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Design and Implementation of a Solar-Based Wireless Electric Vehicle Charging System Using Inductive Coupling

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ABSTRACT
Wireless charging of electric vehicles (EVs) is emerging as a promising solution to eliminate the limitations of conventional wired charging systems. This paper presents the design and implementation of a solar-powered wireless EV charging station based on inductive coupling. The proposed system consists of a transmitter coil powered by a solar-based supply and a receiver coil placed in the vehicle, enabling contactless energy transfer. The system integrates Arduino Nano, IR sensors, and a control circuit to automate charging at designated parking spots. Experimental analysis is carried out to evaluate the effect of distance and alignment between coils on power transfer efficiency. The results demonstrate that efficient wireless power transfer can be achieved at short distances, making the system suitable for practical EV charging applications. This work highlights a cost-effective and eco-friendly solution for future EV infrastructure.

INTRODUCTION
The increasing shift from conventional fuel-based vehicles to electric vehicles (EVs) has created a strong need for efficient and user-friendly charging systems. Traditional wired charging methods often lead to clutter, require multiple charging points, and become inconvenient when several vehicles need to be charged at the same time. To address these limitations, this project introduces a wireless charging approach that eliminates the need for physical connections.

The proposed system is based on inductive power transfer, where energy is transmitted between two coils—one at the charging station and the other in the vehicle—through a magnetic field. This method improves convenience, reduces human effort, and enhances safety by removing cables from the charging process. Additionally, the system supports both stationary charging and the possibility of charging vehicles while in motion, increasing flexibility.

Another important aspect of the project is the use of solar energy as a power source. This makes the system environmentally friendly and reduces dependence on non-renewable energy resources. It also contributes to lowering emissions and promoting sustainable development.

Overall, the project aims to develop a practical and efficient wireless EV charging system that minimizes infrastructure complexity, improves charging convenience, and supports the future growth of electric vehicles.

LITERATURE REVIEW
The existing research on wireless power transfer (WPT) for electric vehicles shows that it is a promising alternative to conventional charging methods. Studies indicate that system performance mainly depends on factors such as coil configuration, operating frequency, and proper alignment between transmitting and

receiving units. Techniques like inductive and resonant coupling are widely used due to their stable performance over short and medium distances.

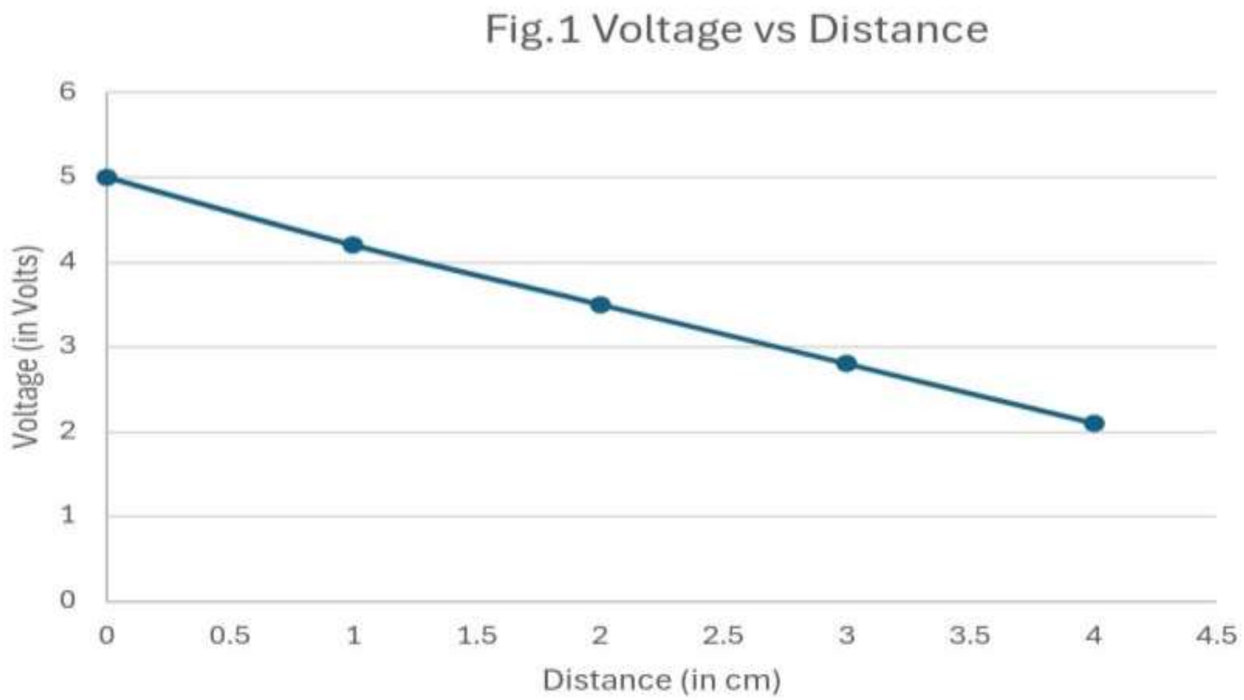
Researchers have also explored the use of renewable energy sources, especially solar power, to make EV charging more sustainable and environmentally friendly. In addition, smart systems using Internet of things (IoT) have been proposed to improve monitoring, scheduling, and efficient use of charging infrastructure.

Despite these advancements, practical challenges such as power losses, alignment sensitivity, and high setup cost still limit widespread adoption. This project focuses on developing a simplified and efficient wireless charging model that improves usability while addressing some of these limitations

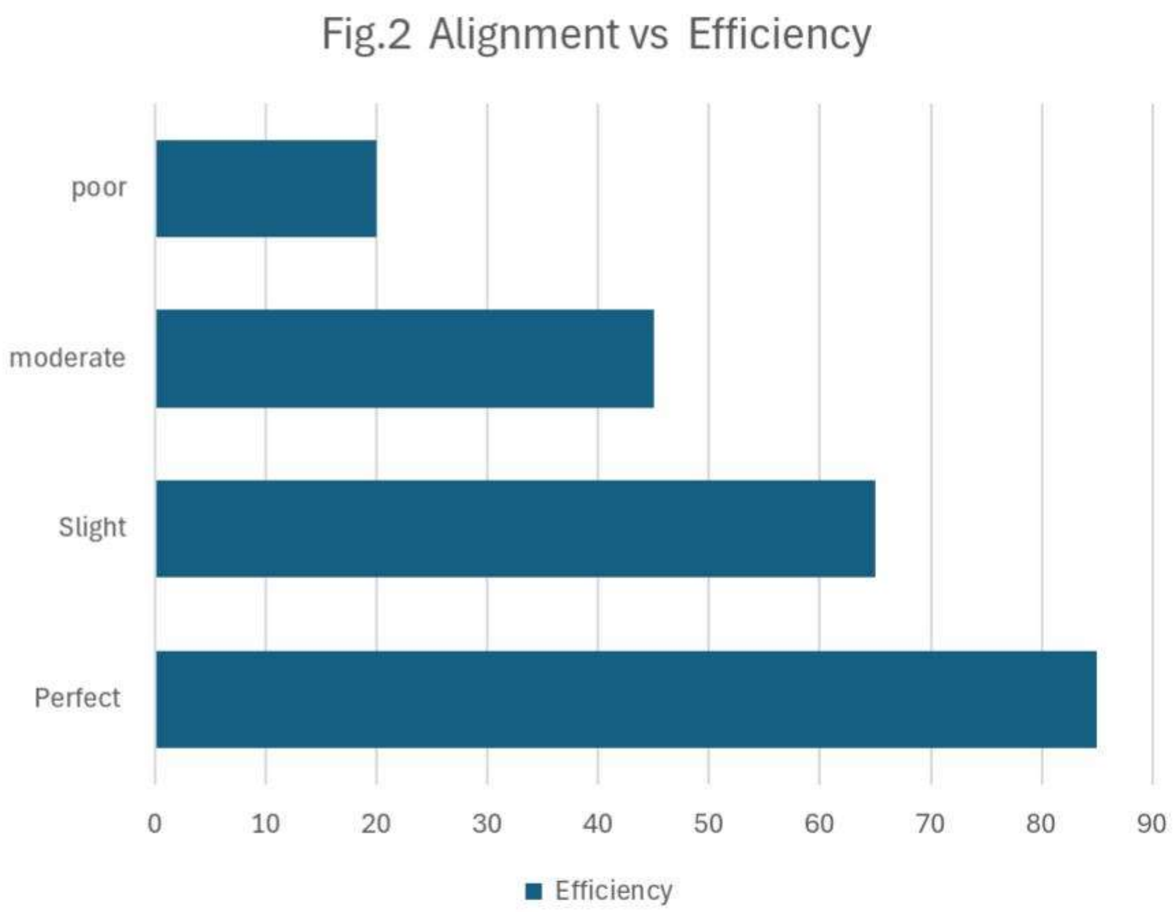
PROPOSED SYSTEM

The proposed system consists of a transmitter coil powered by a solar energy source and a receiver coil placed in the electric vehicle. The transmitter generates a high-frequency alternating current, which creates a magnetic field around the coil. When the receiver coil is placed within this magnetic field, an induced current is generated due to electromagnetic induction. This induced current is then converted into DC using a rectifier circuit and used to charge the battery. An Arduino Nano is used to control the system, while IR sensors detect vehicle presence and activate the charging mechanism automatically.

RESULTS & ANALYSIS



The performance of the developed wireless charging system was evaluated by analyzing the variation in output with respect to coil separation and alignment. It was observed that as the distance between the transmitting and receiving coils increases, the induced voltage at the receiver side decreases significantly due to weaker magnetic coupling.



Additionally, any misalignment between the coils leads to a noticeable drop in power transfer efficiency. The system delivers its best performance when both coils are properly aligned and placed at a minimal distance. These observations indicate that coil positioning plays a critical role in the effectiveness of inductive wireless charging systems, and maintaining optimal alignment is essential for achieving reliable energy transfer.

CONCLUSION

The project demonstrates the practical implementation of a wireless electric vehicle charging system using inductive power transfer combined with solar energy. As the adoption of electric vehicles continues to grow, conventional wired charging methods pose limitations such as inconvenience, infrastructure complexity, and safety concerns. This system addresses these challenges by enabling contactless power transfer, making the charging process simpler, safer, and more user-friendly.

The proposed model effectively uses transmitter and receiver coils to transfer energy through a magnetic field, eliminating the need for physical connections. Integration of renewable solar energy further enhances the sustainability of the system by reducing dependency on non-renewable resources and minimizing environmental impact. The inclusion of components such as Arduino Nano, sensors, and control circuits ensures proper system automation, monitoring, and efficient energy management.

From the analysis and testing, it is evident that wireless charging technology has strong potential for future transportation systems. It can significantly improve convenience by allowing both stationary and dynamic charging, thereby reducing charging time and range anxiety associated with electric vehicles.

However, certain challenges such as alignment of coils, efficiency over distance, and standardization still need to be addressed for large-scale implementation. Continuous research and technological advancements are required to overcome these limitations and improve system performance.

In conclusion, this project highlights wireless power transfer as a promising solution for next-generation electric vehicle charging. By combining inductive coupling with renewable energy sources, it presents a sustainable and efficient alternative to traditional charging methods. With further development, this technology has the potential to transform the EV ecosystem and play a significant role in achieving cleaner and smarter transportation systems.

REFERENCES

1. Supriyadi, Edi Rakhman, Suyanto, Arif Rahman and Noor Cholis Basjaruddin, "Development of a Wireless Power Transfer Circuit Based on Inductive Coupling, "TELKOMNIKA, Vol.16, No.3, June 2018, pp. 1013~1018
2. N. Uthaya Banu, U. Arun Kumar, A. Gokula Kannan, M.K. Hari Prasad and A.B. Shathish Sharma, "Wireless Power Transfer in Electric Vehicle by Using Solar Energy, " Asian Journal of Electrical Sciences, Volume 7, Issue 1, January-June 2018
3. Govind Yatnalkar and Husnu Narman, "Survey on Wireless Charging and Placement of Stations for Electric Vehicles, "Conference: 2018 IEEE International Symposium on Signal Processing and Information Technology (ISSPIT), December 2018
4. Md M. RANA, WEI XIANG, Internet of Things Infrastructure for Wireless Power Transfer Systems, IEEE Access, volume 6, pp.19295-19303, 24 Jan 2018.IEEE
5. Sahil Rupani, Nishant Doshi, A review on smart parking using internet on things (IOT), The 3rd International Workshop on Recent advances on Internet of Things: Technology and Application Approches (IoT-T&A 2019) Nov 2019, Coimbra, Portugal.
6. Julian Timpner, Lars Wolf, A Back-end System for an Autonomous Parking and Charging System for Electrical Vehicles, International Electrical Vehicle Conference Greenville, SC, USA IEEE 2012
7. Mehmet Sukru Kuran, Aline Carnerio Viana, Luigi Iannone, Daniel Kofman, Gregory Mermound, Jean P. Vasseur, A Smart Parking
8. Adilet Sultanbek, Auyez Khassenov, Yerassyl Kanapyanov, Madina Kenzhegaliyeva, Mehdi Nagheri, Intelligent Wireless Charging Station for Electrical Vehicles, International Siberian Conference on Control and Communication, 2017, IEEE
9. Zhe Wei, Yue Li, Yongmin Zhang, Lin Cal, Intelligent Parking Garage EV Charging Scheduling Considering Battery Charging Characteristic, IEEE Transaction on Industrial Electronics, Vol 65, 3 March 2018