

A Review on Characteristics of Wireless Power Transfer

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Abstract: In this paper we discuss the various types of WPT scheme implementations. we analysis wireless power transfer, we discuss the advantage and disadvantage of wireless transfer system, current trends of WPT system technology and research done by various researchers in the field of WPT system. WPT is the transmission of power from AC source to batteries without wire or connector is called wireless power transfer. Today WPT technology used in many applications smart devices household products and the various field of electronics by the use of technology wireless power transfer we can remove the wired connectors and other mode of transferring power physical link due to this the mobility and use of these devices become convenient for everyone the use of WPT technology in near future increases rapidly research and development work in WPT maybe increase in near future the distance between power transfer wireless link or power receiving source like rechargeable device or battery source or increases the power voltage transfer capacity are the main research and development areas for future development.

Keywords: WPT (wireless power transfer), CPT (capacitive power transfer), IPT (inductive power transfer), MPT (Microwave Power Transfer), LPT (Laser power transfer)

I. INTRODUCTION

Long time ago in many type of power transmission done by wired network and physical link between power transmission and power receiver source without physical link or wired connection power transmission not possible but in with the advancement of technology power transmission without wire or any physical link or connectors happen possible. The 19th century saw many developments in techniques of transferring electrical power from AC source to rechargeable devices, batteries [1][2].

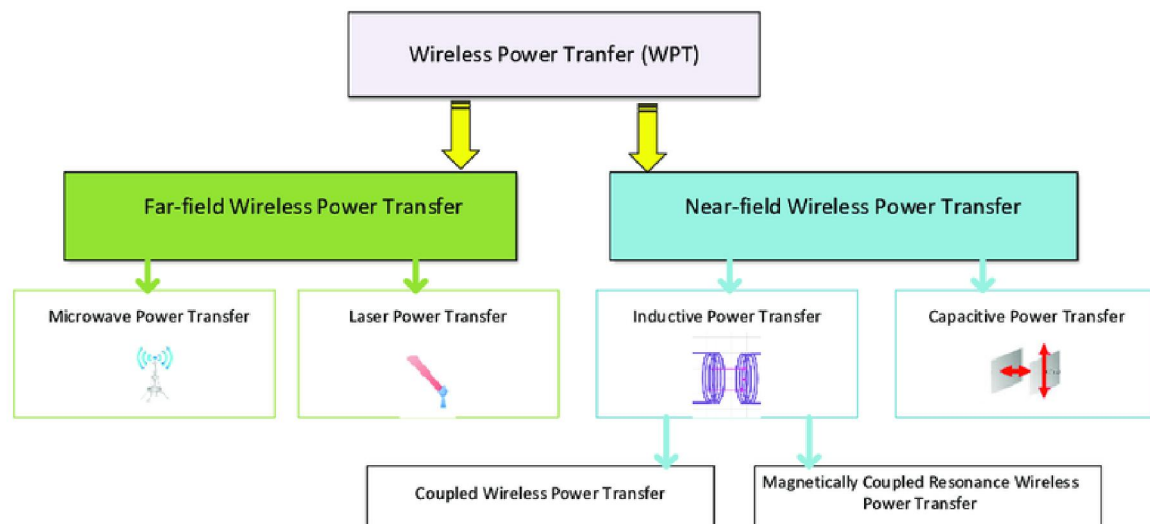


Figure 1: Wireless Power Transfer Classification

In the figure 1 given above based on distance between power transmission source and power receiving source WPT can be grouped into two types, namely:

1. Far field based WPT system
2. Near field based WPT system

1.1 Far field based WPT system

In far field WPT system radioactive techniques used in this type of power transfer system power is transferred by a medium which is called beams of electromagnetic radiation, like microwaves or laser beams. using these techniques we can transport energy longer distances and focus of this beams always on aimed at the receiver [3].

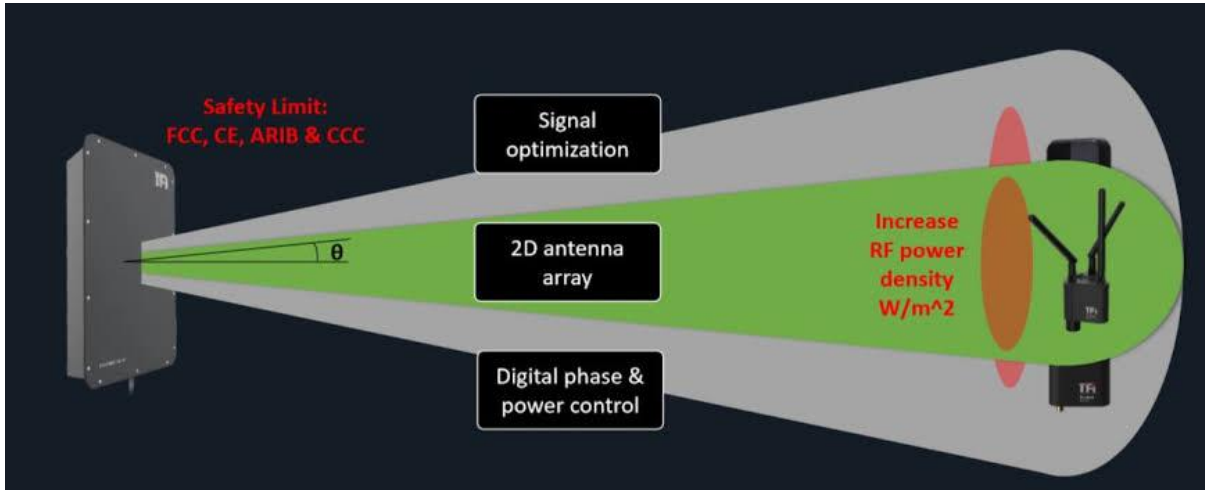


Figure 2: Far field related wireless power transfer system

1.2 Near field based WPT system

Near field WPT system operates based on the near-field electromagnetic coupling of coils. In near field WPT system radioactive operates based on the near-field electromagnetic coupling of coils. Techniques used in this type of power transfer system power are transferred by the near-field electromagnetic coupling of coils. By using these techniques we can transport power at distances. This type of technology transfer power very short distances in which by using same dimensions coils. In this type of system we can increase power transfer distance by using flat relay resonators [4] [5].

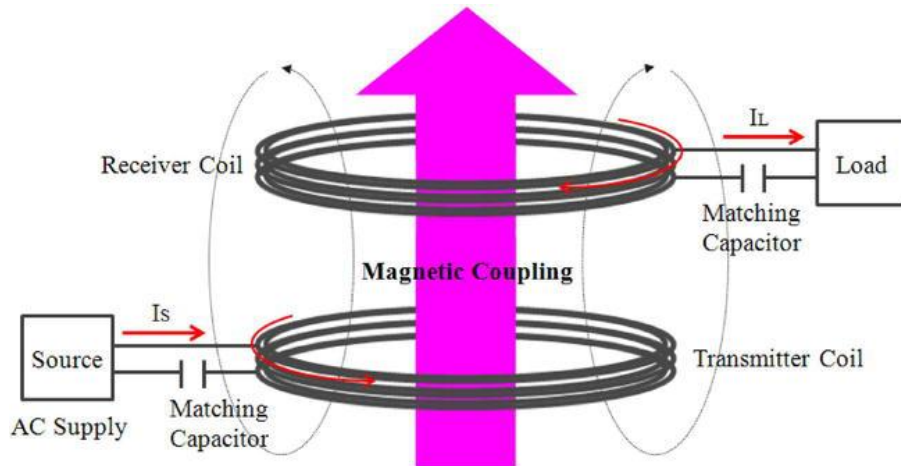


Figure 3 near field wireless power transfer system

II. TPYES OF FAR FIELD AND NEAR FIELD WPT

There are three types of WPT system are used mostly in far field WPT system.

- (a). Microwave power transmission (MPT)
- (b). Laser power transfer (LPT)
- (c). Solar powered based satellite (SPS)

2.1 Microwave Power Transmission (MPT)

It plays very vital role in the fields of WPT system. Microwave power transmission system mostly used in far filed WPT system in this type of power transmission system we know that we can't transfer AC (alternating current) easily in the form of microwave power transmission system so overcome from this issue firstly AC to DC converter used which convert the AC into DC after the conversion of AC power into DC power in microwave power transmission work on the principle of electromagnetic radiations in this type of wireless power transmission system magnetron participated we know that when we flow the electrons in magnetrons in that condition it is generated microwaves which controlled by external magnetic field in this type of WPT system a high power electromagnetic beam worked between transmitting and receiving point for this type of transmission it is very necessary that two point firstly transmitting point and secondly receiving point come into the same line of sight [6] [7].

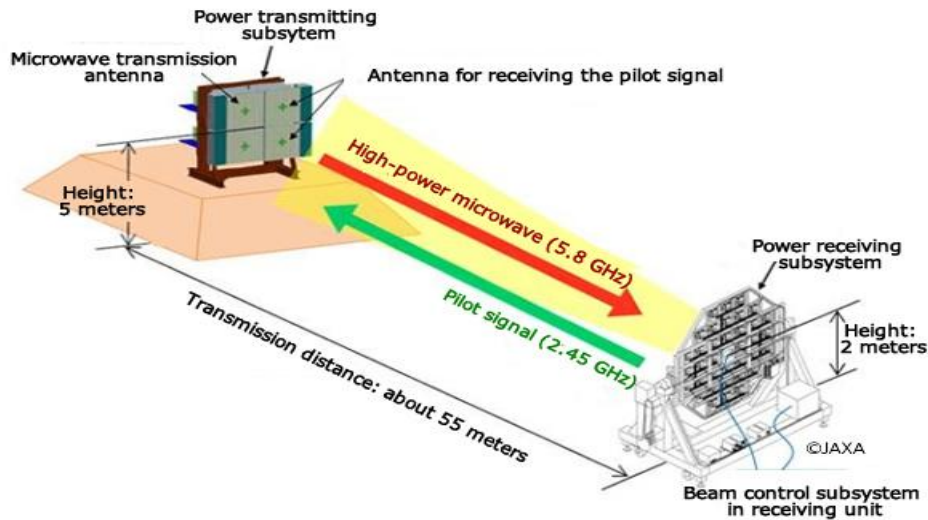


Figure 4 Microwave power transfer

2.2 Laser Power Transfer

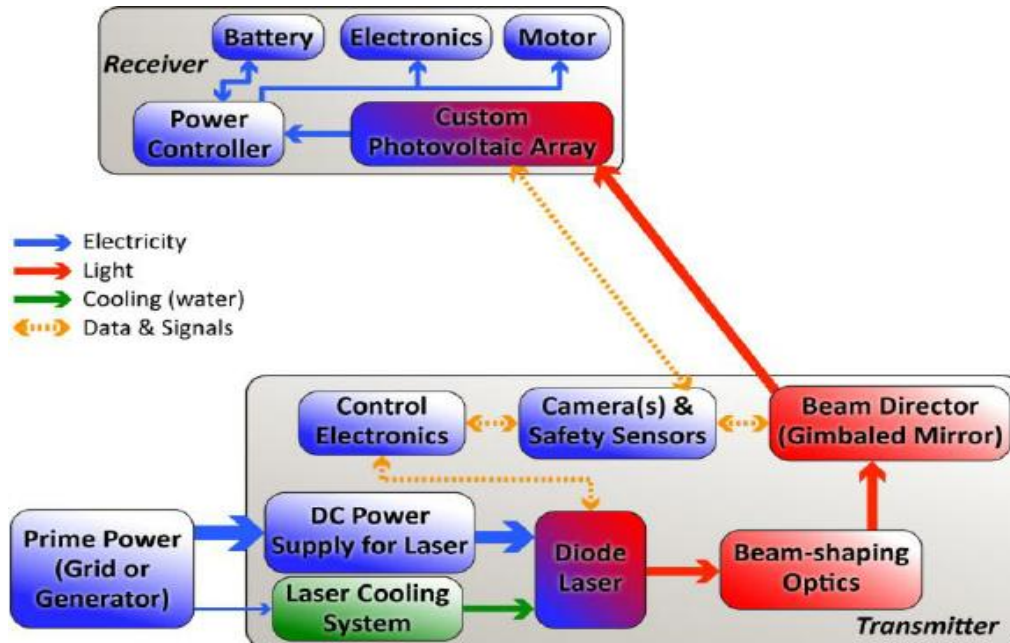


Figure 5: Laser power transfer

Laser based wireless power transmission is another concept for transmission of wireless power between transmission and receiver point but in reality it is very complicated and costly technique the reason behind is that in LPT high focused powerful light from transmission point to transfer to the receiver point receiver point equipped with photovoltaic cells which convert the light into energy main disadvantage of this type of technique is that it's required transmission of laser light from same line of sight to the receiver point if any distortion happened between transmission and receiver point in that circumstances transmission power may be revoked for some time strong laser light is very dangerous and harmful for humans and animals robust tracking devices and surveillance system are required which may be costly for implementing [8] [9].

2.3 Solar Powered Satellite

It is the another type of wireless power transmission in this type of wireless power transmission satellite which are deployed in our solar environment and moves around the earth get power from sun in the form of solar energy this energy transfer to the earth in the form of microwave energy in other words we say that solar powered satellite works as transmission point and antenna , telephone tower, drone, aircraft etc works as receiver point in this type of wireless communication [10].

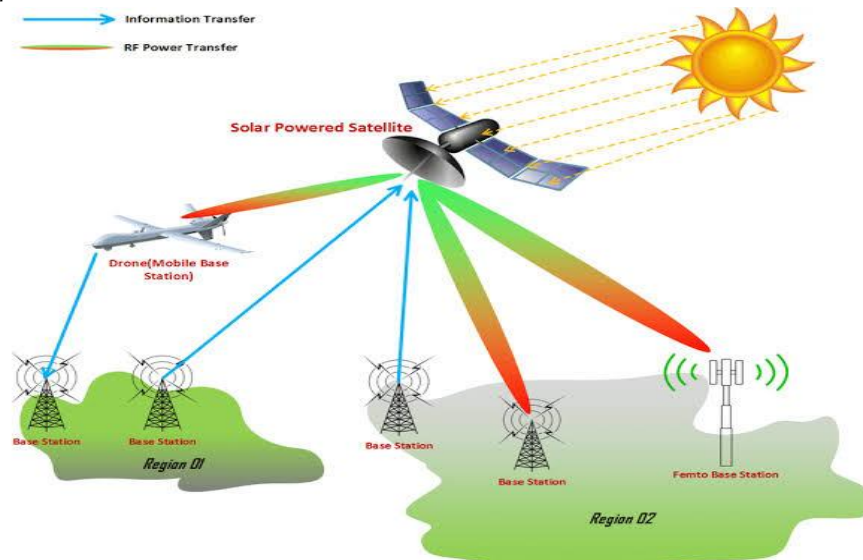


Figure 6 Solar power based WPT system

There are two types of WPT system are used mostly in near field WPT system.

1. Inductive Power Transfer (IPT)
 - (i) Coupled WPT System
 - (ii) Magnetically Coupled Resonance WPT system
2. Capacitive Power Transfer (CPT)

A. Inductive Power Transfer (IPT)

Inductive WPT technology categorized into near field wireless transfer technology we know that inductive power technology based on faraday's law which introduced the magnetic induction concept firstly demonstrated by Tesla in 1914 practically in inductive power transfer current flow by the source coil which produces a magnetic flux after that it's induces a current flow in the load coil inductive based WPT technology mostly used in smart devices and household electronics applications [11].

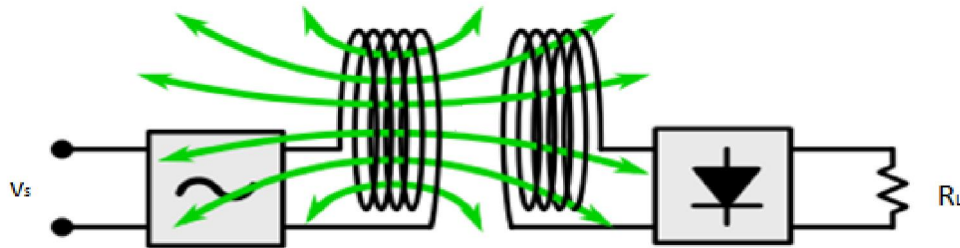


Figure 7 Inductive coupling transfer

B. Coupled WPT System

Coupled WPT system is the main technology in WPT system it's used many types of applications there are some benefits of this type of technology but some disadvantages of this technology which we are discuss one by one we know that inductive coupling technology mostly used in low power WPT based charging and powered based devices inductive coupling main disadvantage are firstly it is provide WPT services for distance upto 20 cm and when we increased it's distance power efficiency decreases with increasing distance and it's inductive frequency range from hertz to kilohertz and used for very low powered electronics based applications. It is show non-radiative behavior because its transmission frequency is very low due to it's low power transmission it's safe to people and not harmful it's easy to implement and install power transfer in this type of wireless power transfer transmission happen from coil to coil it's used in electronics applications like RFID devices, wireless sensors devices which requires power, complicated vehicle devices and smart devices etc [12].

C. Magnetically Coupled Resonance WPT System

Magnetically coupled resonance WPT system follows the same fundamental concepts as inductive coupled WPT system. It also transports electricity from a source to a load. In this type of WPT technology same range resonant frequency applied between magnetically coupled resonance coils. But it's efficiency much better then Coupled WPT system based on high power transmission and good range upto several meter for wireless power transmission and it's range of transmission of energy from few kHz to 10 MHz but compared to Coupled WPT system Magnetically Coupled Resonance WPT system is not easy to implement due to it's complicated techniques its shows 50% more efficiency compared to inductive coupling in terms of power transfer due to its high voltage wireless power transfer capacity and good range compared to inductive coupling up to several meters it's used many household based electronics applications, electronics cars and vehicles etc [13].

D. Capacitive Power Transfer

In Capacitive Power Transfer transferring of power implemented between electrodes which made from metal plates. In this type of technology first we make charged retaining capacitor with the help of two electrodes which make made from metal surface first electrodes acts as transmission point of power and second electrodes works as receiver point of power and capacitive wireless power transmission happen between both electrodes at transmitter electrodes creates alternating voltage which induce by the concept of electrostatic induction on receiver electrodes after this process AC current flow in the load circuit practically CPT system implementation and installation is not costly compared to Inductive coupling based power transfer and magnetically coupling based power transfer but capacitive power transfer required very low space between or distance between two metal plates or electrodes in which firstly act as transmission point of power and secondly as receiver point of power but there are some disadvantage of capacitive coupling is that firstly electric field do not shared or provide safety characteristics as like magnetic field due to this dangerous and safety level is very low for humans and electronics circuit and devices but in terms of efficiency it is much better then Inductive power transfer [14].

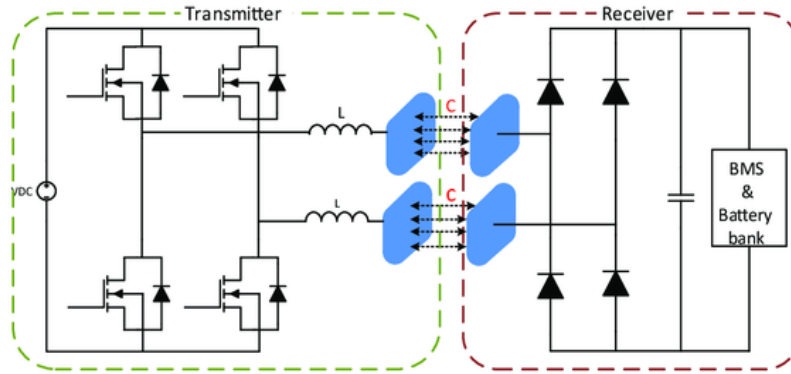


Figure 8 Capacitive coupling transfer

III. COMARISION OF WIRELESS POWER TRANSFER TECHNOLOGY

Table I

Technology	Efficiency	EMI	Frequency	Cost	Size/ Volume	Complexity of System	Suggested Power Level
Inductive Power Transfer	medium	medium	10-50 kHz	medium	medium	medium	medium/ high
Capacitive Power Transfer	low	medium	100-500 kHz	low	low	medium	low
Permanent Magnet Coupling Power Transfer	low	high	100-500 kHz	high	high	high	medium/ low
Resonant Inductive Power Transfer	medium	low	1-20 MHz	medium	medium	medium	medium/ low
Online Inductive Power Transfer	medium	medium	10-50 kHz	high	high	medium	high
Resonant Antenna Power Transfer	medium	medium	100-500 kHz	medium	medium	medium	medium/ low

IV. CONCLUSION

After the review of this paper we reached on the following conclusion is that various types wireless power transfer technology came into existence based on types of technology which implement in various types of wireless power transmission it's differ from each other based on performance parameters like efficiency, EMI, Frequency, cost of implementing and installation in various applications, size and it's volume, complexity of the technology and suggested power level based on electronics applications in which it's implement research and development work is the requirement of the future various types of research work done by researchers worldwide main focus of the research is that to improved the efficiency of the WPT system firstly increased the distance of WPT between two point from transmission point to receiver point secondly improved the efficiency level by decreasing power loss between two point from transmission point to receiving point, third decreases the complexity and for implementing and installation for various electronics applications as per requirement of the power.

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