International Journal for Modern Trends in Science and Technology
Volume: 09, Issue No: SI02, March, 2023
ISSN: 2455-3778
http://www.ijmtst.com

ENHANCING ENERGY EFFICIENCY WITH WIRELESS POWER TRANSMISSION FOR ELECTRIC VEHICLES

R. SAI TEJA[1] | A. HEMANTH KUMAR[1] | M. SUBHASH[1] | B. RAKESH NAYAK[1] | T.V. DHARMARAJU[1]

[1]Department of Automobile Engineering, Godavari Institute of Engineering and Technology(A), Rajahmundry.
*Corresponding Author Email ID: saiteja.r016@gmail.com

ABSTRACT

The main Aim of this project is to transfer the power wirelessly in an effective way to the electric vehicle. Using the electrical components which are useful for wireless power charging like coils, receivers, capacitor etc. which induct in a dynamic way. Evaluate performance of WPT couplers embedded in road way and plan for road-worthiness from both civil and electrical engineering involvement.By automating the charging process, WPT can save time and effort, especially in busy or high-traffic areas where finding an available charging station can be difficult. It can also be used to provide a continuous flow of power to EVs while they are in motion, which could significantly increase their range and reduce the need for frequent stops to recharge. These provide an innovative and sustainable way to genarate energy so that these Automobiles are charged.
KEYWORDS: Power, Electrical Vehicles, Wireless Technology, Batteries, Energy, Transmission.

1. INTRODUCTION

Wireless power transmission is a method of charging the vehicle without the physical connections it is also a method of transmitting electrical energy from the power source to the vehicle without wires. Wireless power transmission is gaining popularity for electric vehicles (EVs) as a more convenient and efficient way to recharge their batteries.

The basic principle of wireless power transmission is electromagnetic induction. In this wireless power charging the power is passed through power grid & sends power to charged controler by the charge controller the power transmitter transmitts power by the wiring and the vehicle is equipped with power receiver and the power is stored in EV battery.

There are two main types of wireless power transmission: magnetic induction and magnetic resonance. In magnetic induction, the transmitter and receiver coils are placed in close proximity to each other, typically within a few centimeters. The Transmitter generates the magnetic field through Coil that passes current to the receiver coil, which charges the EV battery.

In magnetic resonance, The Transmitter and Receiver coils are engaged to the same resonant frequency, allowing the energy to be transmitted over a greater distance. This enables wireless charging to be done while the EV is in motion, such as the embedded charging pads in roads or parking lots.

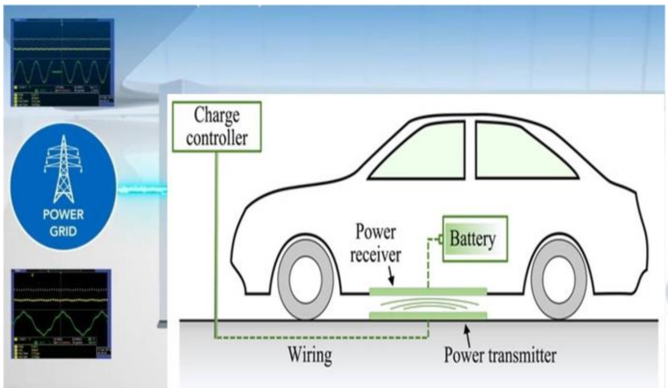


Fig 1.1 Wireless Power Transmission

Wireless power transmission in electric vehiclesgives major advantages over basic plug-in charging including convenience, reduced wear and tear on charging equipment, and improved safety by reducing the risk of electrical shock. However, the technology is still relatively new and requires further development to address issues such as efficiency, cost, and compatibility with different types of EVs.

2. LITERATURE REVIEW

Wireless power transmission (WPT) for electric cars (EVs) is a new technology that seeks to minimise dependency on plug-in charging systems, increase user comfort, and, in the end, promote the wider adoption of electric mobility. This literature review's goal is to offer an overview of current research in the topic of wireless power transfer for electric cars.

2.1. Historical Background

Nikola Tesla demonstrated wireless power transmission in 1891, while J. C. Bose established the idea of resonant coupling in 1897. Nevertheless, the University of Auckland successfully demonstrated a wireless charging system for an electric bus in 1987, which was the first practical application of WPT for Electric Vehicles.

2.1.1 Types of Wireless Power Transmission

Magnetic induction, magnetic resonance, and microwave power transmission are all examples of wireless power transmission technologies. Magnetic induction is the most generally used EV charging technique, and it includes wirelessly transferring electricity via magnetic field between the transmitterand receiver coil.

2.1.2 Technical Challenges and Solutions

The efficiency of the system is one of the primary technological problems of WPT for EVs. The distance between the transmitting and receiving coils, the size of the coils, and the frequency of the electromagnetic field all have an impact on efficiency. Researchers have proposed a variety of techniques to increase WPT efficiency, including the use of resonant coupling, coil size and position optimization, and the use of high-frequency power electronics.

2.1.3 Safety Considerations

Safety is another critical feature of WPT for EVs. The method includes the transmission of electromagnetic radiation, which might endanger humans and animals' health.

Researchers have recommended many methods, including using shielding materials and applying rigorous rules, to assure the safety of WPT systems.

2.1.4 Commercialization and Future Directions

WPT for EVs is still in its early phases of commercialization, and various obstacles must be overcome before the technology can be broadly used. Thesedifficultiesinclude WPT system standardisation, the creation of cost-effective solutions, and the formation of a regulatory framework. Notwithstanding these obstacles, the market for WPT for EVs is likely to expand dramatically in the next years, and the technology has the potential to transform the way we think about electric transportation.

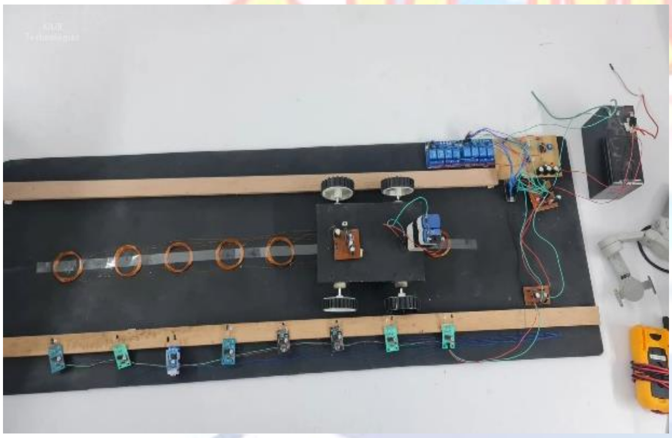
To summarise, wireless power transfer for electric vehicles is a fast-expanding technology with the potential to transform how we charge our electric vehicles. While major technological and safety hurdles remain, the future appears bright for WPT, and we should expect to see tremendous advancement in the next years.

3. PROPOSED WORK

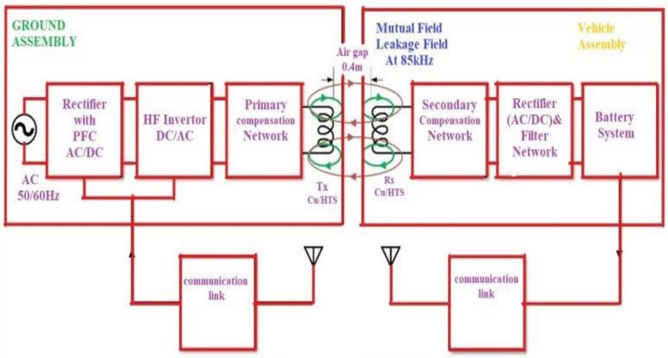
A power source, which is a high-speed switching circuit, primary impedance compensating wireless power transfer through inductive coupling, and wireless power transfer through inductive coupling form the WPT system.

The GA is linked to the distribution network of the energy Grid and Powered by low-frequency alternating current (AC).

The frequency of the power source is inadequate to link both coils and transferred energy. The Power therefore changed in eithersingle or two-step process. Despite the fact that direct conversion from low-frequency alternate currentpower grid to high-frequency primary coil input is possible, most charging systems employ two-stage AC/DC/AC conversion. In the first step, a rectifier converts alternating power to direct current (DC), followed by power factor correction (PFC) to ensure a high-power factor and low harmonic content.



3.1 WirelessPower Transmission

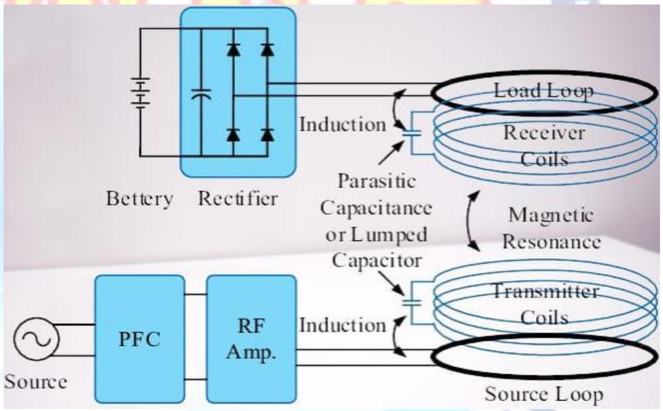


Main Components of WPT Systems

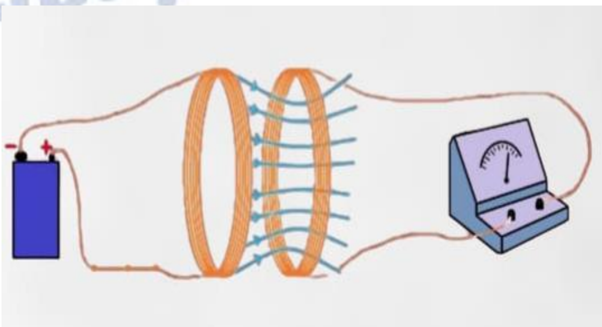
Methodology for EVs is typically based on the principle of magnetic resonance coupling, which involves the use of an electromagnetic field to transfer power from a power source to receiver without the need for physical contact or wired connections. Some of the key technologiesused in wireless power transmission for electric vehicles include:

a. InductivePower Transfer (IPT): IPT is a technology that uses a magnetic field to transfer power wirelessly between a primary coil (located in the ground or on a charging pad) and a secondary coil (embedded in the vehicle). IPT is relatively simple and efficient, but has limited range and efficiency.

b. MagneticResonance Coupling: This technology uses magnetic fields to transfer energy wirelessly between a resonant source and a resonant receiver. The resonance allows for efficient transfer of power over a larger distance than IPT, and can also be designed to be more tolerant to misalignment between the transmitter and receiver.



c.Radio frequency (RF) Power Transfer: RF power transfer uses radio waves to transmit energy wirelessly from a source to a receiver. This technology has the potential for longer range and higher efficiency than IPT or magnetic resonance coupling, but is still in the early stages of development.



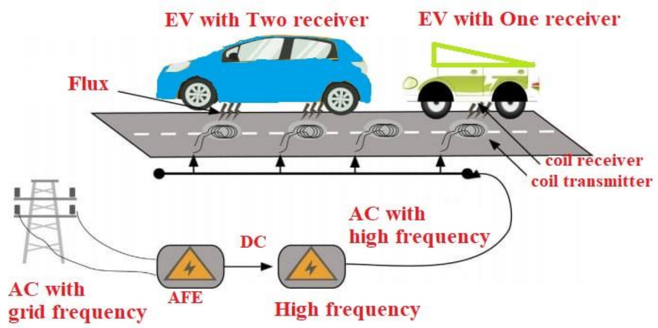
d.LaserPower Transfer: Laser power transfer involves the use of a laser beam to transfer energy wirelessly to a receiver on the vehicle. This technique has the potential for high efficiency but it is in hold for some safety concerns and require alignment between The Transmitter and Receiver.
Overall, magnetic resonance coupling is currently the most widely used technology for wireless power transmission for electric vehicles, with several commercial systems already available on the market.

4. RESULTS

The fundamental frequency content of the output current diminishes as the receiving coil gradually deviates from the sending coil.

The AC- DC converter's input voltage follows the output of the outer loop controller. The signal output by the inner loop controller is used to drive the IGBT.

The coil's excitation AC current operates at a frequency of 80 kHz. The Transmitter and Receiver coils are separated vertically by 200mm.



Wireless Transmitter System Composition

5. CONCLUSION

After analysing the alternatives now accessible for stationary systems when picking the primary and secondary pad topologies, the choice was made to use a basic primary track topology for the in-ground system. The use of a Multicoil secondary as the car travelled across the track illustrated how such a system may help minimise abrupt power spikes while still allowing continuous power transfer.

This study proposes a Dynamic Wireless Power Transfer system that evolves from a stationary WPT system. To validate power transmission, a stationary WPT system rated at 10 kW was developed, manufactured and tested. The recommendedand stationary WPT system had an equivalent circuit, according to the theoretical analysis reported in this study.

REFERENCES

[1] Badrinath Kulkarni, Devaji Patil, Rahul. G. Suryavanshi, "IOT Based PV assisted EV Charging Station for Confronting Duck Curve", Computational Techniques Electronics and MechanicalSystems (CTEMS) 2018 International Conference on, pp. 36-39, 2018

[2] Edwin Selva Rex CR, Marcaine Beno M, Annrose J. A Solution for Combined Economic and Emission Dispatch Problem using Hybrid Optimization Techniques. J Electr Eng Technol, 2019: 0123456789, doi: 10.1007/s42835-019-00192-z.

[3] Mokarram MJ, Niknam T, Aghaei J, Shafie-Khah M, Catalão JPS. Hybrid Optimization algorithm to solve the non-convex multiarea economic Dispatch problem. IEEE Syst J 2019;13(3):3400–9. Doi: https://doi.org/10.1109/JSYST.2018.2889988.

[4] Elena Paul, Nimmy Paulson, RijoBijoy, Benny K.K, "WIRELESS CHARGING OF ELECTRIC VEHICLES", International Research Journal of Engineering Technology, Vol.6, Issue 6, June 2019.

[5] P. Magudeswaran, G Pradeeba, S. Priyadarshini, M. Sherline Flora, "DYNAMIC WIRELESS ELECTRIC VEHICLE CHARGING SYSTEM" International Research Journal of Engineering and Technology, Vol.6, Issue 3, March 2019.

[6] Omar Nezamuddin, Euzeli Ciprianodos Santos, "Vehicle-to-Vehicle In-Route Wireless Charging System", Transportation Electrification Conference & Expo (ITEC) 2020 IEEE, pp. 371-376, 2020.K. Elissa, "Title of paper if known," unpublished,2020.

[7] H. de Wilde and P. Kroon, "Policy options to reduce passenger cars co2 emissions after 2020.

[8] Mohamed, F. Aymen, S. Lassaad, B.H. Mouna Practical validation of the vehicle speed influence on the wireless recharge system efficiency
Int Energy Conf (2020).

[9] Rao GS, Kumari GV, Rao BP. Chemo-inspired GA for non-convex economic load, dispatch 2021.

[10] A. Flah, Irfan ahmed khan, A. Agarwal, L. Sbita, G. MarceloField-oriented control strategy for double-stator single-rotor and double-rotor single-stator permanent magnet machine: design and operationComput Electr Eng, 90 (2021).

[11]J2847/6A: Communication for Wireless Power Transfer Between Light-DutyPlug-In Electric Vehicles and Wireless EV ChargingStations—SAE International. Available online: https://www.sae.org/standards/content/j2847/6_202009/ (accessed on 6December 2021).

[12] J2836/6A: Use Cases for Wireless Charging Communication for Plug-In Electric Vehicles—SAE International. Available online: https://www.sae.org/standards/content/j2836/6_202104/ (accessed on 6 December 2021).

[13] IEC 61980-1: Electric Vehicle Wireless Power Transfer (WPT) Systems—Part 1: General Requirements. Available online: https://global.ihs.com/doc_detail.cfm?document_name=IEC%2061980%2D1&item_s_key=00656450 (accessed on 6 December 2021).

[14] T.V Dharmaraju, Yeo Yardjouman, T. Praveen Kumar, S. SaiKiran, LakamthotiAjith "Development of a Last Mile Delivery Electric Vehicle". International Journal for Modern Trends in Science and Technology 2021, 7, pp. 16-27. https://doi.org/10.46501/GIETAE04.

[15] A Ramaraju; M Manikanta Mahesh; P Yahoshuva; P Jagadesh and T V Dharmaraju. "Numerical Simulation of an Electric Lastmile's Delivery Vehicle". International Journal for Modern Trends in Science and Technology 2021, 7, pp. 28-33. https://doi.org/10.46501/GIETAE05.

[16] IEC/TS 61980-2: Electric Vehicle Wireless Power Transfer (Wpt) Systems—Part 2: Specific Requirements for Communicationbetween Electric Road Vehicle (EV) and Infrastructure. Availableonline: https://global.ihs.com/doc_detail.cfm?document_name=IEC%2FTS%2061980%2D2&item_s_key=00786994#product-details-list (accessed on 6 December 2021).298.

[17] IEC/TS 61980-3: Electric Vehicle WirelessPower Transfer (WPT) Systems—Part 3: Specific Requirements for the Magnetic FieldWireless Power Transfer Systems. Available online: https://global.ihs.com/doc_detail.cfm?&document_name=IEC%2FTS%2061980%2D3&item_s_key=00786995&item_key_date=800631& (accessed on 6 December 2021).