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Analysis of Wireless Power Transmission Using Resonant Inductive Coupling for small distance

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ABSTRACT

Wireless power transmission is the means to power devices without a built in power source such as a generator or battery. One initial use of such technology is found in powering small devices where maximum size of the device occupies the battery itself. This research work deals with the feasibility of wireless power transmission through resonant inductive coupling for powering medical implants. This uses transmission and receiving coils as the coupling antennas. The primary benefits to using inductive coupling are the simplicity of the transmission and receiving antennas, additionally for small power transmission this is a much safer means of conveyance. To demonstrate the research a circuit is developed as a receiving circuit to light an LED at a distance up to two feet. As the transmission distance is decreased the efficiency of the system using inductive coupling improves exponentially.

Key words: Efficiency, Inductive coupling, resonant, solenoid.

I. INTRODUCTION

This document will detail the need and usefulness of wireless power transmission and furthermore the feasibility of using inductive coupling as the means for wireless power transmission. The paper will outline the design process and the logical steps taken in the experimentation and design of the final unit.

The first section of the document will explicitly illustrate the problem. With the complexity of the problem in mind and what must be accomplished began research on the available means to transmit power without a physical connection. Once the initial background research was accomplished it was necessary to layout the advantages and disadvantages of all the available means for wireless power transmission. Once all the necessary criteria for each system were known we chose the best solution for the problem. The solution found is the inductive coupling. Furthermore because of the transmission power through the surrounding area it must be taken care that the system would not endanger others and be FCC compliant.

II. METHODOLOGY

In this research, it is tried to transfer the power with wireless method. An AC oscillating waveform into a DC voltage which on the receiving end will light an LED to demonstrate the instantaneous power transfer. The frequency of oscillation of the AC signal must not exceed 100MHz. The power transfer needs to be done over a

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two feet distance or greater. The transferred AC power needs to be converted to DC power and boosted up enough to drive a low power display design, such as an LED in continuous or pulsed mode. The whole system must be FCC compliant.

One of the major issue in power system is the losses occurs during the transmission and distribution of electrical power. As the demand increases day by day, the power generation increases and the power loss is also increased. The major amount of power loss occurs during transmission and distribution. The percentage of loss of power during transmission and distribution is approximated as 26%. The main reason for power loss during transmission and distribution is the resistance of wires used for grid.

The efficiency of power transmission can be improved to certain level by using high strength composite overhead conductors and underground cables that use high temperature super conductor. But, the transmission is still inefficient. According to the World Resources Institute (WRI), India's electricity grid has the highest transmission and distribution losses in the world – a whopping 27%. Numbers published by various Indian government agencies put that number at 30%, 40% and greater than 40%. This is attributed to technical faults (grid inefficiencies) and power theft. So having reviewed that, it is found that we require having an alternative form of power transmission. Wireless transmission could just be the alternate option and below are the gradual advancement in the field of wireless power transmission.[1]

With all literature survey, there were different solutions for the above problem. In this research, In this paper we are proposing the inductive coupling method. There are the use of antennas, inductive coupling, and laser power transfer. In addition, we had to be aware of how antennas and inductive coupling would be affected by the frequency we select. [1]

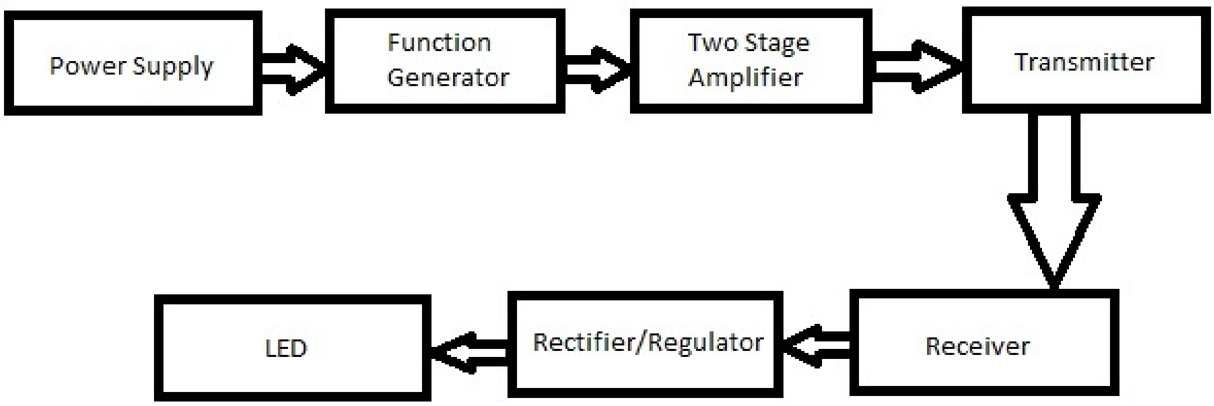

Fig1: Overall system block diagram

III. DESIGN, SIMULATION AND EXPERIMENTAL ANALYSIS:

Three major points of emphasis that would be crucial in designing an efficient inductive coupling system are: The coils should be oriented such that they share the same axis. Upon experimentally testing the wireless power transmission of the coils in different position, it was noted that axial orientation of both transmitter and receiver coils yielded much better power transmission. A solenoid configuration was used for the design of the

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transmitter and receiver. The receiver should be larger than the transmitter. With same configuration as above, the transmitter and receiver were swapped from their designated configuration to measure which configuration yielded the most output voltage. It was noted that a voltage output was much more when the transmitter was much larger than receiver.

The higher the frequency the more power can be transferred over a given distance. Higher frequency is preferred for greater power transmission over all distances. One of the major improvements made to the coupling circuit was accomplished by impedance matching. Impedance Matching is a technique commonly used in power transfer systems and communication systems to improve the efficiency of the system. The power transferred to the load reaches its maximum when Zsource=Z*load,

$$jwL = -1/jwC$$

Similarly, *Q* Factor is defined in terms of the ratio of the energy stored in the resonator to the energy supplied by a generator, per cycle, to keep signal amplitude constant, at a frequency (the resonant frequency), *fr*. Higher *Q* indicates a lower rate of energy loss relative to the stored energy of the resonator; the oscillations die out more slowly. The Q factor of series circuit is given by:

$$Q=Xl/R = 1/R.Xc = (1/R)*sqrt(L/C)$$

Hence resistance used is small for larger value of Q factor. The Q factor of a parallel RLC circuit is given by Q=R*sqrt(L/C), hence larger resistance is used . The entire system was also modeled using coupling coefficient. A coupling coefficient is a number that expresses the amount of electrical coupling that takes exists between two circuits.

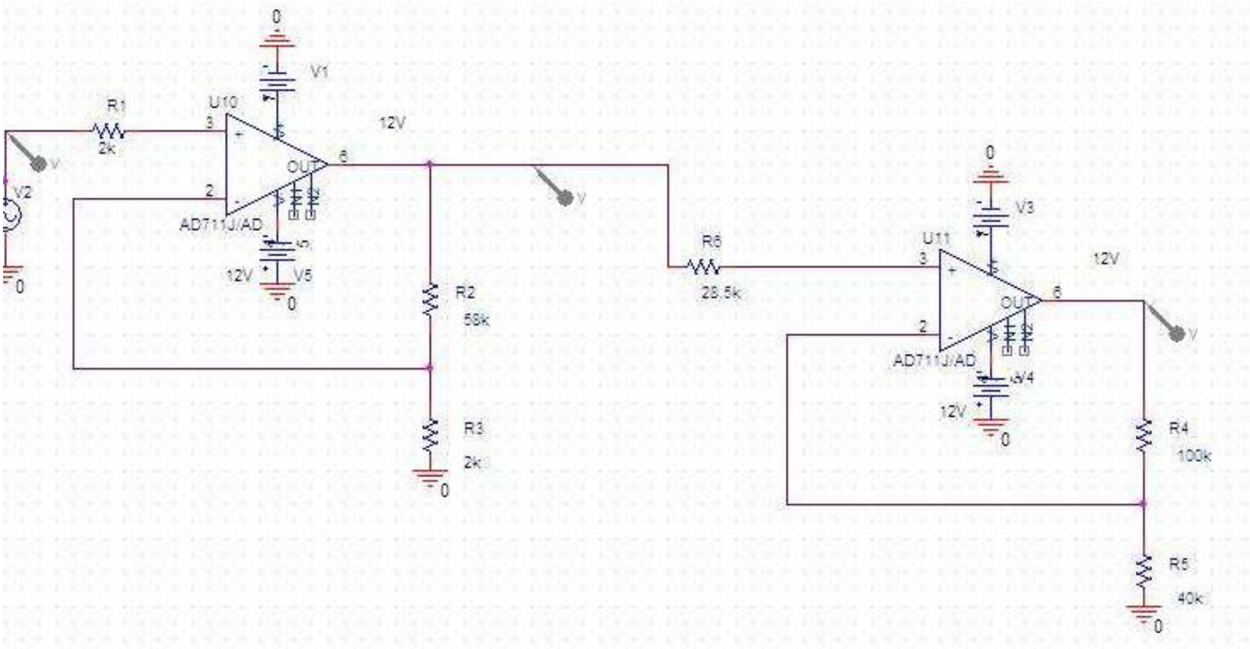

Fig.2: Two stage voltage amplifier design

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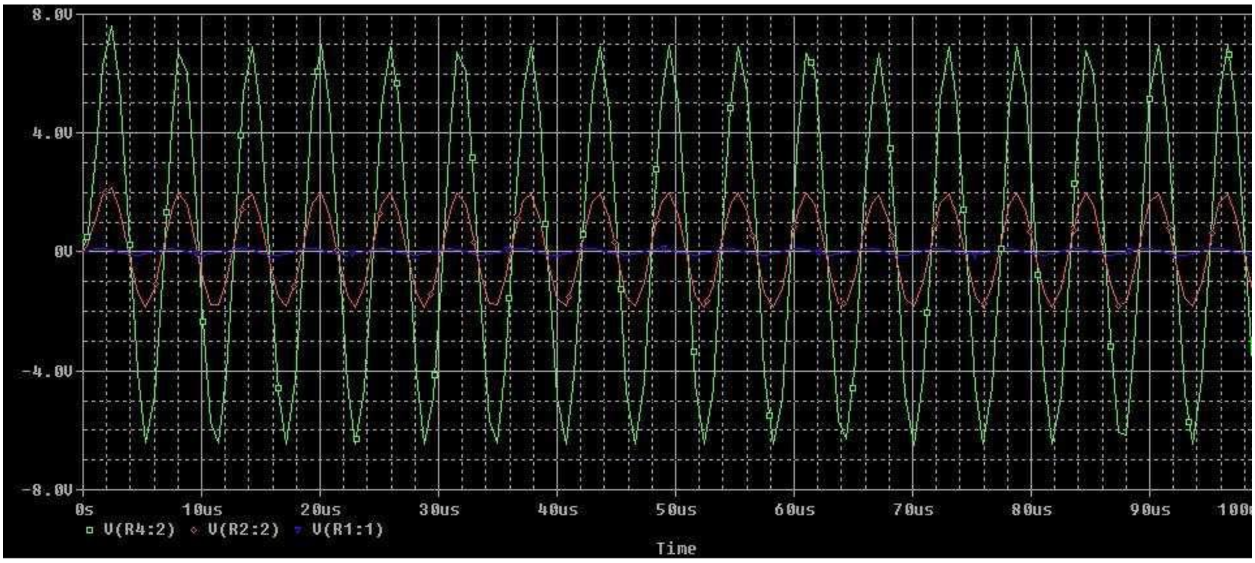

Fig.3: Output of two stage voltage amplifier design

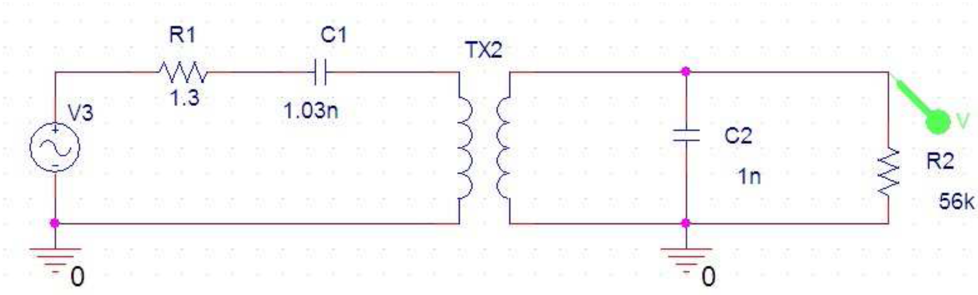

Fig.4: Schematic diagram of the coupling circuit

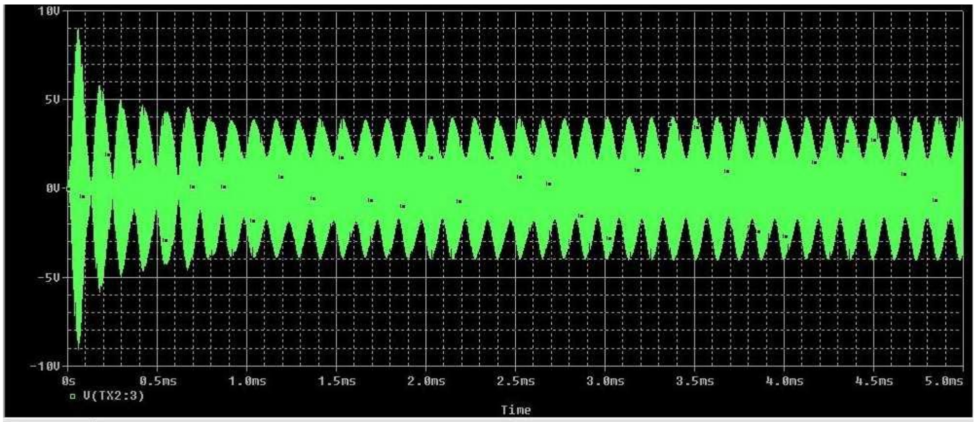

Fig. 5: Simulated output for received power

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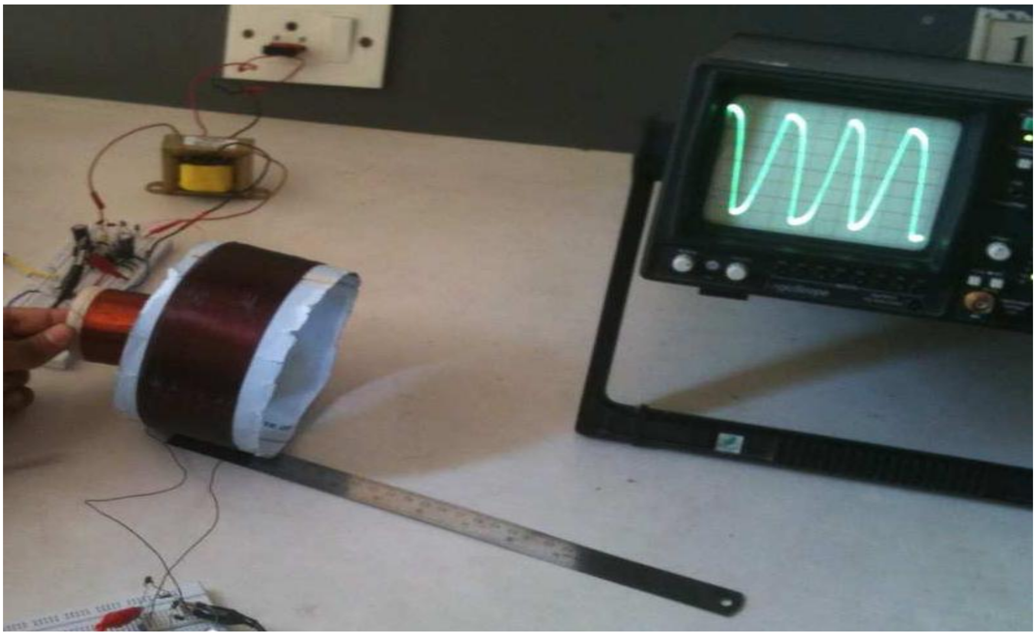

Fig.6: Output from near distance

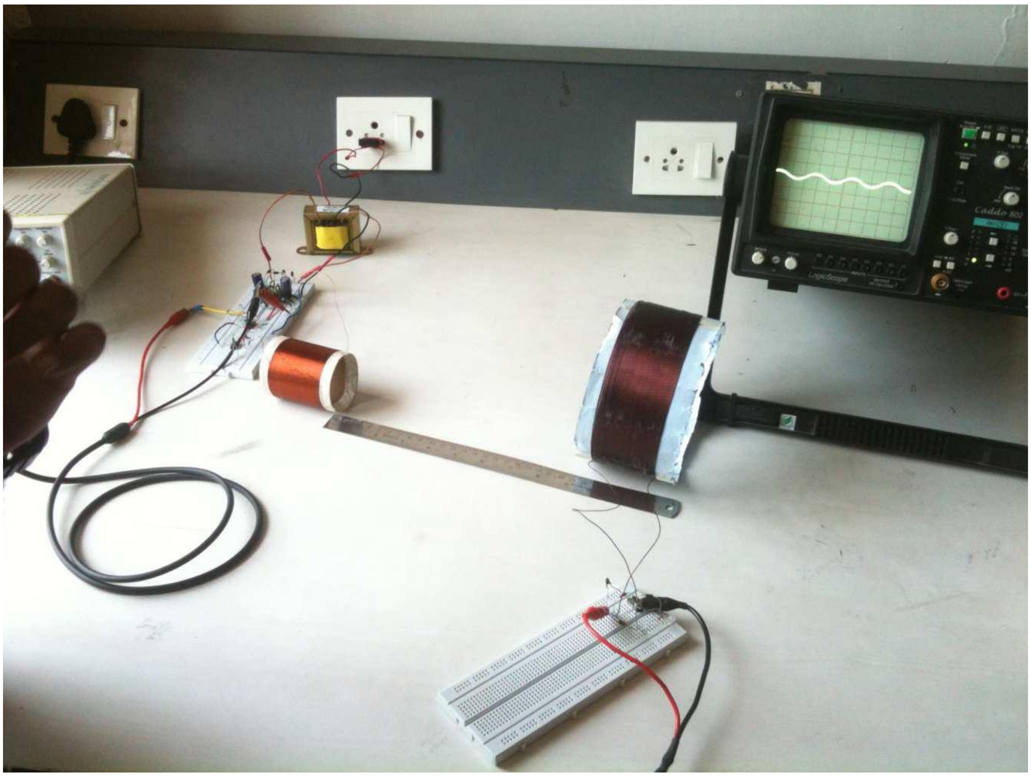

Fig.7: Output from far distance

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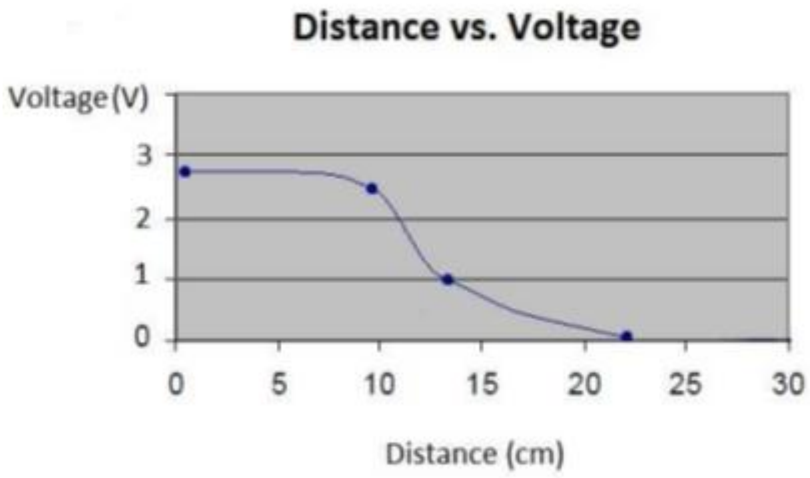
III. RESULT

The coils were placed co axially and the output voltages for the respective distances were measured. The following table shows the data recorded.

Sl.No.	Distance (cm)	Voltage(Volts)	Current(mA)
1	0	2.6	1.03
2	10	2.5	0.193
3	13.5	1.02	0.092
4	22	0.2	0.027

Table1: Distance versus voltage

However the following graph shows that the efficiency between power transmitted and power received, increases exponentially as the distance decreases, the data taken for the graph was compiled using the design project.



Graph1: Distance versus voltage characteristics

It is also possible to make the signals more directional in the z direction by using a conical coil as a transmitter instead of the solenoid In order to generate the maximum amount of flux which would induce the largest voltage on the receiving coil, a large amount of current must be transferred into the transmitting coil. The oscillator is not capable of supplying the necessary current, thus the output signal from the oscillator should be passed through a power amplifier to produce the necessary current. The key design aspect of the power amplifier is to generate enough current while producing a clean output signal without large harmonic distortions. For this purpose, a simple switch-mode amplifier design can be chosen.

IV. APPLICATIONS

The applications of resonant inductive coupling type wireless power transmission are many. Resonant inductive type coupling work very well in close contact, need less maintenance, are less radioactive and have much better efficiency than other forms of wireless power transmission. Some of the applications are Medical body implants,

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with or without battery sources, Household electronics such as mobile, notepads etc., Toothbrushes, small aquarium motors, trimmers etc.

V. CONCLUSION

A model of wireless power transmission using inductive coupling has been successfully developed and tested with a LED. With minimum expenditure the model was developed following the FCC rules and keeping the output level below 1 Watt. The model was tested for different distances and the output received was measured. It was found that the inductive coupling was more powerful as the distance between the transmitter and receiver was decreased. It is thus evident that inductive coupling is much more suited to small distance application such as consumer electronics and medical implants that can be operated at close range.

VI. FUTURE SCOPE

Inductive coupling still has a definite future in the short range transmission distance. This particularly has medical implementations to transmit a few inches to power a remote sensor implanted in the human body. Similarly it has been used to power electronic household or personal devices. With small adjustments and use of higher frequency to produce a larger output, it can be used to power smaller electronic devices.

REFERENCES

[1] Boone E. Ovens and P.S.S. Prasad, The Use of Lithium batteries in Biomedical Devices, 15th June, 1989

[2] G. L. Peterson, “THE WIRELESS TRANSMISSION OF ELECTRICAL ENERGY,” [online document], 2004, [cited 12/10/04], http://www.tfcbooks.com/articles/tws8c.htm

[3] R. Lundin, "A Handbook Formula for the Inductance of a Single-Layer Circular Coil," Proc. IEEE, vol. 73, no. 9, pp. 1428-1429, Sep. 1985.