

**WIRELESS POWER TRANSFER FOR EV BATTERY CHARGING**

*Major project report*

*submitted by*

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**UNDERTAKING:**

We are the under signed students of V semester E&EE, here by state that the Major project " **WIRELESS POWER TRANSFER FOR EV BATTERY CHARGING** “is carried out by us independently under the guidance of Ms. Ashwini G Department of Electrical and Electronics Engineering, NIE, Mysuru.

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**ABSTRACT**

Wireless Power Transfer (WPT) is the technology by which one or multiple transmitters generate an electromagnetic wave, which is processed by one or several receivers

without any type of conductor in order to extract power from the wave. In contrast towireless communication systems, the electromagnetic wave in WPT systems is used by the receiver to store energy in a battery or to power electronics.

Wireless charging systems are one of the keys enabling technologies for widespread adoption of electric vehicles (EV)with inherent safety, user convenience, flexibility, and comparable efficiencies with that of the plug-in chargers. High-efficiency, flexibility, not requiring thermal management on wires, misalignment tolerance, compactness, and cost effectiveness are the fundamental expectations forwept systems used for EV charging applications. Furthermore, a light-weight and small vehicle-side assembly is expected due to the limited volume on the vehicle. A compact vehicle-side unit would also not constrain the vehicle energy efficiency with heavy add-on components. It is also critical to reach desired

coupling between the primary and secondary couplers in order to achieve high efficiency, reasonable primary coupler current, misalignment tolerance, and also to reduce the electric and electromagnetic fringe fields in and around the vehicle

**1.INTRODUCTION**

The wireless solution is increasingly spreading as method of battery charging for Electric Vehicles (EVs). The standard technology of wireless EV battery charging is based on the Inductive Power Transfer (IPT) between two coupled coils, one connected to the electrical grid and the other one connected to the rechargeable battery. The IPT provides benefits in terms of safety and comfort, due to the absence of a plug-in operation: through IPT, the electrocution risk typically arising from power cords is avoided and the battery charging operation can automatically start.

According to the state of the EV, there are mainly two types of IPT for the wireless charging: static IPT, when the vehicle is stationary and nobody is inside it (e.g. in a parking area); dynamic or quasi-dynamic IPT, when the vehicle is being used (e.g. while in motion or during the traffic red light). The wireless power transfer obviously represents the only solution for the dynamic charging, since the wired connection would be impossible during the motion.

In spite of the undeniable advantages brought by Inductive Power Transfer, the researchers have to deal with several issues in order to make this technology even more attractive for the EV market.

First of all, an IPT system is inherently less efficient in terms of power transfer efficiency if compared to a conventional wire-based system. Indeed, due the magnetic coupling between the coils, there is an unavoidable minimum leakage magnetic field, leading to an energy loss. Furthermore, some technical aspects need to be taken into account in the practical implementation of an IPT system: for example, in order to obtain the maximum coupling, the misalignment between the coils must be as small as possible. As far as safety is concerned, even if the IPT allows to reduce the electrocution risk, some care is required regarding the magnetic field exposure.

**2. LITERATURE SURVEY**

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| --- | --- | --- | --- |
| SI.NO | TITLE | AUTHORS | CONTENT |
| 1 | WPT Level-3 Wireless  Charger with Compact Secondary Coupler | Omer Onar, Veda P. Galigekere, Jason Pries, Gui-Jia Su, Shenli Zou, Saeed Anwar, Jonathan Wilkins,  Randy Wiles, Larry Seiber, and Cliff White | One of the key challenges in a WPT system with a small  vehicle coil is to determine the effects of variation in the coupling coefficient and load power on the various parameters of the wireless charging system. A loosely coupled transformer model was used to derive circuit models to analyze the  sensitivity to variation of load and *k* at different operating frequencies. |
| 2 | Wireless Power Transfer  for Electric Vehicles:  Foundations and Design  Approach | Alicia Triviño-Cabrera•  José M. González-González•  José A. Aguado | wireless power transfer  is supported by an electromagnetic wave travelling from the power emitter to the power receiver. In WPT systems, the electromagnetic field is exclusively generated to transfer power. Conversely, energy harvesting techniques make use of the electromagneticwaves  generated to transfer information to acquire energy to power devices. |
| 3 | An Efficient Wireless Power Transfer Methodology for  Electric Vehicle Battery Charging | Burkul Rushikesh Vijay and Dr. Pawan Chandrakant Tapre | The technology of wireless  power transmission can eliminate the employment of the wires and batteries, thus increasing the mobility, convenience,  and safety of an device for all users.[2] Wireless power transfer is helpful to power electrical devices where  interconnecting wires are inconvenient, hazardous are not possible. |

**2.1 BACKGROUND HISTORY**

* Resonant inductive coupling, also known as “electro-dynamic induction” used by Nikol Tesla in 1894 to wirelessly light up phosphorescent and incandescent lamps. That was situated at the 35 South Fifth Avenue laboratory, and later at the 46 E.Houston Street laboratory in New York City. A device called the high-voltage was patented by Nikola Tesla in 1897.

* In California 1975 Wireless high-power transmission using microwaves experiments in the tens of kilowatts have been performed at Goldstone.
* In 1910 an experiment was held using incandescent light powered wirelessly by electromagnetic induction. The bottom of a large cylinder was made by using an electromagnet, a coil of wire with alternating current through it. It creates a magnetic

field. Above the magnet’s pole the lamp is attached to another coil of wire. The magnetic field generate electricity that lights the lamp. The lamp then looks like an original Edison lamp with a carbon filament..

* Hatem Zeine an American physicist, inventor demonstrated how wireless power transmission using phased array antennas can deliver electrical power up to 30 feet in 2013. It uses the same radio frequencies as Wi-Fi.
* Researchers at the University of Washington experimentpower over Wi-Fi, at ranges of up to 20 feet in 2015. They also experiment using Wi-Fi that it can be used to wirelessly trickle- charge nickel–metal hydride and lithium-ion coin-cell batteries at distances of up to 28 feet.
* Federal Communication Commission (FCC) certified the first mid-field radio frequency (RF) transmitter of wireless power in 2017.

**3. STATEMENT OF PROBLEM**

* Wireless EV charging technology is interoperable, convenient, and harder to vandalise compared to traditional public charging units.
* The user never has to step out of the EV to deal with different connectors, heavy cables, or hassle with a not-so-friendly user interface to make payments.
* The entire process of EV charging is simplified, offering a much better end-user experience.
* The driver simply aligns the car with the transmitter pad on the ground and charging begins automatically.
* The technology is especially useful for electric buses, that are essential candidates for electrification. Wireless charging lowers the cost of operation, results in more affordable buses with smaller batteries, and extends the lifetime of batteries.
* Wireless EV charging has the potential to increase EV uptake.

1. **SCOPE OF THE PROJECT**

One of the problems in electric vehicle is range anxiety which is the fear that a vehicle has insufficient range to reach its destination and would thus strand the vehicle’s occupants. To avoid this problem dynamic wireless charging systems can be installed on the roads so that the Electric Vehicles can be charged while in motion and also a charge monitoring system can be developed for the authorised owner to get the notification about the status of the battery of the vehicle. Furthermore, In-wheel Wireless Charging System (IW-WCS) can be developed to reduce the air gap and coil misalignment issues in the dymamic wireless charging system. This can be done by integrating secondary coils with the wheels of the vehicle. The alignment system can be modified by giving the direction about the position of the vehicle to the owner whenever the vehicle is misaligned.