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Wireless Power Transfer by Using Inductive Coupling

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Abstract: - The Wireless power transfer (WPT) is an efficient transmission of transferring the power without using wires or electrical conductors as a physical connection. The Wireless power transfer can eliminate the use of the wires and the batteries, thus increasing the mobility, convenience, and safety of an electronic devices for all users. The objective of this paper is to design and construct a method to transmit power wirelessly through air gap and charge low power devices. Wireless power transfer is useful to power electrical devices where interconnecting wires are inconvenient, hazardous, or are not possible.

Key Words— ***Wireless Power Transfer, Low power devices , Electrical devices.***

I. INTRODUCTION

In present electricity generation the transmission and distribution losses are the main concern of the present power technology. The transmission and distribution system causes some losses of 26% to 30 % of the energy generated. The transmission of power without using wires is very efficient way to overcome from transmission and distribution losses.
Nikola Tesla is the one who first conceived the idea Wireless Power Transmission and demonstrated “the transmission of electrical energy without wires" that depends upon electrical conductivity as early as 1891[2]. In 1893, Tesla demonstrated the illumination of vacuum bulbs without using wires for power transmission at the World Columbian Exposition in Chicago. The Wardenclyffe tower was designed and constructed by Tesla mainly for wireless transmission of electrical power rather than telegraphy.
The power can be transmitted using Inductive coupling for short range, Resonant Induction for mid-range and Electromagnetic wave power transfer for high range. WPT is a technology that can transport power to the locations, which are otherwise not possible or impractical to reach. Charging low power devices and eventually mid power devices by means of inductive coupling could be the next big thing. Major issue in power system is the losses which occur in the transmission and distribution of electrical power from the generating station. The power losses mainly occur due to resistance of wires or conductors used in the power system. Hence wireless power system is the best alternative for efficient power transfer as it does not involve conductors and hence no losses occur associated with it.

II. LITERATURE SURVEY

- It is the transmission of power without using wires.
- Its principle is based upon Faraday law of Electromagnetic induction.
- The cost of the distribution and transmission become less.
- The power can be transmitted to places to which the wired transmission is not possible.
- Reliable and fast technology.

III. WIRELESS POWER TRANSFER TECHNOLOGY

A. Near Field Technique

Inductive Coupling: Inductive coupling generally defined as coupling between to LC circuits where resonant frequency is same. It works by using magnetic field induction that is the natural part of current’s movement through wire, as an example alternating current in a primary coil that is connected to a source can produce a varying magnetic field that induces a voltage across the terminals of a secondary coil at the receiver. Primary and secondary coils are two distinct coils in inductive coupling.
Resonant Inductive Coupling: Resonant inductive coupling is transmitting power between two coils that are tuned to resonate at the same frequency. Resonance occurs when the self-resonant frequency of coils equal to the frequency of AC power supply, when the equivalent Circuits of coils in high frequency have the minimum impedance. Then, the most

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energy will be transferred from the resonant path. Resonant transfer works by making a capacitively loaded primary coil ring with an oscillating current. This Generates an oscillating magnetic field. Because the coil is highly resonant, any energy placed in the coil dies away relatively slowly over very many cycles; but if a second coil is brought near it, the coil can pick up most of the energy before it is lost, even if it is some distance away. The fields used are predominately non-radiative.

Air Ionisation: Ionisation of air is the toughest technique of energy transfer. When the electric field becomes very strong around 2.11MV/m, Conditions are ripe for the air to begin breaking down. The Electric field causes the surrounding air to become separated into positive ions and electrons – the air is ionized. The ionization does not mean that there is more negative charge (electrons) or more positive charge (positive atomic nuclei / positive ions) than before. The importance of this separation/stripping Is that the electrons are now free to move much more easily than they could before the separation. So this ionized air is much more conductive than the previous non-ionized air. Incidentally, the ability or freedom of the electrons to move is what makes any material a good conductor of electricity.

B. *Far Field Technology*

Microwave Transmission: It is possible to achieve a long range using this method. In this method, Microwave is sent to the long distances which are received through Rectenna. The main Problem with this particular strategy is how the diameter of antenna needs to be order of kilometre. Power transmission via radio waves can be produced more directional, allowing longer distance power beaming, with shorter wavelengths of electromagnetic radiation, typically in the microwave range. Rectenna conversion efficiencies exceeding 95% are actually realized.

Laser Transmission: In this particular method, laser is beamed for the photovoltaic cells which extract the electrical energy. This method is quite challenging to implement and manage.

IV. SYSTEM ARCHITECTURE

Wireless power transfer Wireless power transmission (WPT) is the efficient transmission of electric power from one point to another through vacuum or an atmosphere without the use of wire or any other substance.

AC Power Supply: In WPT 230V AC supply is given to the step down transformer.

Step Down Transformer: The 230V AC supply is then given to the transformer which is a step down transformer. As because the transformer only operates on AC supply it is necessary to give the AC supply to the system. This step down transformer converts 230V to 23V.

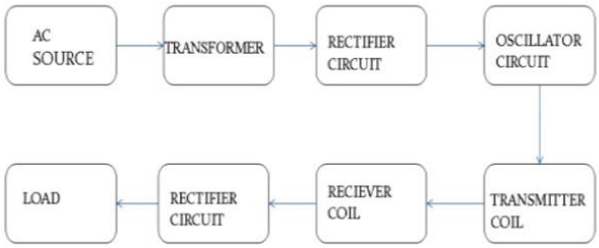

Fig.1. Block diagram of Wireless Power Transfer

Fig.2. Experimental setup of WPT

Rectifier Circuit: The rectifier is a device that converts AC signals to DC signals. In this we used the bridge rectifier because the bridge rectifier works in both positive and negative half cycle. That gives full wave rectification. The rectifier is takes the 23V AC supply from transformer and convert it into 23V DC that requires for the circuit.

Oscillator Circuit: In this project the oscillator circuit is requires for generating the frequency up-to 1MHz. As well as it converts the DC supply return to AC.

Transmitter Coils: The transmitter coils are made up of copper coils, the supply is given from the oscillator is goes in this coils. Because step of down voltage the current is increases and this current is required for the produce the magnetic field. Due to current the flux are produces surrounding the coils and because of this the magnetic flux is produces between the transmitter and receiver coil.

Receiver Coil: The receiver coils are also made up of copper, the receiver receives the electric current from the transmitter. There is AC supply is takes place. Then the supply is given to the rectifier circuit that converts the AC signals to DC signals

Load: The 12V DC supply is comes from rectifier which having the wattage of 12 Watts. The load is used are the

LED's or the DC fan.

Applications:

- It be used in for charging various devices as cell phones, laptop etc.
- It is used in Electronics Devices
- It is also used in industrial applications.
- Wireless power transmission used for in electric vehicles.
- It is used in military and medical.
- It is also used for charging artificial heart.

Advantages:

- It does not use wires.
- No e-waste
- It is very efficient and harmless technology.
- The losses associated with the conductors will be reduced which will improve the system efficiency.
- The cost of electrical energy for all types of Consumers would also be cheaper.
- The transfer of Electrical power is possible to areas where use of Conductors is impossible.

Disadvantages:

- High initial cost
- In wireless power transmission distance creates the issue in transmission. Because as increasing the distance of the Transmission the strength of the magnetic field getting weak and therefore the efficiency of transmission can be reducing.
- The effect of microwave radiations at high doses received is not suitable to human health.

V. CONCLUSION

The goal of this paper is to design and implement a wireless transfer for low power devices via inductive coupling. After Analyzing the whole system step by step for optimization, a system was designed and implemented. With the advancements in the field happening all the time, a worldwide wireless power transfer system is a possibility in the near future.

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