

Wireless Resonant Charging for Electric Vehicles: A Dynamic Approach

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Abstract— The primary goal of this project is to create a dynamic wireless charging (DWC) system using magnetic resonance coupling in order to overcome the limitations of current electric vehicle (EV) charging infrastructure. In contrast to conventional plug-in charging stations, this method offers benefits such as the ability to charge EVs while in motion, elimination of charging station requirements and reduction of range anxiety. Dynamic wireless charging provides wireless power transmission through cables which makes more convenient for the users. The system boost charging efficiency by adjusting power transmission based on the speed and battery level of the vehicle. The project involves designing and prototyping of a magnetic resonance coupler to transfer power and monitoring battery status. And also controls the vehicle's motor rotation by controllers and user interfaces. The proposed method utilizes Arduino UNO as the master controller with other drivers and modules such as Node MCU, L298N Motor Driver, and HC05 Bluetooth Module.

Keywords—Electric vehicle (EV), Dynamic wireless charging (DWC), Magnetic resonance coupling

I. INTRODUCTION

Transfer of wireless power has been an innovation of great interest since the invention of the mode of wireless power transfer by Nikola Tesla [1]. In the late 19th century Nikola Tesla, who was one of the most brilliant inventor discovered Magnetic resonance coupling, which has been combined with the idea of dynamic charging by other researchers. Lack of charging infrastructure and range anxiety are the key factors that retard the acceptance of electric vehicles. One of the significant barrier to widespread EV adoption has been range anxiety which is brought on by worries about the short range of EVs and the accessibility of charging stations. The drawbacks of conventional charging techniques such as static wireless power transfer include shorter charging times, heavy large batteries, less convenience which aggravates range anxiety among EV consumers. We would be examining the effectiveness of strategies to boost the efficiency and tackle these problems. Dynamic charging of EVs presents a promising solution to address these challenges. Numerous techniques such as inductive power transfer, radiative power transfer etc., have been discovered for dynamic charging, of which magnetic resonance coupling was proven to be the most effective and superior for Indian Highways.

Dynamic wireless charging improves the range of electric vehicles (EVs) by wirelessly providing power to them while they are moving, avoiding the need for frequent stops at charging stations. EVs can now effortlessly charge while driving by implementing dynamic wireless power transmission infrastructure on roads thereby eliminating range anxiety and reducing the size of batteries which can decrease the cost of EVs. EVs system needs charging stations which is not applicable in all environs whereas dynamic wireless charging allows continuous charging during driving which increase convenience and suitability. It also eliminates the need for physical cables and reduces the complexity and making the charging process practicable for EV users. This technology also makes EVs flexible to charge while navigating both highways and urban roads without the constraints of stationary charging stations. Magnetic resonance coupling has become one of the most promising dynamic power transfer mechanisms among other ways. This method achieves efficient power transfer over large distance when both transmitter and receiver coils attain the required resonant frequency while minimizing energy losses and maximizing safety. In our project, "Wireless Resonant Charging for Electric Vehicles: A Dynamic Approach," we focus on implementing dynamic wireless power transmission using magnetic resonance coupling. Through meticulous design and experimentation, we aim to optimize and analyze the efficiency and effectiveness of dynamic charging for EVs, addressing the challenges of range anxiety and inadequate charging infrastructure.

A. Wireless Power Transfer System (WPTS)

The three most important things to consider in WPT systems when lowering the reluctance effect concerning the efficiency of the power transferred for great air gaps are shape, dimensions of coils, choosing coil and core materials [5]. The charging operation for wireless electric vehicles is as depicted in "Fig. 1". Here, the inverter converts the AC power from the grid to a DC power needed by the converter and again rectified to AC suitable for the transmitting coil placed on the ground. The transmission of this AC power took place wirelessly by magnetic resonance method to the receiving coil placed under the vehicle's chassis and converted back to DC power used to charge the battery [3].