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WIRELESS POWER TRANSMISSION USING INDUCTIVE COUPLING

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***ABSTRACT*:**

Wireless power transfer is nothing but transferring the power from source to destination without use of wires. Why we are going to wireless power transfer (WPT) it provide reliable power transmission and low maintenance cost. There are 3 major types of wireless power transfer are Short range (Inductive coupling), Medium range (Resonant coupling), long range (Microwave power transfer). It is cheap and efficient. The faults which are occurred by the wired transmission can be avoided by this wireless transfer .It is eco-friendly which is the major necessity today. Also we can avoid the problem of e-waste. Just imagine the future with wireless electricity, where there will be no need of cables and transmission lines. In this paper we are considering about the wireless power transmission using inductive coupling method. The power of 6V is transferred from source to destination is up to the distance of 20cm .

Keywords: Inductive coupling, Microwave power transmission, Resonance, Tesla theory, Wireless Power Transmission.

I. INTRODUCTION

In our present electricity generation we are mostly depend upon the wire transmission. . Much of this power is wasted during transmission from power plant generators to the consumer. The resistance of the wire used in the electrical grid distribution system causes a loss of 26-30% of the energy generated. This loss implies that our present system of electrical distribution is only 70-74% efficient. We have to think of alternate state - of - art technology to transmit and distribute the electricity. The wireless power transmission is an eco friendly phenomenon. Now- a- days global scenario has been changed a lot and there are tremendous development in every field. If we don't keep pace with the development of new power technology we have to face a decreasing trend in the development of power sector. The transmission of powerwithout wires may be one noble alternative for electricity transmission[3].

II. THE TECHNOLOGIES AVAILABLE

In this remarkable discover the "true wireless" and the principles upon which transmission and reception even in the present day system are based Dr.Nickola tesla shows us that he is indeed the "Father of the Wireless." The most well known and famous Wardenclyffe Tower (Tesla Tower) was designed and constructed mainly for wireless transmission of electrical power, rather than telegraphy . The most popular concept known is Tesla Theory [3] in which it was firmly believed that Wardenclyffe would permit wireless transmission and reception across large distances with negligible losses. In spite of this he had made numerous experiments of high quality to validate his claim of possibility of wireless transmission of electricity. But this was an unfortunate incidence that people of that century was not in a position to recognize his splendid work otherwise today we may transmit electricity wirelessly and will convert our mother earth a wonderful adobe full of electricity.

The 187-foot Wardenclyffe Tower (Tesla Tower) is built by Dr.Tesla in 1903. This was to be the first broadcasting system in the world [4]. Tesla wanted to transmit electricity from this Tower to the whole globe without wires using the Ionosphere. The figure 1 shows the Nikola tesla tower.

Figure 1

III. TYPES OF WIRELESS POWER TRANSFER

There are three types of wireless transmission of power based on the distance

I. Short Range- Inductive Coupling
II. Mid Range- Resonant Inductive Coupling
III. Large Range- Microwave Power Transmission

A. INDUCTIVE COUPLING

It consists of two coils one is source coil and the other one is destination coil. An alternating current in the transmitter coil generates a magnetic field which induces a voltage in the receiver coil. It is the simplest method of wireless power transfer the power can be transmitted only up to few meters. The efficiency of the power transfer depends on the coupling between the inductors and their quality. The example of inductive coupling is the transformer.

B. RESONANT INDUCTIVE COUPLING

The capacitor and inductor to form the resonator. The capacitor act as a electric field and inductor act as a magnetic field. Capacitor is connected parallel the coil. Resonance makes two objects interact very strongly. The power transmission is done only when the resonance condition satisfied [2], [4]. Resonance is the phenomenon in which the reactance of the capacitance and the inductance should be equal.

C. MICROWAVE POWER TRANSMISSION

This is the long range power transmission. The power can be transmitted to a long distance up to kilometers. There are three steps involved in thus method. First one is electrical energy is converted to microwave energy. Then the microwave is captured using rectanna. Then the microwave is converted into electrical energy [5]. Ac cannot be directly converted to microwave energy. Ac is converted to dc. Then the dc is converted to microwave using magnetron.

IV. BLOCK DIAGRAM FOR WIRELESS POWER TANSMISSION.

The fig 2 shows us the block diagram representation of wireless power transfer. It consists of ac source, rectifier, oscillator, transmitter coil, receiver coil and load.

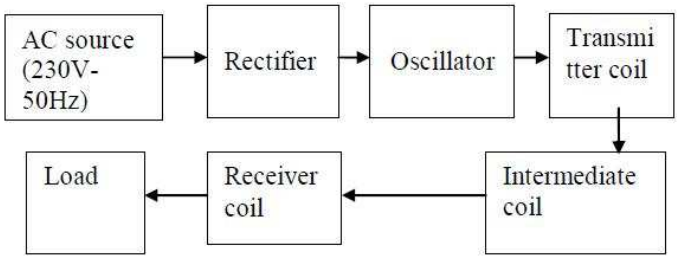

Fig 2.Block diagram representation of witricity

The power supply of single phase 230V-50Hz is connected to the rectifier unit. The rectifier converts ac voltage into dc voltage. A capacitor and an inductor together form an oscillator both capacitor and inductor store energy. The capacitor store energy in the form of electrostatic field and inductor store energy [1]. The transmitter coil transmits the power from the source to the destination in the form of magnetic wave. The receiver coil receives the magnetic wave and it converts it into electrical energy. Then the received power is given to the electrical load or battery.

V. WORKING PRINCIPLE.

Witricity works on the principle of mutual inductance between two coils. The transmitter coil is connected to the ac supply and the receiver coil is connected to the load or batteries.[4] When the power is switched on the transmitter coil is to convert electricity into magnetic field which is oscillating at particular frequency. Then the second coil at the receiver end to convert magnetic field into electricity. The figure 3 show us the transmitter and receiver coil. Where M is denote the mutual inductance between two coils.

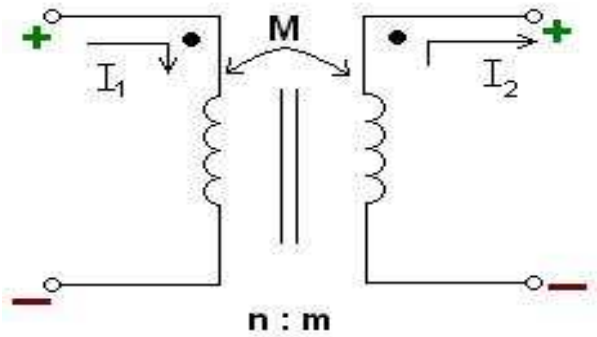

Fig 3.Transmitter and Receiver coil

The power can be transferred from transmitter coil to receiver coil due to faraday of electromagnetic induction. The current entering at one end and leaving at another end of coil is determined by dot rule. The number of turns in the primary and secondary winding is may be equal.

VI. WITRICITY IN OUR DAILY LIFE

In this figure there is only one source coil and many receiver coil. The source coil is connected to the power supply. The source coil gets energized and then the electromagnetic field is created in the source coil the magnetic waves spread in the entire room. The receiver coil receives the magnetic wave and it induces the electric power in the receiver coil. The power flow is not only in a unidirectional it is a Omni directional [11]. There is a company named Witricity is on new York, its products are based on the wireless power transfer. This company get a huge response from the society. This company also made the revolution on the wireless power transfer concept. Toyota Company made an new project on this concept. The Toyota company's electrical vehicles are now being recharged automatically when its get into the garage. Sony electronics had made a project on wireless power transfer, they had proved that a LCD television works in this concept. Dell company had implemented the concept of charging the laptops without the usage of wires. Massachutte institute of

technology students had experimented a project on the wireless power transfer.

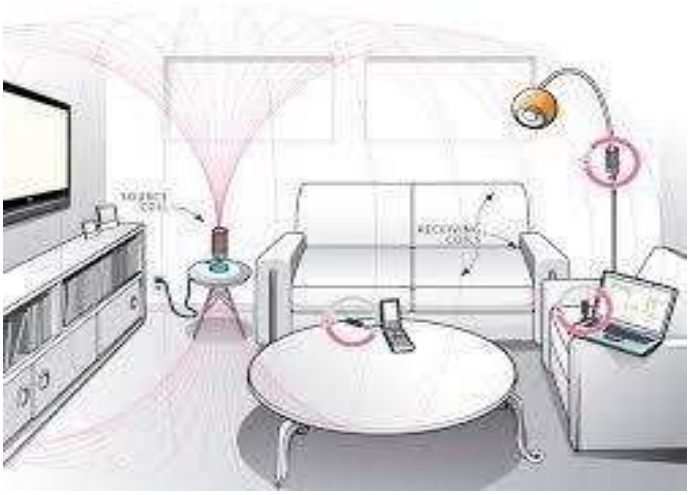

Fig 4.Witricity in our daily life

The figure 4 describe the wireless power transfer in our daily life .There are more number of researches are going in wireless power transfer to improve the efficiency. In future, the world would completely wireless. Some of the companies are giving sponsor ship to the wireless ideas. For example, Toyota Company is introducing a new method of charging the electrical vehicles. The vehicles can automatically charged when it is leaved in a garage.

VII. WIRELESS POWER TRANSFER USING INDUCTIVE COUPLKING

In our project wireless power transmission is done by using inductive coupling technique. In this we had converted ac voltage to dc voltage using rectifier. The power is transmitted from transmission coil to receiver coil as dc voltage due to mutual induction principle. The project we had done is shown below in figure 5.

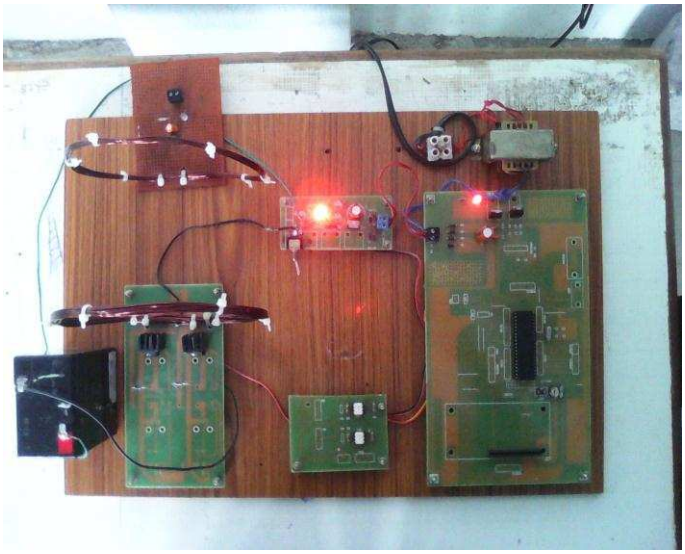

Fig 5.Hardware model for inductive coupling

It consists of PIC micro controller, transmitter coil, rectifier, receiver coil, optoisolator and an oscillator. Crystal oscillator is an oscillator that produces electrical oscillations at a frequency determined by the physical characteristics of a piezo electric crystal. The range of the crystal oscillator is 20 MHz the oscillators are connected externally with the micro controller to provide high frequency to the oscillator circuit in the micro controller. The oscillator circuits provide clock signal to the microcontroller.PIC controller means Peripheral interface controller. It integrates all type of interfacing ports and memory model. It consists of memory, register, oscillator, input output port, interrupter. The supply given to the PIC is 5V. The pulse width modulation is generated by the PIC controller.

VIII. SPECIFICATION

The table 1 describes the specification for wireless power transfer using inductive coupling.

Component	Ratting
Step-down transformer	230V-15V
Diode rectifier	15V
Regulator	7812 ,7805
PIC Controller	16F877A
PWM pulse	5ms
Crystal oscillator	20MHz
Capacitor	1000micro farad
Resistor	1kilo ohm
Diode	1N4007
MOSFET	IRF540N
LED	2V
Primary and Secondary turns	21,9
Opto-isolator	MCT2E
Battery	6V,1.5A

Table 1.specification for inductive module

Opto-isolator is a semiconductor device which is used to allow signals between them and isolate the signals. Optoisolator is used here to separate the transmitter circuit and the micro controller circuit. The optical gap between the isolators does not conduct current. So the sensitive load like the micro controller will be safe. The transmitter and receiver coil is separated by some distance. Transmitter and receiver coil was wounded with the 21SWG (standard wire gauge). Primary winding has 18 turns and then the secondary winding has 9 turns. The input to the transmitter coil is from the 6V lead acid battery. The input to the transmitter coil is from the 6V lead acid battery. The transmitter coil energized to create a magnetic field here the electric energy is converted to magnetic waves and then transmitted. The magnetic rays are received by the receiver coil. The receiver coil energies and induce the electric field and it electrical power is used by load. In our project we had done the power transmission up to the distance of 22cm.

IX. MERITS, LIMITATIONS OF WIRELESS TECHNOLOGIES

MERITS

In day to day the amount of E-waste problem had increased. In our wireless transmission it doesn't need any cables wires and other materials. So the E-waste problem can be minimized. Another advantage is it reducing the total cost as compared to our existing network also it need less maintenance. There is no possibility for any interference and disturbances due to this wireless transfer [7]. It doesn't cause anything on both living and non-living things. In wire transfer the power flow is in one direction i.e unidirectional. But in witricity the power flow ominidirection. It is the one of the big advantage. If you need more lamp in your place means simply place the lamp where ever you need it there is no need for the electrician. There is no collaboration wire due to the absence of wire in the power transmission [10]. The probability of fault occurrence is very low. There are no short circuit problems and arc will produce. It will not interfere with any biological organisms like humans and animals.The magnetic ray does not affect our environment.

LIMITATION

Wireless power transmission must satisfy certain condition like resonance if the condition is not satisfied there is no power transmission take place .There is a loss of power transmission if there is a strong Ferro magnetic substance. In wireless power transmission the initial cost is high. It requires standard material to avoid over heating problem. The power can be transmitted only over a certain distance.

X. ECONOMIC IMPACT

The concept looks to be costly initially. The investment Cost of Tesla Tower was $150,000 (1905). In terms of economic theory, many countries will benefit from this service. Only private, dispersed receiving stations will be needed. Today we are spending more money to installation of poles, wires and cables. In wire mode power transmission maintenance is frequently required. It will increase the total cost for power transmission and fault level is more due to wire collapration. But in the concept of witricity provide low maintenance cost and the power can be flow in ominidirectional.

XI. CONCLUSION

The transmission of power without wires is not only a theory, it is now a reality. It provide non-radiative energy transfer and it does not harm the environment. In our project we had observed the power transmission is efficient up to 20cm distance. The electrical energy can be economically transmitted without wires to any terrestrial distance. Wireless transmission of electricity has tremendous merits like high transmission integrity and Low Loss (90 – 97% efficient) and can be transmitted to anywhere in the globe and eliminate the need for an inefficient, costly, and capital intensive grid of cables, towers, and substations. In near future the world should be completely wireless and it can minimize the E-waste problem.

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