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Wireless Power Transmission for Electric Vehicles

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ABSTRACT: The wireless power transmission for electric vehicles (EVs) on roads explores the development of an innovative system to charge EVs dynamically while they are in motion. Utilizing resonant inductive coupling, power is transmitted wirelessly from embedded road infrastructure to receiver coils in EVs. The objective is to eliminate the need for traditional charging stations and reduce range anxiety. The system aims to optimize energy efficiency, minimize losses, and enable continuous charging, offering a sustainable solution to EV adoption. This technology could transform transportation, reduce dependence on charging stations, and pave the way for a more eco-friendly future.

I. INTRODUCTION

Over the last decade, many technological advancements have taken place in the field of electric vehicles (EV). Reduction in size of batteries, reduction of charging time, longer driving hours in a single charge etc. are some of the areas where big strides have taken place over the last few years. But there hasn't been any improvement in the charging methods used. Even today electric vehicles are charged via plug-in chargers. So, the development of a wireless power transfer (WPT) circuit is to be the latest approach that is to be taken in order for further development of the electric vehicle industry.

The rapid advancement of technology and the increasing focus on sustainability have brought about revolutionary changes in the transportation industry. Among the most significant innovations is the concept of wireless power transmission (WPT) on roads, specifically designed to support electric vehicles (EVs). As the demand for EVs continues to rise globally, driven by the need to reduce greenhouse gas emissions and reliance on fossil fuels, the limitations of conventional charging infrastructure are becoming more evident. Wirelesspower transmission for EVs on roads offers a transformative solution, addressing challenges related to range anxiety, charging downtime, and infrastructure scalability. Wireless Power Transfer (WPT) systems transfer electric energy from a source to a load without any wired connection. WPTs are attractive forWireless power transmission is a technology that enablesthe transfer of electrical energy from a source to a receiver without the use of physical connections like cables. By utilizing principles of electromagnetic induction or resonant inductive coupling,

WPT systems can efficiently deliver energy over short distances. When applied to roadways, this technology allows EVs to charge dynamically while in motion, eliminating the need for frequent stops at charging stations. This concept, often referred to as dynamic wireless charging, has the potential to redefine the future of transportation by creating a seamless and efficient ecosystem for EVs.wires, ease of charging, and fearless transmission of power in adverse environmental conditions. Adoption of WPTs to charge the on- board batteries of an electric vehicle (EV) has got attention from some companies, and efforts are being made for development and improvement of the various associated topologies. WPT is achieved through the affordable inductive coupling between two coils termed as transmitter and receiver coil. In EV charging applications, transmitter coils are buried in the road and receiver coils are placed in the vehicle. Inductive WPT of resonant type is commonly used for medium-high power transfer applications like EV charging because it exhibits a greater efficiency.



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II. LITERATURE SURVEY

- Tesla (1891–1900s): Nikola Tesla was the pioneer of wireless energy transmission, demonstrating long-range wireless power with Tesla coils. Though impractical at the
- time, it laid the groundwork for modern WPT.
- Kurs et al. (2007): Demonstrated efficient mid-range power transfer using resonant inductive coupling, reviving interest in wireless power for practical applications, including EVs.
- Lee et al. (2015): Focused on the coil design and compensation topology for improved efficiency and reduced electromagnetic interference (EMI).
- Zhang et al. (2016): Presented optimization strategies for the coil alignment, which significantly affects the power transfer efficiency.
- Covic and Boys (2013): Pioneered the concept of dynamic charging, enabling EVs to charge while moving. This addresses range anxiety and reduces the need for large onboard batteries.
- Shin et al. (2014): Developed a segmented coil system embedded in roadways that activates only when a vehicle is overhead, enhancing energy efficiency and safety.
- Sample et al. (2011): Researched resonant inductive systems with high-quality factors, achieving better efficiency over longer distances than traditional IPT.
- Choi et al. (2017): Proposed frequency control techniques to maintain resonance under variable loading conditions, which is essential in dynamic environments.
- SAE J2954 (2016, updated in 2020): A key standard for wireless EV charging, defining interoperability, safety limits for human exposure to EM fields, and communication protocols.

OLEV (Online Electric Vehicle) project byKAIST, Korea (2013–ongoing): Demonstrated a real-world implementation of dynamic Design aspects of power converters and coil designs capable of reducing power losses in the system was also mentioned. Connect an electric vehicle to the power grid to have a bi- directional power flow was also discussed. By conducting thorough analysis of the aforementioned papers, it has been inferred that the misalignment of coils has to be taken care in design to maintain constant output voltage. Also, the controllers used in the design have to be effective for power transfer, thus the overall efficiency of the system is not affected and regarding the resonant frequency, it has to be high enough so that for different coupling coefficient, the resonant frequency of the system does not change.

III. METHODOLOGY

In wireless power transfer system, a compensating network is added to the coil so as to produce resonance and to increase the coefficient of coupling and WPT efficiency of the system without considerable difference in the coil sizes. Generally, the magnetizing inductance of the coils used are small which in turn can induce large reactive power. To increase the inductance of magnetization, the number of turns can be increased at the cost of increasing the parasitic resistance of WPT and increasing conduction losses. Therefore, the reactive power and conductive losses of the WPT converter must be analyzed properly to design the magnetizing inductance.



Figure 1.1: Block diagram of proposed system



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The block diagram WPT shows in the Fig.6.1. It consist of Transmitting coils and Receiving coils to exchange the power between them the Transmitting coil connected with the AC input and inverter, the receiving coils connected with battery for energy managementAn induction coil create alternating electromagnetic field from within the transmitter circuit powered with 12V. The second induction coil takes power from the electromagnetic field and convert sit back in to AC current to the receiver circuit. Increase the number of turns of the receiver coil to increase the transmission distance, when low current is suitable in your application. As distance increase current capacity of receiver will drop.

Wireless power transmission technologies use time-varying electric, magnetic, or electromagnetic fields. The term "wireless charging" usually refers to inductive charging. This technology uses a charging station that creates an alternating magnetic field. A device with the proper induction coil will receive energy from that field when it is placed nearby, making it receive power without a physical connection. An important issue associated with all wireless power systems is limiting the exposure of people and other living things to potentially injurious electromagnetic fields. Wireless power transfer is the transmission of AC power from a power source to an electrical load, without

IV. CONCLUSION

The necessity for operating energy efficient power mechanisms in high frequency environments led to the development of wireless power transmission. The literature survey depicts out the inefficiency of current methods for charging the EVs. Therefore, a high efficiency wireless power transfer system for EV charging applications is studied .The required outputs are generated across each stage and hence the proposed circuit is suitable for wireless power transmission in vehicular application. In the coming future those EVs and its charging methods will be embraced over the conventional vehicles.

V.FUTURE SCOPE

Wireless power transfer technology is a field that has a huge potential of becoming a mainstream technology in the future. From the simulations that is conducted, the proposed wireless power transfer circuit can be used for EV charging applications. With the necessary research and development in this field, it is possible to create an electric bicycle from a conventional bicycle that is capable of charging wirelessly. In the future, the same circuit as used in this simulation can be replicated in ANSYS Twin Builder software and the coil design can be imported from ANSYS Maxwell 3D software to simulated. the use of discrete human made condctors.

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