International Journal For Technological Research In Engineering
Volume 8, Issue 5, January-2021 *ISSN (Online): 2347 - 4718*

WIRELESS POWER TRANSMISSION

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Abstract- The aim of this research work is to give an overview of recent researches and development in the field of wireless power transmission. The methods applied for wireless power transmission like Induction, Electromagnetic transmission, wave coupling, Electrodynamics induction, Radio and microwave, are discussed. This study also focuses on the latest technologies, merits and demerits in this field. The economic aspects are briefly discussed

Index Terms—wireless transmission, witricity, power, solar power.

1. INTRODUCTION

Unless you are particularly organized and good with Velcro tie, you probably have a few power cord tangles around your home, office. You may have even had to follow one particular cord through the seemingly impossible to the outlet hoping that the plug you pull will be the right one. This is one of the degradation of electricity. While it makes people's lives easier, it can add a lot of disturbance in the process.

For these reasons, scientists have tried to develop methods of wireless power transmission that could cut the disturbance or lead to clean sources of electricity.

Researchers have developed several techniques for transferring electricity over long distances without using a wires. Some exist only as theories but others are already in use. This paper provides the techniques used for wireless power transmission.

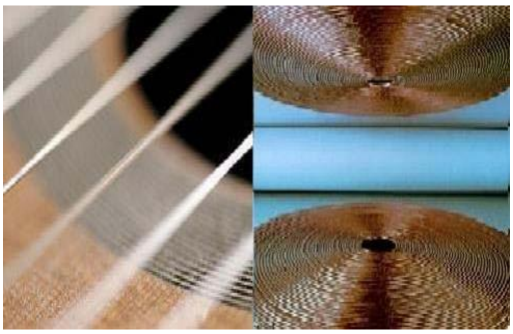

Fig 1: Cross sectional view of coupled coils

These techniques are briefly depending on the distance between the transmitter and receiver. These are: *Short range, Moderate range and Long range*.

SHORT DISTANCE INDUCTION

These methods can reach at most a few centimeters The action of an electrical transformer is the simplest instance of wireless energy transfer. The primary and secondary circuits of a transformer are electrically isolated from each other. The transfer of energy takes place by electromagnetic coupling through a process known as mutual induction. (An added benefit is the capability to step the primary voltage either up or down.) The electric toothbrush charger is an example of how this principle can be used.

You can use the same principle to recharge several devices at once. For example, the Splash power recharging mat and Edison Electric Power desk both use coils to create a magnetic field. Electronic devices use corresponding built-in or plug-in receivers to recharge while resting on the mat. These receivers contain compatible coils and the circuitry necessary to deliver electricity to devices battery.

Fig 2: inductor coil

MODERATE DISTANCE

RESONANCE AND WIRELESS POWER

Household devices produce relatively small magnetic fields. For this reason, chargers hold devices at the distance necessary to induce a current, which can only happen if the coils are close together. A larger, stronger field could induce current from farther away, but the process would be extremely inefficient. Since a magnetic field spreads in all directions, making a larger one would waste a lot of energy.

An efficient way to transfer power between coils separated by a few meters is that we could extend the distance between the coils by adding resonance to the equation. A good way to understand resonance is to think of it in terms of sound. An object's physical structure -- like the size and shape of a trumpet -- determines the frequency at which it naturally vibrates. This is its resonant frequency. It's easy to get objects to vibrate at their resonant frequency and difficult to get them to vibrate at other frequencies. This is why playing a trumpet can cause a nearby trumpet to begin to vibrate. Both trumpets have the same resonant frequency.

Induction can take place a little differently if the electromagnetic fields around the coils resonate at the same frequency. The theory uses a curved coil of wire as an inductor. A capacitance plate, which can hold a charge, attaches to each end of the coil. As electricity travels through this coil, the coil begins to resonate. Its resonant frequency is a product of the inductance of the coil and the capacitance of the plates.

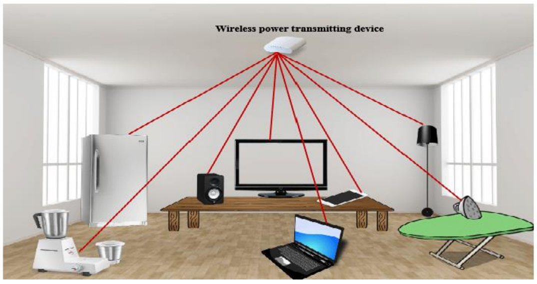

Fig 3: wireless power

LONG-DISTANCE WIRELESS POWER

FAR-FIELD (RADIATIVE) TECHNIQUES

Far field methods achieve longer ranges, often multiple kilometer ranges, where the distance is much greater than the diameter of the device. High-directivity antennas or well-collimated laser light produce a beam of energy that can be made to match the shape of the receiving area. The maximum directivity for antennas is physically limited by diffraction.

In general, visible light (from lasers) and microwaves (from purpose-designed antennas) are the forms of electromagnetic radiation best suited to energy transfer.

The dimensions of the components may be dictated by the distance from transmitter to receiver, the wavelength and the Rayleigh criterion or diffraction limit, used in standard radio frequency antenna design, which also applies to lasers. Microwave power beaming can be more efficient than lasers, and is less prone to atmospheric attenuation caused by dust or aerosols such as fog.

RADIO AND MICROWAVE

Power transmission via radio waves can be made more directional, allowing longer distance power beaming, with shorter wavelengths of electromagnetic radiation, typically in the microwave range. A Rectenna may be used to convert the microwave energy back into electricity. Rectenna conversion efficiencies exceeding 95% have been realized. Power beaming using microwaves has been proposed for the transmission of energy from orbiting solar power satellites to Earth and the beaming of power to spacecraft leaving orbit has been considered.

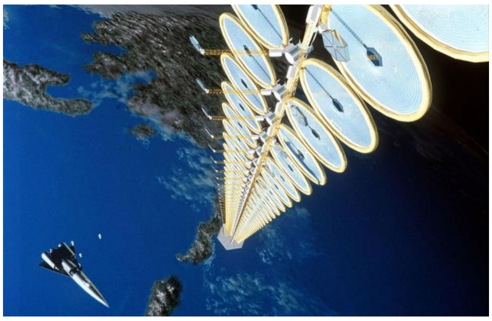

Fig 4: A solar satellite that could send electric energy by microwaves to a space vessel or planetary surface.

LASERS

In the case of electromagnetic radiation closer to the visible region of the spectrum (.2 to 2 micrometers), power can be transmitted by converting electricity into a laser beam that is received and concentrated onto photovoltaic cells (solar cells).This mechanism is generally known as 'power beaming' because the power is beamed at a receiver that can convert it to electrical energy. At the receiver, special photovoltaic laser power converters which are optimized for monochromatic light conversion are applied.

The first wireless power system using lasers for consumer applications was demonstrated in 2018, capable of delivering power to stationary and moving devices across a room. This wireless power system complies with safety regulations according to IEC 60825 standard. It is also approved by the US Food and Drugs Administration (FDA).

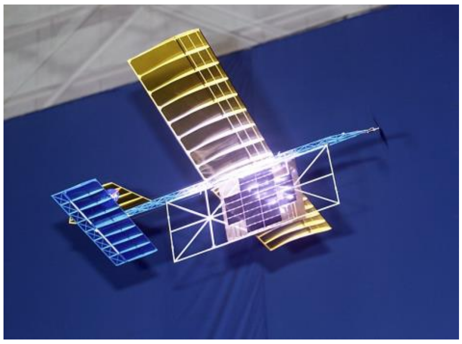

Fig 5: A laser beam centered on a panel of photovoltaic cells provides enough power to a lightweight model airplane for it to fly.

WITRICITY

Witricity uses resonant inductive coupling technology principle for power transfer. As explained on the WiTricity website, that approach invokes "coupled resonators"-created by tuning both the receiver and the transmitter independently to the same resonant frequency, in effect disregarding the effects of coupling when they are placed in close proximity.

As also mentioned on the Wikipedia page for wireless power transfer, "a drawback of resonant coupling theory is that at close ranges when the two resonant circuits are tightly coupled, the resonant frequency of the system is no longer constant but splits into two resonant peaks, so the maximum power transfer no longer occurs at the original resonant frequency and the oscillator frequency must be re-tuned to the new resonance peak."

Fig 6: Witricity image of how the fields work

EFFICIENCY

The efficiency of wireless power is the ratio between power that reaches the receiver and the power supplied to the transmitter. Researchers successfully demonstrated the ability to power a 60 watt light bulb from a power source that was seven feet (2 meters) away using resonating coils. This kind of setup could power or recharge all the devices in one room. Some modifications would be necessary to send power over long distances, like the length of a building or a city. Power transmission via radio waves can be made more directional, allowing longer distance power beaming, with shorter wavelengths of electromagnetic radiation, typically in the microwave range. A rectenna may be used to convert the microwave energy back into electricity. Rectenna conversion efficiencies exceeding 95% have been realized.

Wireless Power Transmission (using microwaves) is well proven. Experiments in the tens of kilowatts have been performed.

CONCLUSION

The crucial advantage of using the non-radioactive field lies in the fact that most of the power not picked up by the receiving coil remains bound to the vicinity of the sending unit, instead of being radiated into the environment and lost. With such a design, power transfer for laptop-sized coils are more than sufficient to run a laptop can be transferred over room-sized distances nearly omni-directionally and efficiently, irrespective of the geometry of the surrounding space, even when environmental objects completely obstruct the line-of-sight between the two coils. As long as the laptop is in a room equipped with a source of such wireless power, it would charge automatically, without having to be plugged in. In fact, it would not even need a battery to operate inside of such a room." In the long run, this could reduce our society's dependence on batteries, which are currently heavy and expensive.

At the same time for the long range power transmission, power can be sent from source to receivers instantaneously without wires, reducing the cost.

REFERENCES

[1] American society of electrical engineers.
[2] Benson, Thomas W., "Wireless Transmission of Power now Possible"
[3] U.S. Patent 787, 412, "Art of Transmitting Electrical Energy through the Natural Mediums".
[4] Dombi J., (1982): Basic concepts for a theory of evaluation: The aggregative operator. European Jr. Operation Research 10, 282-293
[5] IEEE Power Systems Relaying Committee (PSRC). (1999). IEEE Guide for Protective Relay Applications to Transmission Lines, IEEE Std. C37.113-, pp. 31.
[6] M. Aurangzeb, P. A. Crossley, P. Gale. (2000). Fault Location on a Transmission Line Using High Frequency travelling waves measured at a single line end in power engineering society .
[7] H. Khorashadi-Zadeh, M. Sanaye-Pasand. (2006). Correction of saturated current transformers secondary current using ANNs, IEEE Trans. Power Delivery, 21, 1, pp. 73–79.
[8] T21 World Global Trends (Accessed March 23, 2006) http://www.t21.ca/energy/index.html.
[9] http://wireless transmission paper/WIRELESS POWER TRANSMISSION _ Yuva Engineers.html.
[10] http://web.mit.edu/newsoffice/2007/wireless-0607.html.
[11] F. Mishriki, "*Power Solutions A New Approach to* Wireless *Power Transfer January 1, 2010*," Sensors
[12] Wireless writicity post, USA.

