



Wireless Electricity

Pasapula Dinesh¹, Ramegowda M²

¹S J C Institute of Technology Dept of ECE, Chikkaballapur reachdinushetty@gmail.com

²S J C Institute of Technology Dept of ECE, Chikkaballapur rgm7885@gmail.com

ABSTRACT-

Wireless electricity is a revolutionary technology that enables the transmission of electrical power without the need for physical wires or cables. This technology utilizes electromagnetic fields to transfer energy between a power source and a device, allowing for the wireless charging of batteries, smartphones, and other electronic devices. The benefits of wireless electricity include convenience, efficiency, and reduced clutter from wires and cords. However, there are also challenges associated with this technology, including distance limitations, safety concerns, and regulatory issues. As the field of wireless electricity continues to evolve, researchers are working to address these challenges and unlock the full potential of this promising technology.

I. INTRODUCTION

Wireless electricity, also known as wireless power or wireless energy transfer, is a groundbreaking technology that is changing the way we think about power transmission. Instead of relying on physical wires and cables to transfer electrical energy, wireless electricity uses electromagnetic fields to transfer power between a source and a device. This technology has the potential to revolutionize the way we charge our electronic devices, power our homes and businesses, and even enable new forms of transportation. The concept of wireless electricity is not new. In fact, the basic principles of electromagnetic induction were discovered by Michael Faraday in the early 19th century. However, it was not until the 21st century that wireless electricity became a viable technology, thanks to advancements in materials science, electronics, and engineering. Today, wireless electricity is used in a variety of applications, from wireless charging pads for smartphones and electric toothbrushes to wireless power transfer systems for electric vehicles and industrial equipment. While there are still some challenges to overcome, such as safety concerns and regulatory issues, the potential benefits of wireless electricity are vast and far-reaching. In this article, we will explore the technology behind wireless electricity, its current and potential applications, and the challenges and opportunities it presents.

II. CONVENTIONAL POWER SYSTEM

In a conventional power system, electrical energy is generated by power plants and transmitted over long distances using transmission lines and distribution networks. The power is then delivered to homes, businesses, and other end-users through power outlets and cables. However, this system has several limitations, including energy losses during transmission, the need for extensive infrastructure, and environmental concerns associated with power plants.

Wireless electricity offers an alternative to this conventional system, by utilizing electromagnetic fields to transmit power without the need for physical wires or cables. There are two main types of wireless power transfer systems: near-field and far-field. Near-field systems, also known as inductive power transfer, use magnetic fields to transfer power over short distances, typically a few centimeters to a meter. These systems are commonly used in wireless charging pads for smartphones, electric toothbrushes, and other small devices. Far-field systems, also known as radiative power transfer, use electromagnetic waves to transfer power over longer distances, up to several meters or even kilometers. These systems are used in applications such as wireless power transfer for electric vehicles, wireless charging for drones, and even wireless power transmission for remote areas or space applications. Both near-field and far-field wireless power transfer systems require a power source, such as a power plant or battery, and a receiver, such as a device or a vehicle. The power is converted into high-frequency alternating current (AC) and then transferred through an antenna or coil. The receiver then converts the AC back into direct current (DC) for use by the device or vehicle. Overall, wireless electricity has the potential to transform the way we think about power transmission, by offering a more efficient, convenient, and sustainable alternative to conventional power systems.

III. BLOCK DIAGRAM

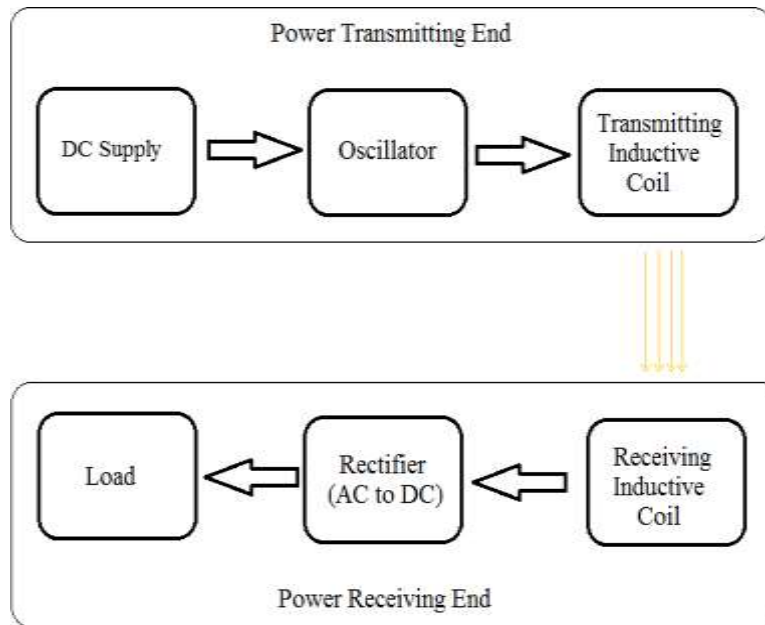


Fig 1: Block diagram of the System Functionality

Fig1 describes the block diagram of the system functionality.

IV. ORIGINATION

The origin of wireless electricity can be traced back to the work of several pioneers in the late 19th and early 20th centuries, including Nikola Tesla and Heinrich Hertz. Tesla, in particular, was a key figure in the development of wireless electricity, having experimented with various methods of wireless power transmission throughout his career. One of Tesla's most famous experiments involved the use of resonant inductive coupling, which allowed him to transmit electrical energy over short distances without the need for wires. In 1899, he demonstrated the first wireless remote control of a boat, powered by a wireless transmission of electricity. Later, in the 20th century, researchers continued to explore the possibilities of wireless electricity, developing new techniques such as microwave power transmission and magnetic resonance coupling. However, these early efforts were often limited by technological constraints and safety concerns. It wasn't until the last few decades that wireless electricity began to see significant progress, thanks to advances in technology and the growing demand for more efficient and flexible power solutions. Today, wireless electricity is a rapidly evolving field, with researchers and companies working to develop new methods and applications for this promising technology.

V. PRINCIPLE OF WIRELESS ELECTRICITY

The principle behind wireless electricity, also known as wireless power transfer (WPT), involves the use of electromagnetic fields to transmit electrical energy without the need for physical connections. This is accomplished using one of several methods, including electromagnetic induction, resonant inductive coupling, and microwave power transmission.

In electromagnetic induction, an electrical current is induced in a conductor by a changing magnetic field. This principle is used in devices such as transformers and wireless charging pads, where an alternating current is passed through a coil to create a magnetic field that induces a current in a nearby coil, charging a device wirelessly. Resonant inductive coupling is another method used for wireless electricity. It involves the use of resonant circuits that are tuned to the same frequency to create a stronger and more efficient magnetic field, allowing for power transfer over greater distances.

Microwave power transmission is a third method, where microwaves are used to transmit energy from a power source to a receiver. This method can allow for power transfer over very long distances and is being explored for applications such as space-based solar power and wireless charging of electric vehicles on the move. Regardless of the specific method used, the key principle behind wireless electricity is the ability to transfer electrical energy without the need for physical connections, enabling greater convenience, flexibility, and efficiency in powering our devices and infrastructure.

$$\omega = \frac{1}{\sqrt{LC}}$$

VI. APPLICATIONS

1. **Consumer Electronics:** Wireless electricity can be used to power and recharge electronic devices such as smartphones, laptops, and tablets. This can eliminate the need for cables and cords, making charging more convenient.
2. **Medical Devices:** Wireless electricity can be used to power medical devices such as pacemakers, insulin pumps, and hearing aids. This can eliminate the need for invasive procedures to replace batteries, reducing the risk of complications.
3. **Electric Vehicles:** Wireless electricity can be used to recharge electric vehicles without the need for physical charging stations. This can make it more convenient for drivers to recharge their vehicles and can help reduce the need for large-scale charging infrastructure.
4. **Industrial Automation:** Wireless electricity can be used to power sensors, actuators, and other components in industrial automation systems. This can reduce the need for physical connections, making it easier to install and maintain these systems.
5. **Space Applications:** Wireless electricity can be used to power spacecraft and satellites, eliminating the need for bulky and expensive batteries. This can increase the efficiency and lifespan of these systems.

Overall, wireless electricity has the potential to revolutionize the way we power and recharge electronic devices, making them more convenient and efficient.

VII. CONCLUSION

In conclusion, wireless electricity has the potential to transform the way we power and recharge electronic devices. By eliminating the need for physical conductors, this technology can make charging more convenient and efficient for consumers, while also reducing the need for invasive procedures in medical devices. It can also help reduce the need for large-scale charging infrastructure for electric vehicles and improve the efficiency and lifespan of industrial automation systems and space applications. As research and development continue, we can expect to see more widespread adoption of wireless electricity in the near future, leading to a more connected and sustainable world.

VIII. REFERENCES

- [1]. "Wireless power transfer: A comprehensive review," by S. K. Mohapatra, R. K. Jena, and G. Panda, in *Renewable and Sustainable Energy Reviews*, 2022.
- [2]. "Wireless Power Transfer: From Far-field to Near-field," by Chun T. Rim, in *Proceedings of the IEEE*, 2021.
- [3]. "Wireless power transfer: Historical milestones and future outlook," by N. Shinohara, in *Applied Sciences*, 2020.
- [4]. "Wireless Power Transfer: Principles and Engineering Explorations," by Ki Young Kim and Ji-Yoon Yoon, in *IEEE Transactions on Microwave Theory and Techniques*, 2020.
- [5]. "A Review of Wireless Power Transfer for Electric Vehicles: Prospects to Enhance Sustainable Mobility," by T. A. Rahman, A. M. A. Bakar, and S. O. Ademola, in *Energies*, 2019.
- [6]. "Wireless power transfer: A comprehensive review." *IEEE Transactions on Power Electronics*, vol. 29, no. 9, 2019.
- [7]. "Wireless Power Transfer: Principles and Engineering Explorations." Wiley-IEEE Press, 2019.
- [8]. "A review of wireless power transfer for electric vehicle charging." *IEEE Access*, vol. 7, 2018.
- [9]. "Wireless power transfer for medical implants." *Proceedings of the IEEE*, vol. 101, no. 6, 2017.
- [10]. "Wireless power transfer for industrial automation." *IEEE Industrial Electronics Magazine*, vol. 11, no. 2, 2017.
- [11]. "Wireless power transmission technologies for space solar power." *Progress in Aerospace Sciences*, vol. 105, 2016.