

# Modeling of 'Tesla Rooms' based on Wireless Power Transfer Technology

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**Abstract** – We introduce 'Tesla Rooms' that has the capability of powering all the devices in the room wirelessly. As we know, we are surrounded by a huge number of gadgets and electronic devices that either require wired supply from the mains or are powered by a chemical battery source. Wires lead to messy structures which in turn lead to loss of mobility of devices while on the other hand batteries are a big hurdle towards efficient and durable handy electronic devices. We are trying to build a room using most popular conventional as well as advanced methods to develop a room that focuses on various wireless power transfer technologies.

**Key Words:** Tesla Room; WiTricity; WPT; Class D & E amplifiers; Coils; Magnetic resonance; Resonant Frequencies.

## 1. INTRODUCTION

In an era of booming electronic products, we are flooded with a huge number of electronic gadgets that either requires a wired power supply or has a battery-powered system to power these devices. Wired devices have the biggest disadvantage of messy wiring and limitations in mobility where on the other hand battery-powered devices like cell phone and other wearable electronic products face the problem of shortage of battery capacity. Though there are advancements in increasing capacity of battery there will always be a need for more, with growing functionalities and importance of these products in our daily activities. The wireless medium of power transmission overcomes all of these disadvantages.

Wireless power transmission techniques have greatly evolved in recent times and Tesla Room is an outcome of these evolutions. This room consists of a combination of most conventional and advanced methods of wireless power transmission i.e. inductive coupling and resonance based inductive coupling. The name Tesla Room is given to pay tribute the great scientist Nikola Tesla whose pioneering ideas and experiments laid the foundation of wireless power

transmission. Later remarkable advancements were achieved through research in this field of which one of the honorable mention goes to the experiments of Marin Soljagic Croatian-American physicist and electrical engineer known for wireless non-radiative energy transfer i.e. resonance based inductive coupling. In this paper, we will have a comparative study of various methods of wireless power transmission and how efficiently we can utilize them to build Tesla Room.

### 1.1 Inductive coupling mechanism for wireless transmission of electricity:

Inductive coupling works on principles of electromagnetism. The source and transmitter in this method are very close to each other but stand isolated. The distance between transmitter and receiver is very short and hence this method is also known as the short range transmission method.

In this method as soon as the primary coil is applied with an A.C. source EMF is generated in the coil which in turn leads to mutual induction on the secondary coil. Due to the action of mutual induction, an inductive coupling mechanism is formed between transmitter and receiver leading to a wireless flow of power. The amount of power transmitted in this method largely depends on the turns ratio and material of the coil. The transformers used in electronic appliances are a good example of inductive coupling. This method is also very efficient and useful for close contact power transmission of devices placed in Tesla Room.

The main disadvantage of this technique is the high power dissipation in terms of heat.

### 1.2 Highly resonant wireless power transmission:

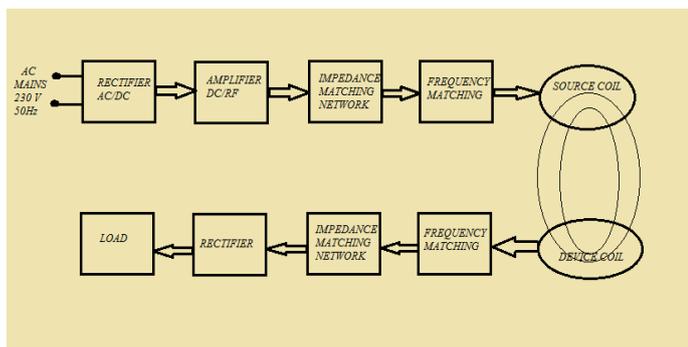
Resonance is the phenomenon in which an object vibrates on a particular frequency, which is applied to it by an external source. Highly resonant wireless power transmission system two basic principles are involved, firstly inductive coupling mechanism and secondly the resonance. After a research, it was observed that the distance can be increased from short range to medium range in inductive coupling by using the principle of resonance.

In this system along with the phenomenon of mutual induction, both the transmitter and receiver are tuned to same frequencies to achieve a comparatively longer distance of wireless power transmission. This method was brought up by Marin Soljagic Croatian-American physicist and electrical engineer. In one of his experiments, he demonstrated powering of 60W bulb wirelessly at a distance of 3 feet using 5 turns copper coil at both transmitter and receiver end at a rough efficiency of 90%. This was greatly achieved due to strong resonant coupling between electromagnetic resonant objects. Nowadays this technique is also known as WiTricity.

This method used is a nonradiative method and can be efficiently used for power transmission up to few meters. No power loss is caused due to the interacting objects placed between source and receiver and also isn't harmful to a human being in any case.

## 2. Designing and Structural implementation of Tesla Room.

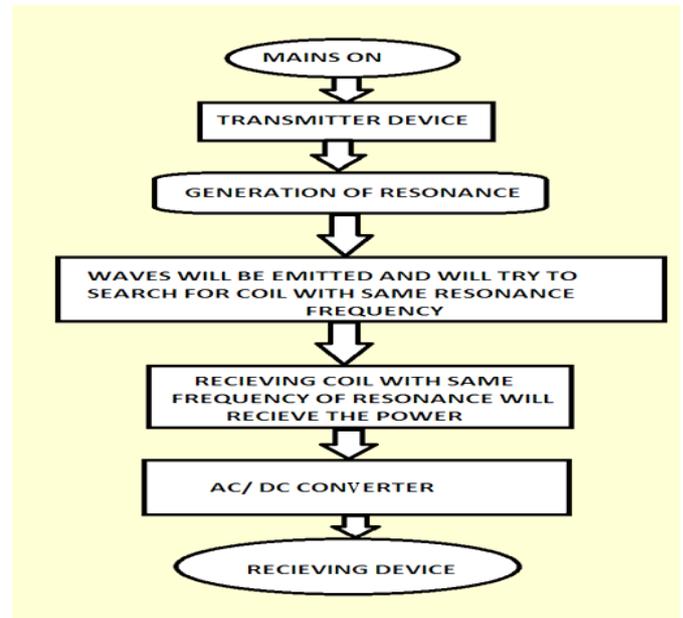
Considering the various methods of wireless power transfer every method has few common flaws such as the size of transmitting coil and losses due to heating of coils. These flaws could be tackled using cooling techniques for the coil but this in return would increase the dimension of the transmitter. To solve this problem we have emerged with the structuring of Tesla Rooms.



**Fig -1: Block Diagram of Wireless Power Transfer used in Tesla Room.**

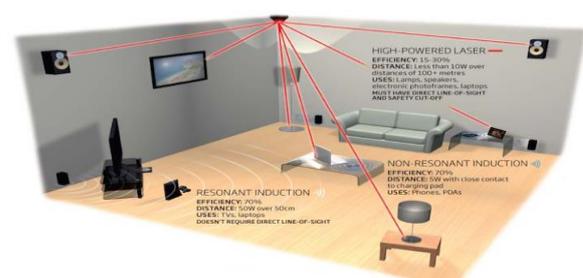
Tesla Room mainly focusses on the problem of the huge size of the coil and its heating tendency. In the structuring of tesla room, the huge coils are embedded inside the walls in the form of grids along with the cooling elements involved in keeping the coil at room temperatures. As we are embedding the coils in the walls of the room it gives us the advantage of more availability of free space in the room and also increase in a range of the power transmission increases considerably making the room truly wireless. Also the grid structure for embedding the coil give us the advantage to activate only

those transmitting coils which are in the range if receiver while disabling the other at the same time. Tesla Room not only focuses on the midrange power transmission methods but a combination of all the methods to improve the power transfer efficiency depending upon the distance between transmitter and receiver.



**Flow Chart -1: Energy transfer from transmitter to the receiver.**

Working of Tesla room can be explained using Fig-1 and flow chart-1. As soon as the wireless transmission system is turned on it will have an AC mains 230 V input. This input is then rectified using rectifiers and given to RF generator for generating the resonance. Further impedance and frequency matching networks are used to tune the circuit of transmitter and receiver to increase the efficiency of power transfer. As soon as the resonance is generated and frequency and impedance matched the coil is charged and resonated at the tuned frequency. At the receiver end, as soon as the frequencies of transmitter and receiver are matched we have efficient wireless power transmission taking place. For the receiver to receive the power transmitted it is mandatory for the receiver end coil to match the frequency and impedance parameters of a transmitter. No other objects in the room are affected due to this technique because there is no power transmission taking place until the frequency matching.



**Fig -2:** The Ideal image of Tesla Room consisting of various Wireless Power Transmission techniques.

### 3. CONCLUSIONS

Implementation of Tesla Room can increase the scope of wireless power transfer without any hurdles of the size of the coil. Also, the problem of excessive heating of coil can be efficiently solved using cooling techniques to minimize the losses in wireless power transmission leading to a higher efficiency. Tesla Rooms are the representation of our futuristic homes.

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