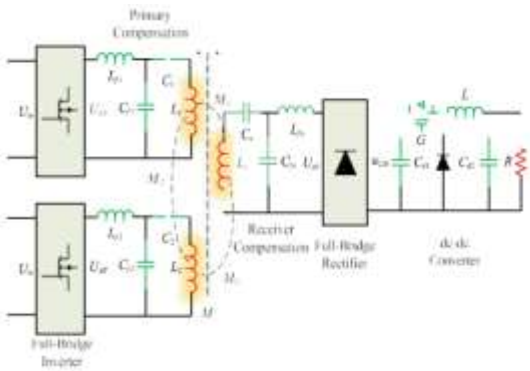

Figure 1.3: Topology of DWPT system

The report presents clear experimental data to support the feasibility and effectiveness of the planned DWPT system under the PIPBC scheme. A 2.2-kW DWPT system's practical implementation is described, and experiments are carried out using scenarios involving both resistor and battery loads. These tests show that the system can effectively transfer power wirelessly in practical settings, which is a crucial confirmation of the suggested methodology. The addition of battery load testing and resistor tests under scores the versatility of the DWPT system, highlighting its potential to solve real-world problems in dynamic wireless power transfer applications and demonstrating its applicability to a variety of scenarios.

An extensive investigation of the state of technology for electric vehicle (EV) charging is reflected in the detailed analysis of the state-of-the-art traction battery technologies, conductive and inductive charging procedures, and significant factors unique to dynamic charging states. The study explores significant developments in wireless power transfer (WPT) charging systems and highlights important contributions to the field's body of research. By compiling the specifications for the driver and vehicle's dynamic wireless power transfer (DWPT) systemThe paper discusses the many factors that must be taken into account for the effective implementation of this technology in the infrastructure interaction environment,, and. Furthermore, the debate over international rules and standards pertaining to EVs emphasizes the necessity of standardization by offering a framework to ensconsistency, safety, and interoperability across diverse DWPT implementations.

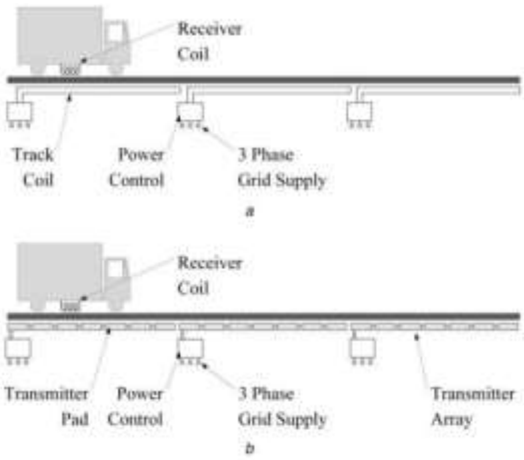

Figure 3.6: Two forms of WPT

(a) OLEV, (b) RIPT

The report deliberately refocuses on deployment situations and areas where DWPT technology adoption could be implemented successfully. Standardization of system architectures and interoperability become crucial when the implementation gap is seen as a major problem instead of a technology constraint. This acknowledgment supports the industry's overarching objective of creating a uniform DWPT methodology, encouraging broad adoption and integration into diverse transportation infrastructures. A more nuanced perspective is added to the conversation by acknowledging outside variables like charging habits, population growth, technological capabilities, energy and power availability, attitudes toward energy usage, and market systems. These variables show the complex interactions between socioeconomic and aspects of technology that affect how feasible home charging options are. Through careful examination of these many factors, the study makes a valuable contribution to the strategic planning and deployment of dynamic wireless charging solutions in the rapidly changing field of electric mobility.

RESULTS:

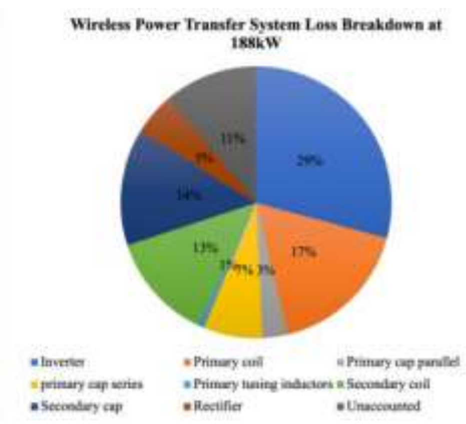

Fig 1.4: Loss breakdown of the WPT systemat 186 kW.

This study presents an in-depth analysis of the design details of dynamic wireless charging (WPT) systems for electric vehicles (EVs), with a particular emphasis on power inverter topologies, compensation networks, and charging couplers, among other important WPT factors. It adopts a methodical approach, providing readers with a detailed procedural guide to help them comprehend the intricacies involved in designing a dynamic charging system. The paper discusses the difficulties and factors that are specific to grid-tied and renewable-integrated dynamic charging systems, which demonstrate the growing significance of grid-connected and environmentally friendly mobility. The study highlights a practical grasp of real-world applications through incisive case examples, enhancing the conversation with complex parameters from developed systems that are currently in use. The primary focus of this article is to decipher relevant characteristics pertaining to grid-tied and PV-integrated dynamic wireless charging systems in light of the changing transportation scenario. The study clarifies the difficulties and offers a useful resource for scholars, engineers, and practitioners in the field by utilizing multiple case stories. The paper's last contribution is a concise flow chart that summarizes its findings. acting as a useful manual for the methodical design of dynamic charging systems. By doing this, it improves the paper's usefulness for individuals working on the development of dynamic wireless charging technology by combining the abundance of information offered throughout into an approachable tool. In-depth research on several wireless charging system topologies designed with electric vehicle (EV) applications in mind is done in this study. The arrangement of coil forms, mathematical models, and architectures relevant to both dynamic and static charging modes are carefully examined by the writers. The invention of a unique and adaptable mathematical model that exhibits great accuracy in both dynamic and static charging settings is one notable contribution. Experiments conducted on a genuine prototype demonstrate the effectiveness of the model and establish its trustworthiness with a small margin of error. The efficiency of the energetic yields is further examined in the article, which also offers formulas for figuring out the wireless charging system's total efficiency. Furthermore, it presents a modeling technique aimed at optimizing system parameters, emphasizing the well researched SS design in particular, demonstrating an all-encompassing strategy for improving performance. Looking ahead, the study emphasizes the arrival of wireless vehicle-to-grid (W-V2G) technology and investigates possible uses of wireless power transfer (WPT). This creative idea permits excess energy to be supplied to electric vehicles, tackling the energy difficulties of peak demand. The paper's significance in the larger context of developing efficient and sustainable electric vehicle technologies is highlighted by the focus on W-V2G technology. The study makes a significant contribution to the ongoing development of wireless charging systems by exploring cutting-edge applications and optimization methodologies. It highlights the potential of these systems to transform the electric car landscape and provide a forward-looking solution to energy concerns.

CONCLUSION:

Dynamic wireless charging, which offers a breakthrough in on-the-go energy replenishment for medium-power and speed EVs, has the potential to completely change the adoption landscape of electric vehicles (EVs). This invention, which departs from conventional fixed charging techniques, eliminates range restrictions and greatly improves convenience by enabling continuous recharging while cars are in motion. Especially useful for applications with recurring routes, dynamic charging allows smaller onboard batteries to be used. reducing their size by as much as 75% while also enhancing safety. Beyond traditional passenger automobiles, the technology's revolutionary reach includes buses, trucks, and potentially useful applications in automated guided vehicles, indoor robots, and personal mobility gadgets. These conditions, which are characterized by regular itineraries and recharging requirements, are perfect for implementing dynamic charging. The smooth assimilation of electric vehicles (EVs) into our everyday existence is becoming more apparent as interoperability is enhanced and reduced vehicle speeds demonstrate adequate energy transfer. This forward-thinking strategy suggests a time when electric cars will be able to adapt and maneuver in a variety of settings with ease, creating a more sustainable and cohesive transportation network.

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