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Designing a Wireless Charging System for Electric Vehicles

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ABSTRACT: Electric vehicles are becoming popular due to their environmental benefits, but efficient charging remains a major challenge. Traditional wired charging systems require physical connections, which can lead to safety issues, maintenance problems, and inconvenience for users. To solve these issues, wireless charging technology is introduced as a modern and efficient solution.This paper presents the design and implementation of a wireless charging system for electric vehicles using magnetic resonance coupling. The system enables energy transfer without direct electrical contact. Different types of wireless charging methods such as stationary, quasi-dynamic, and dynamic charging are analyzed.The proposed system focuses on dynamic wireless charging, where vehicles can be charged while moving. Sensors and control units are used to detect vehicle presence and activate charging only when required. This improves energy efficiency and reduces power loss. The system also includes safety features like temperature monitoring and accident detection. Overall, the proposed method improves user convenience, safety, and system performance.

KEYWORDS: Wireless Charging, Electric Vehicles (EV), Inductive Power Transfer, IoT Monitoring, Smart Charging System, Temperature Monitoring, and Renewable Energy Integration.

I. INTRODUCTION

The demand for electric vehicles is increasing rapidly due to rising fuel costs and environmental concerns. EVs help reduce carbon emissions and dependency on fossil fuels. However, charging infrastructure is still a major challenge. Traditional charging systems depend on cables and connectors, which are not user-friendly and require regular maintenance. Charging time is also high, and users must wait for long periods. These limitations reduce the overall efficiency and adoption of EVs.

Wireless charging technology provides a better solution by eliminating physical connections. It allows automatic charging and reduces human effort. Advanced systems even support charging while the vehicle is moving, which is called dynamic charging.

This technology not only improves convenience but also reduces battery size requirements and increases vehicle range. Therefore, wireless charging is considered an important advancement in EV technology.

II. LITERATURE REVIEW

Supriyadi and Edi Rakhman [1] analyzed how the wire thickness and number of coil turns influence wireless power transfer. Their study shows that increasing the number of turns improves the amount of power transferred. In their experiment, a 0.5 mm diameter enameled copper wire with 26 turns was used along with an input frequency of 470 kHz. At a distance of 1 cm, the system achieved around 1.51% efficiency, which was sufficient to power a 1W LED lamp.

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N. Uthaya Banu and U. Arunkumar [2] discussed different wireless power transfer techniques. Their work focuses on reducing magnetic flux leakage during power transmission and improving overall efficiency. They also highlighted the importance of integrating renewable energy sources to enhance power generation and system performance.

Govind Yatnalkar and Husnu Narman [3] presented a review on the limitations of charging time in electric vehicles. They explained that wireless charging can help overcome long charging durations. Their study also identifies key parameters affecting system performance, such as the distance between coils, alignment of transmitter and receiver, battery capacity, and charging time.

Balamurugan A and Aman Bhattad [4] developed an RFID-based payment system using a PIC microcontroller. In this system, an RFID card is used for transactions, and a new transaction is allowed only after completing the previous one. This approach ensures secure and reliable payment processing, making it suitable for smart campus applications.
Norsuzila Ya'acob and Azita Laily Yusoff [5] proposed a cashless transaction system for students using RFID technology and a database. The system replaces physical money with digital transactions and allows parents to track their child's spending. It also sends notifications about the remaining balance and supports easy recharge for continuous usage.

Vaishali Pande and Nivedita Hasti [6] introduced a smart toll and charging system using RFID technology. Their system helps in identifying vehicles quickly, reducing waiting time and traffic congestion at toll plazas. They also proposed a wireless charging station similar to fuel stations, where vehicles can charge while parked. The system includes automatic entry and exit using sensors and supports cashless payment through RFID tags, improving user convenience and saving time.

III. RESEARCH METHODOLOGY

In the proposed system, wireless power transfer is used as an alternative to conventional wired charging methods. This system operates on the principle of electromagnetic induction between a transmitting coil and a receiving coil.

The transmitting coil is embedded in the road surface or charging platform, while the receiving coil is fixed underneath the electric vehicle. When an alternating current is supplied to the transmitting coil, it produces a varying magnetic field around it. This magnetic field induces an electric voltage in the receiving coil placed within its range.

A microcontroller (Arduino) is used to control and monitor the overall operation of the system. Sensors such as IR sensors are used to detect the presence and position of the vehicle. When a vehicle is detected, a signal is sent to the controller, which then activates the transmitter coil. This ensures that power is transferred only when required, thereby reducing energy loss.

The induced AC power in the receiver coil is converted into DC using a rectifier circuit. This DC power is then regulated and stored in the battery of the vehicle for further use. Switching components like MOSFETs and relays are used to control the flow of current efficiently and provide fast switching operations.

IV. RESULTS AND DISCUSSION

Electromagnetic induction is the basic principle used in wireless charging systems to transfer energy without using physical wires. When an electric current flows through a transmitting coil, it produces a magnetic field around it. If another coil, called the receiving coil, is placed within this magnetic field, an electric voltage is induced in it. This induced energy is then converted into electrical power and used to charge the battery. In this project, proper alignment between the coils is considered important to achieve efficient wireless charging of electric vehicles.

A prototype model of a wireless electric vehicle with line-following capability is developed. The system uses two coils, namely the primary (transmitter) coil and the secondary (receiver) coil. The transmitter coil is placed beneath the road surface, while the receiver coil is fixed under the vehicle.

Infrared (IR) sensors are used to detect the position of the vehicle. These sensors send signals to the Arduino Uno, which acts as the main control unit of the system. Based on the sensor input, the Arduino controls a relay to switch the transmitter coil ON or OFF. If the vehicle moves out of the defined path, the IR sensor sends a signal to the Arduino,

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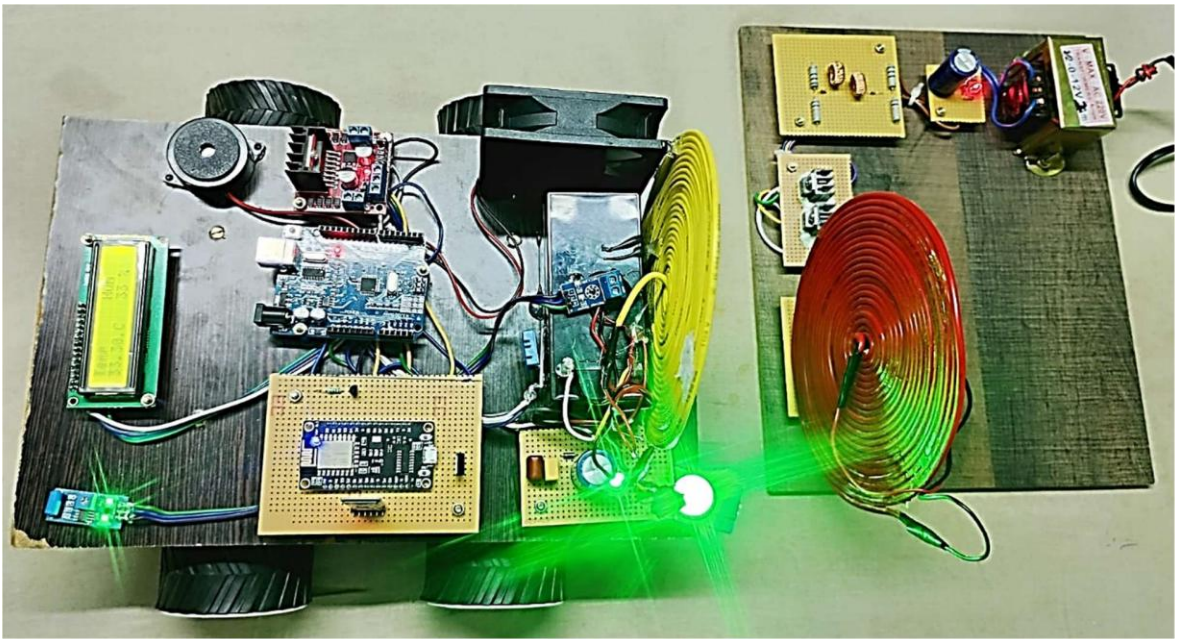
which then turns OFF the relay to stop power transfer. When the vehicle comes within the sensing range, the relay is activated, and charging begins through electromagnetic induction.

The system includes components such as IR sensors, Arduino Nano/Uno, relay module, LCD display, and a wireless charging coil module. The coil transmitter module plays a key role in transferring power wirelessly from the transmitter coil to the receiver coil.

This module works on electromagnetic induction, where a changing magnetic field generates current in the nearby receiver coil. It consists of a transmitter coil, control circuit, and power management circuit. When AC supply is given to the transmitter coil, it creates a continuously varying magnetic field, which acts as the medium for power transfer.
The operation of the transmitter module mainly involves two stages. In the first stage, electrical energy is supplied to the transmitter coil to generate a magnetic field. In the second stage, the receiver coil captures this magnetic field and converts it into electrical energy through induction. The induced AC power is then converted into DC using a rectifier and used to charge the battery or power the load.



V. CONCLUSION

This paper presents a detailed study of different electric vehicle charging methods and various coil design techniques. It explains their features, advantages, and limitations. Both AC and DC charging systems, along with wireless charging methods, are discussed in the study.
Wireless charging stations are becoming more popular because they provide a convenient and efficient way to charge electric vehicles. In wireless charging, different types of coil structures are used, and each design has its own benefits and drawbacks.
The most common and simple method is the static charging system, where one coil is placed on the ground and another coil is mounted underneath the vehicle. This type of design is easy to install, requires less maintenance, and is suitable for low-power charging applications.

In contrast, dynamic charging systems use multiple coils arranged along the ճանապարհ to create a moving magnetic field. This allows the vehicle to charge continuously while it is in motion. Such systems are very useful for applications like electric buses and heavy vehicles, as they reduce the need for frequent stops.

However, dynamic charging systems are more complex in design and require higher installation and maintenance costs compared to static systems.

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VII. FUTURE WORK

The system is capable of transferring around 3.74 kW of power across an air gap of 150 mm, with an efficiency of up to 92.4%. For an electric vehicle with a power rating of 5.1 kW, the total time required to fully charge the battery from an empty state is approximately 1 hour and 39 minutes under this condition.

Wireless power transfer is a rapidly developing technology with strong potential to become widely used in the future. The proposed wireless charging circuit can be effectively applied in electric vehicle charging systems. With continuous research and improvements, this technology can also be extended to convert a normal bicycle into an electric bicycle that supports wireless charging.

In the future, advanced circuit designs and improved coil structures can be developed to make wireless power transfer systems more practical and closer to real-world implementation. With further innovation, it is possible to design a single wireless charging station that can charge different types of electric vehicles, including electric bicycles, cars, and heavy vehicles, with faster charging speed compared to existing methods.

REFERENCES

1. S. Pareek, A. Sujil, S. Ratra, and R. Kumar, "Electric vehicle charging station challenges and opportunities: A future perspective," in Proc. Int. Conf. Emerging Trends in Communication, Control and Computing (ICONC3), Lakshmangarh, India, 2020, pp. 1–6.
2. H. Mehrjerdi and R. Hemmati, "Electric vehicle charging station with multilevel charging infrastructure and hybrid solar–battery–diesel generation," Journal of Energy Storage, vol. 26, 2019, Art. no. 100924.
3. G. Rajendran, C. A. Vaithilingam, N. Misron, K. Naidu, and M. R. Ahmed, "A comprehensive review on system architecture and standards for electric vehicle charging stations," Journal of Energy Storage, vol. 42, 2021, Art. no. 103099.
4. P. Subudhi and S. Krithiga, "Wireless power transfer topologies for static and dynamic EV charging: A review," International Journal of Emerging Electric Power Systems, vol. 21, 2020.
5. P. Nalinnopphakhun, W. Onreabroy, and A. Kaewpradap, "Parameter effects on induction coil transmitter of wireless charging system for small electric motorcycles," in Proc. IEEE Int. WIE Conf. Electrical and Computer Engineering (WIECON-ECE), Thailand, 2018, pp. 145–148.
6. T. Tudorache, V. Bostan, and A. Marinescu, "Numerical analysis of an inductive coupler for wireless EV battery charging systems," in Proc. Int. Symp. Advanced Topics in Electrical Engineering (ATEE), Romania, 2019, pp. 1–6.
7. S. Bhattacharya and T. Yen-Kheng, "Design of static wireless charging coils for electric vehicles," in Proc. Int.
8. Conf. Sustainable Energy Technologies (ICSET), 2012.
9. C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor &Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011. DOI: 10.1080/15325008.2010.541746
10. C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of Electrical Engineering, Vol.63 (6), pp.365-372, Dec.2012. DOI: 10.2478/v10187-012-0054-2
11. C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011. DOI 10.1007/s00202-011-0203-9
12. S.Tamilselvi, R.Prakash, C.Nagarajan,"Solar System Integrated Smart Grid Utilizing Hybrid Coot-Genetic Algorithm Optimized ANN Controller" Iranian Journal Of Science And Technology-Transactions Of Electrical Engineering, DOI10.1007/s40998-025-00917-z,2025
13. S.Tamilselvi, R.Prakash, C.Nagarajan," Adaptive sliding mode control of multilevel grid-connected inverters using reinforcement learning for enhanced LVRT performance" Electric Power Systems Research 253 (2026) 112428, doi.org/10.1016/j.epsr.2025.112428
14. S.Thirunavukkarasu, C. Nagarajan, 2024, "Performance Investigation on OCF and SCF study in BLDC machine using FTANN Controller," Journal of Electrical Engineering And Technology, Volume 20, pages 2675–2688, (2025), doi.org/10.1007/s42835-024-02126-w
15. C. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- Acta Electrotechnica et Informatica Journal , Vol.13 (2), pp.18-31,April-June.2013, DOI: 10.2478/aeei-2013-0025.

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16. C.Nagarajan and M.Madheswaran - 'DSP Based Fuzzy Controller for Series Parallel Resonant converter'- Springer, Frontiers of Electrical and Electronic Engineering, Vol. 7(4), pp. 438-446, Dec.12. DOI 10.1007/s11460-012-0212-0.
17. C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.
18. C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007
19. Suganthi Mullainathan, Ramesh Natarajan, "An SPSS and CNN modelling based quality assessment using ceramic materials and membrane filtration techniques", Revista Materia (Rio J.) Vol. 30, 2025, DOI: https://doi.org/10.1590/1517-7076-RMAT-2024-0721
20. M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022
21. T. Fisher, K. Farley, Y. Gao, H. Bai, and Z. Tse, "Wireless charging technology for electric vehicles: A review of magnetic coupling systems," Wireless Power Transfer, vol. 1, pp. 87–96, 2014.
22. S. Divyapriya, Amutha, and R. Vijayakumar, "Design of residential plug-in EV charging station using IoT and timeof-use tariff," in Proc. Int. Conf. Soft Computing and Network Security (ICSNS), Coimbatore, India, 2018, pp. 1 –5. [10] K. Kumar, J. Kishan, S. Kumar, and V. Nandakumar, "Standards for electric vehicle charging stations in India: A review," Energy Storage, vol. 4, 2022.
23. K. Kumar, S. Gupta, and S. Nema, "A review on dynamic charging of electric vehicles," in Proc. Int. Conf.
24. Electrical Energy Systems (ICEES), Chennai, India, 2021, pp. 162–165.
25. Rajasekar, M. (2025). Risk-Aware Generative AI and Machine Learning Frameworks for Privacy-Preserving Banking and Trade Analytics over Cloud and 5G Networks. *International Journal of Computer Technology and Electronics Communication, 8(4), 11078-11086.*
26. Anujaa, T., Thajudeen Ali Ahamed, A. F., Baranwal, V., Thanikaiselvan, V., Subashanthini, S., Sivaranjani Devi, C., & Rengarajan, A. (2025). A lightweight multi round confusion-diffusion cryptosystem for securing images using a modified 5D chaotic system. *Scientific Reports, 15(1), 31986.*
27. Ramanathan, U., & Rajendran, S. (2023). Weighted particle swarm optimization algorithms and power management strategies for grid hybrid energy systems. *Engineering Proceedings, 59(1), 123.*
28. Soundappan, S. J. (2020). Big Data Analytics in Healthcare: Applications for Pandemic Forecasting. *International Journal of Advanced Research in Computer Science & Technology (IJARCST), 3(1), 2248-2253.*