International Journal of Advanced Trends in Engineering and Management
(ISSN 2583-7052)
pp. 93-96, April

# Designing a Capacitive Wireless Power Transfer System for Electric Vehicles in Motion

R. Vinoth[1], V. Sivaji[2], M. Kishore[3], M. Ranjith[4]

[1]Department of Electrical and Electronics Engineering, Arasu Engineering College, Tamil Nadu, India.
[2,3,4] Final Year UG Students, Department of Electrical and Electronics Engineering, Arasu Engineering College, Tamil Nadu, India.

**[1]Corresponding Author E-mail: vino0677@gmail.com**

**ABSTRACT:** Dynamic wireless power transfer (WPT) is emerging as a promising solution to overcome the limitations of conventional static charging methods for electric vehicles (EVs), particularly the constraints imposed by limited driving range and the reliance on large, heavy battery systems. While static wireless charging has gained global adoption, it requires vehicles to remain stationary and does not adequately address range anxiety. In contrast, dynamic WPT enables energy transfer to EVs while in motion, thereby extending driving range, reducing dependence on high-capacity batteries, and potentially eliminating the need for frequent plug-in charging. This technology operates through electromagnetic coupling between a transmitter coil embedded in the roadway and a receiver coil mounted on the vehicle, where power is transferred via mutual induction. However, system performance is highly sensitive to coil alignment and the air gap between transmitter and receiver. In this study, a pair of copper Archimedean coils is designed and analyzed using ANSYS Maxwell simulation software to evaluate the effects of vertical and horizontal misalignment on power transfer efficiency. The system achieves a transferred power of 3.74 kW across a 150 mm air gap, with a maximum efficiency of 92.4%. For an EV with a 6.1 kW battery capacity, the estimated charging time from a fully depleted state is approximately 1 hour and 39 minutes under these conditions. Furthermore, a dynamic charging lane model is developed, and the power transfer characteristics are evaluated based on mutual inductance as the vehicle traverses the lane. The results demonstrate that dynamic WPT can significantly enhance the operational range of EVs and represents a viable pathway toward continuous, on-the-move charging infrastructure.

**Keywords:** Wireless Power Transfer (WPT), Electric Vehicles (EVs), Dynamic Charging, Mutual Induction, Archimedean Coils

## 1. Introduction

Wireless power transfer (WPT) technology has gained significant attention over the past decade due to its inherent advantages over conventional wired power transmission methods, including enhanced convenience, reduced maintenance, and improved operational safety. It has been widely explored across a broad spectrum of applications, ranging from low-power biomedical implants to high-power systems such as electric vehicle (EV) charging and railway transportation, with some prototype systems demonstrating efficiencies of 95% or higher. Among the various approaches, magnetic WPT systems are particularly prominent, as they utilize magnetic field coupling to transfer electrical energy between two or more coils separated by a relatively large air gap. This principle enables efficient, contactless energy transfer without the need for physical connectors. In this study, a wireless charging system specifically designed for a lightweight electric vehicle is developed, implemented, and experimentally evaluated to assess its performance and feasibility.

## 2. Proposed Work Explanation

In this proposed system, we implement ARDUINO microcontroller based wireless power charging methodology in electric vehicles. This system consists of ARDUINO microcontroller, inductive coils, vehicle prototype module.

Solar panel system is implemented to transfer the power to the primary coil. Solar panel is connected to the battery directly. Then it can driven into the rectifier circuit through an inverter. In inverter circuit is connected by ARDUINO micro controller to switching the power supply. The switched power is fed into the inverter through driver circuit. The coil has high capacity of inductance which can able to transfer the power with high frequency. It is named as the high frequency coil. Those power input are connected to the high frequency primary coil which is laid under the road segment.

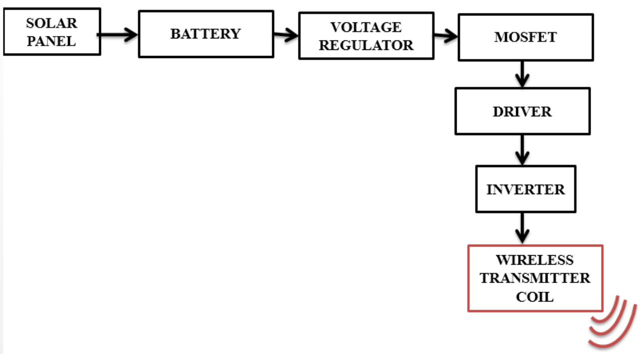


**Figure 1:** *Transmitter section*

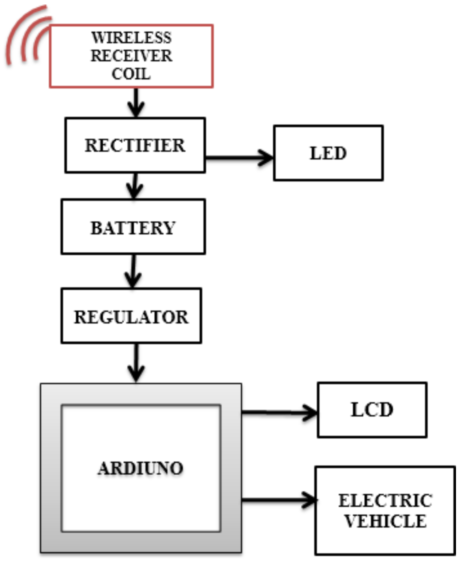


**Figure 2:** *Receiver Section*

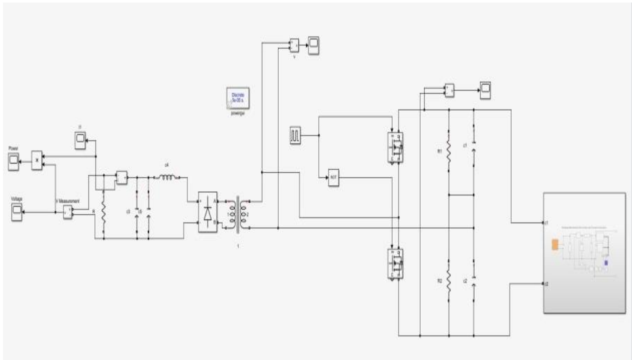

**Figure 3:** *Simulation Wireless Power Transfer*

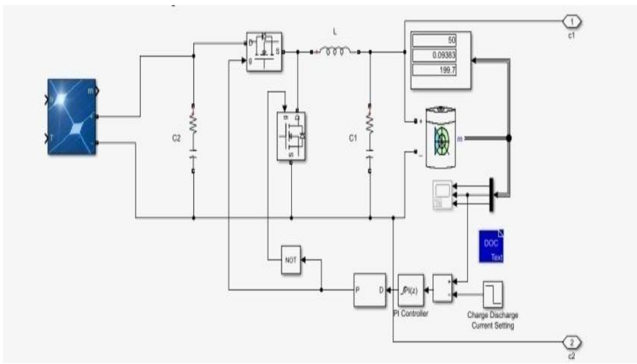


**Figure 4:** *Half Bridge Bidirectional DC-DC Converter with PI Current Control Z*

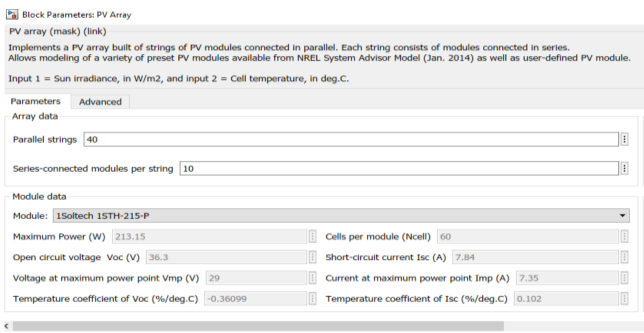

**Figure 5**: *Solar Array*

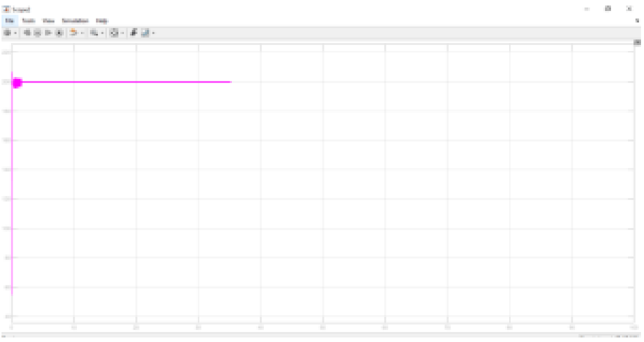

**Figure 6:** *Input DC Voltage*

The output dc voltage rating is 200v is designed for maintain the constant the dc voltage

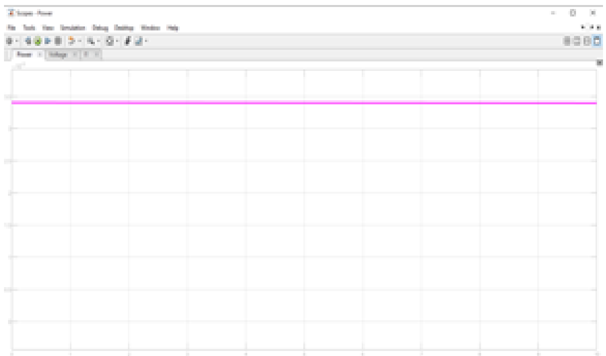

**Figure 7**: *Power Transfer*

The power transfer 3kw power transferred and charging of electric vehicle, its charge the battery voltage and transfer the power and charge our battery.

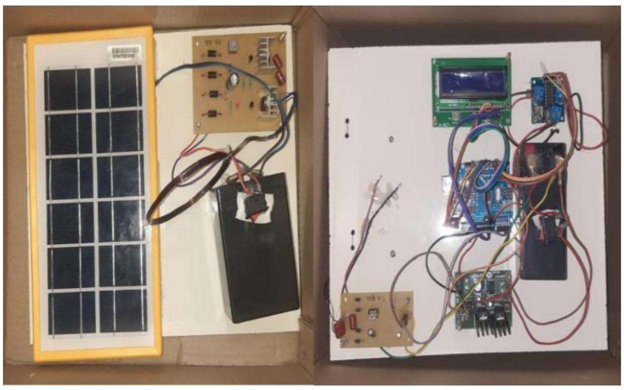

**Figure 8:** *Hardwar Kit*

## 3. Conclusion

Research on WPT is getting popular these years. This work compares the most famous WPT technologies and develops an effective one known RIPT. The RIPT method is used for resonating the transmitter coil frequency and receiver coil frequency. It shows how air gap and misalignment affect the WPT while the EV is driven in the charging lane. Firstly, WPT is simulated in the Ansoft Maxwell 3D simulation software to see the reduction in mutual inductance for air gap and horizontal displacement between the coils in x-axis and y-axis. Then verify the output data using mathematical equations. Equations for self-inductance, mutual inductance, coupling coefficient, voltage, and current are discussed here. The calculation for load power and efficiency for the 150mm air gap is shown. From the load power, the time for the full charge of the battery of an EV can be easily determined. Hence, a model is established to see the power transfer for different speeds and finally how far the EV can go with this consumed power. But, how efficiently the receiver pad can catch the power from the transmitter pad is also depends on the speed of the EV. Shielding materials like ferrite planner and aluminum plates can be used to transfer more power to the receiving end. This work helps to understand the wireless charging of EVs in the track for high resonant frequency in the means of RIPT and can be extended for future work in this field..

## References

1. F. Lu; H. Zhang; C. Mi, Year: 2017, “A review on the recent development of capacitive wireless power transfer technology,” Energies, Vol: 10, No: 11, pp. 1752.

2. M. Ghorbani Eftekhar; Z. Ouyang; M. A. E. Andersen; P. B. Andersen; L. A. de S. Ribeiro; E. Schaltz, Year: 2016, “Efficiency study of vertical distance variations in wireless power transfer for E-mobility,” IEEE Trans. Magn., Vol: 52, No: 7, pp. 1–4.

3. M. Catrysse; B. Hermans; R. Puers, Year: 2004, “An inductive power system with integrated bi-directional data-transmission,” Sens. Actuators A,

Phys., Vol: 115, No: 2–3, pp. 221–229.

4. Y. Yang; M. El Baghdadi; U. Lan; Y. Benomar; J. Van Mierlo; O. Hegazy, Year: 2018, "Design methodology, modeling, and comparative study of wireless power transfer systems for electric vehicles," Energies, Vol: 11, No: 7, pp. 1716.

5. H. Ushijima-Mwesigwa; M. Z. Khan; M. A. Chowdhury; I. Safro, Year: 2017, "Optimal installation for electric vehicle wireless charging lanes," arXiv: 1704.01022.

6. R. Vaka; R. K. Keshri, Year: 2019, "Design considerations for enhanced coupling coefficient and misalignment tolerance using asymmetrical circular coils for WPT system," Arabian J. Sci. Eng., Vol: 44, No: 3, pp. 1949–1959.

7. R. Godoy; E. Maddalena; G. Lima; L. Ferrari; V. Pinto; J. Pinto, Year: 2016, "Wireless charging system with a non-conventional compensation topology for electric vehicles and other applications," Eletrônica de Potência, Vol: 21, No: 1, pp. 42–51.

8. H. Li; J. Li; K. Wang; W. Chen; X. Yang, Year: 2015, "A maximum efficiency point tracking control scheme for wireless power transfer systems using magnetic resonant coupling," IEEE Trans. Power Electron., Vol: 30, No: 7, pp. 3998–4008.

9. Z. Huang; S.-C. Wong; C. K. Tse, Year: 2017, "Control design for optimizing efficiency in inductive power transfer systems," IEEE Trans. Power Electron., Vol: 33, No: 5, pp. 4523–4534.

10. D. Baros; N. Rigogiannis; P. Drougas; D. Voglitsis; N. P. Papanikolaou, Year: 2020, "Transmitter side control of a wireless EV charger employing IoT," IEEE Access, Vol: 8, pp. 227834–227846.