"Performance of Wireless Power transfer via High frequency resonating coil"

Ramesh Walake Prof. M. P Yanagimath Sidram Melavanki Pavadeppa Chandaragi Shrinidhi Patil

rameshwalake12345@gmail.com

HIRASUGAR INSTITUTE OF TECHNOLOGY, NIDASOSHI

ABSTRACT

The main aim of this paper is to give a overview of recent researches and development in the field of wireless power transmission. The methods applied for wireless power transmission like Induction, Electromagnetic transmission, Electrodynamic induction, Radio, Microwave and Electrostatic Induction. This paper focuses on the latest technologies, merits and demerits in this field. Day by day new technologies are making our life simpler. Wireless power transmission could be one of the next technologies that bring the future nearer. In this paper, it has been discussed that it is possible to charge low power devices wirelessly via inductive coupling. It minimizes the complexity that arises for the use of conventional wire system. In addition, the paper also opens up new possibilities of wireless systems in our other daily life uses.

I. INTRODUCTION

One of the major issues of power system is the losses occurring during the transmission and distribution of electrical power. The percentage loss of power during transmission and distribution is approximated as 26%.The main reason for power loss during the transmission and distribution is the resistance of wire used in grid. According to the world resources institute (WRI), India's electricity grid has highest transmission and distribution in the world. Transmission of electrical energy from a power source to an electrical load without man-made conductors is called as wireless power transmission. It is useful in cases where interconnecting wires are inconvenient, hazardous and impossible. The problems associated with wireless power transmission differs from that of wireless telecommunications. A large part of the energy sent out by the generating plant must arrive at the receiver to make the system economical. To reduce the problems associated with wired power transmission the idea of wireless power transfer is created. As many people have experienced the problem associated with lack of socket availability for electronic use, the concept of wireless power transfer system is developed which minimizes the number of wires and makes the space more tidy and organized.

II. TYPES OF WIRELESS POWER TRANSMISSION TECHNIQUE

Based on the distance there are three types of wireless power transmission techniques. Those are A). Short Range- Inductive Coupling, B) Mid Range- Resonant Inductive Coupling, C) 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 one of the simplest method of wireless power transfer where power can be transmitted only up to few meters. Here the efficiency of the power transfer depends on the coupling between the inductors and their quality.

B. RESONANT INDUCTIVE COUPLING: The resonator consists of capacitor and inductor. 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 is satisfied. 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 this method. First one is electrical energy is converted to microwave energy. Then the microwave is captured using rectenna. Then the microwave is converted into electrical energy. AC cannot be directly converted to microwave energy. AC is converted to DC. Then the dc is converted to microwave using magnetron.

III. EXPERIMENTAL SETUP

The block diagram representation of wireless power transfer using resonating coil is shown below. It consists of ac source, rectifier, High frequency transformer, transmitter coil, receiver coil and load. The power supply of single phase 230V-50Hz is connected to the rectifier unit. The rectifier converts AC voltage into DC voltage. The capacitor stores energy in the form of electrostatic field and inductor stores the energy. 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.

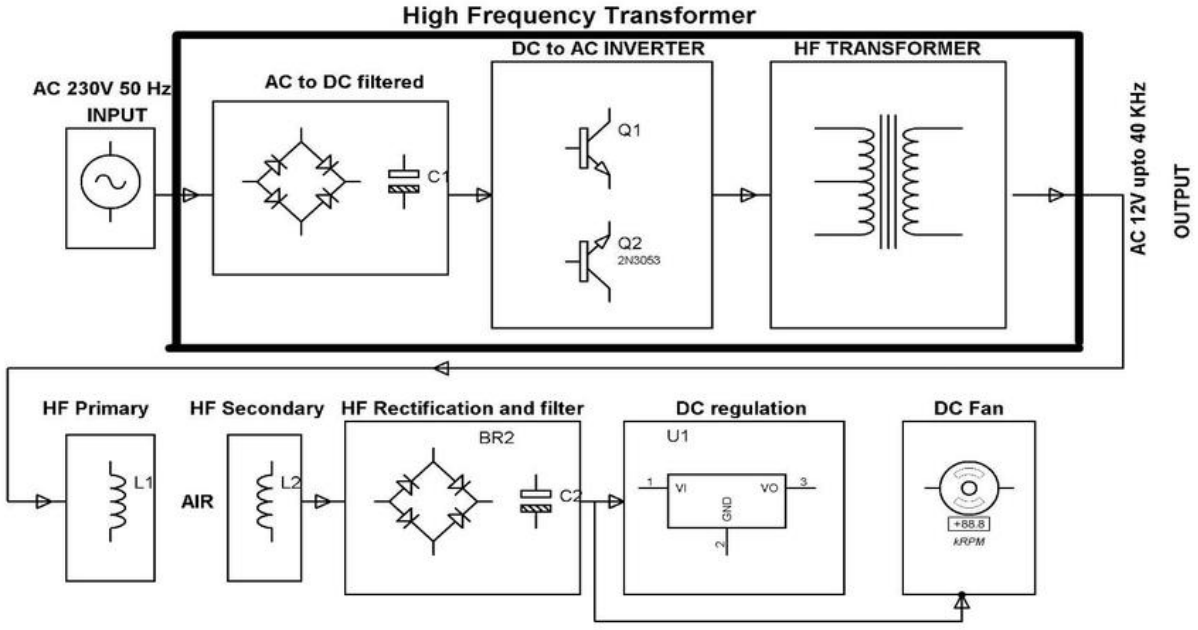

Fig 1: Block diagram of proposed wireless power transfer

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. When the power is given to transmitter coil it converts electricity into magnetic field which is oscillating at particular frequency. Then the second coil at the receiver end converts magnetic field into electricity.

The working behind wireless power transmission is electromagnetic induction. We need a power source and a transmitting and receiving antenna to which we can connect the thing to be powered i.e the electrical load or just the load. The power source will deliver a high power signal to the antenna. This will create an electrostatic field around the antenna that changes as the signal to it changes. The receiving antenna will be in the path of these waves, and the waves will pass by it and "sweep" it with their moving electromagnetic fields. This will induce a signal in the receiving antenna proportional to the energy that the antenna captures. This signal will cause current flow that will power the load. A magnetic field is created inside the coil through the current that moves through the coil inside. Another current will be produced in another coil, due to the magnetic field. This current is supplied to the load.

Wireless Power Transfer Systems (WPTSs) are designed as two sections. One is a transmitting section and the other is a receiving section. The transmitting section transfers power to the receiving section by using the basic principle of resonating coil and the technology is based on magnetic field. WPT has the benefits of safe, convenient, flexible and autonomous.WPT is a disruptive technology.

Transmitting system is supplied from the grid as AC input. This AC power is converted to controllable DC current by the rectifier and comprises a Power Factor Correction (PFC) stage which is used to reduce losses. Then there will be a High frequency inverter which is used to convert high frequency DC to high frequency AC. This HF AC power is given to high frequency transformer. The HF transformer delivers excitation current to a series-tuned primary coil of sufficient magnitude to magnetize the air volume between it and the coil mounted secondary. The HF transformer is used for electrical isolation. The primary and secondary coils are kept at a distance and the mutual inductance is used for transfer of power. Voltage induced at the secondary is rectified, filtered, and delivered to the load directly from the WPT rectifier. WPT applications may require inclusion of an HF transformer to provide electrical isolation of the WPT.

IV. WIRELESS POWER TRANSFER USING RESONATING COIL

In our project wireless power transmission is done by using resonating coil 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 is due to mutual induction principle. The project we had done is shown below in figure 2.
It consists of 89C51 Micro controller, transmitter coil, rectifier, receiver coil and high frequency transformer. Microcontroller is used as a load with two 16x2 LCD’s to display power transfer. Toggle keys are used to switchover the loads like fan etc. The primary and secondary transmission coil is having 18 turns with 9 mm diameter.

The table 1 describes the specification for wireless power transfer using resonating coil.

Name of the component	Specification
Regulator IC	IC 7812
Regulator IC	IC 7805
Rectifier Diodes	1N4007
Capacitor	1000 µf/25V Electrolytic
Capacitor	0.1µF Ceramic Disc type
Transformer	230V AC Pri,14-0-14 1Amp Sec

Table 1: Component details

The hardware module of our proposed system is as shown below.

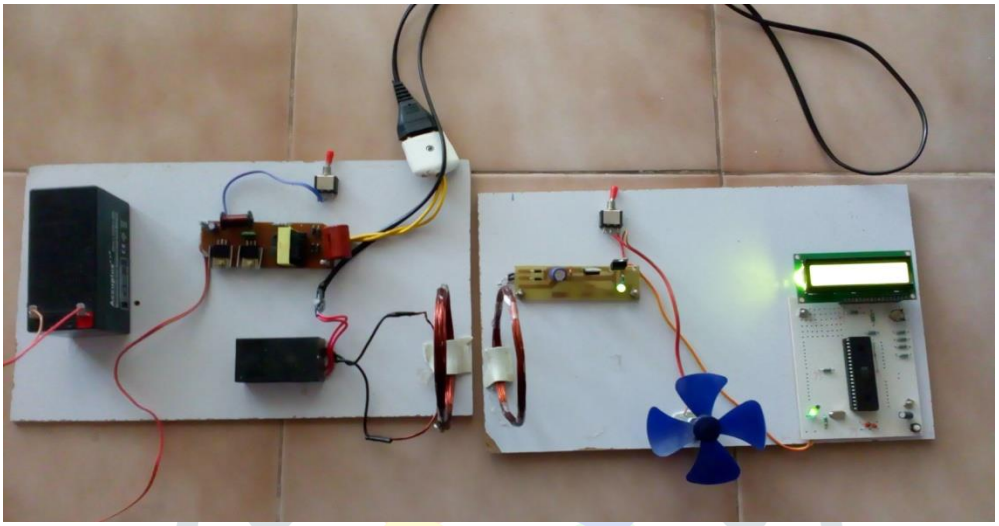

Fig 2: The Hardware module of proposed system.

V. ADVANTAGES, DISADVANTAGES AND APPLICATIONS

A. ADVANTAGES: In day to day life the amount of E-waste problem had increased. In our wireless transmission technology it doesn't need any cables wires and other materials. So the E-waste problem can be minimized. Another advantage is that it reduces 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. It doesn't cause anything on both living and non-living things. In wired 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. The probability of fault occurrence is very low. It will not interfere with any biological organisms like humans and animals. The magnetic ray does not affect our environment. Its more reliable. Because never run out of battery. Its more convenient as no need to change the batteries, wires. As this technology reduces the use of disposal batteries its environmental friendly.

B. DISADVANATAGES: 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. Initial cost is high.

C. APPLICATIONS: Wireless power transmission technology can be used in office buildings and factories. Used in Electric an automobile charging moving and static as well used in Consumer electronics, public Access Charging Terminals. The digital hardware's like Smart Phones, Portable Media Players, Digital Cameras and Tablets also can use WPT. This technique can be utilized in cordless power tools, cordless vacuum cleaners and for industrial purposes.

VI. CONCLUSION

The transmission of power without wires is not only a theory, it is now a reality. It provides non-radiative energy transfer and it does not harm the environment. In our project we had observed that the electrical energy can be economically transmitted without wires to any 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 eliminates the need for an inefficient, costly, and capital intensive grid of cables, towers, and substations. It is low maintenance cost but high initial cost. In near future the world should be completely wireless and it can minimize the E-waste problem.

REFERENCES

[1] Shinohara, Naoki (2014). Wireless Power Transfer via Radiowaves. John Wiley & Sons. pp. ix–xiii.ISBN 1118862961.

[2] Bush, Stephen F. (2014). Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid. John Wiley & Sons. p. 118.ISBN 1118820231.

[3] "Wireless energy transfer". Encyclopedia of terms. PC Magazine Ziff-Davis. 2014. Retrieved December 15,2014.

[4] Rajakaruna, Sumedha; Shahnia, Farhad; Ghosh, Arindam (2014). Plug In Electric Vehicles in Smart Grids: Integration Techniques. Springer. pp. 34–36.ISBN 981287299X.

[5] Gopinath, Ashwin (August 2013). "All About Transferring Power Wirelessly". Electronics For You E-zine (EFY Enterprises Pvt. Ltd.): 52–56. RetrievedJanuary 16, 2015.

[6] A. Mariya Pnthoni Pravin,A.Ajendra Narayanan, R.Balaganesh, P.Manikandan & J.Saravanan (april 2014), "Wireless power transmission using Inductive coupling" International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE).