International Journal of Academic Engineering Research (IJAER)
ISSN: 2000-001X
Vol. 2 Issue 6, June – 2018, Pages: 1-5

Design and Implementation of a 50MM Distance Wireless Power Transfer System Using Magnetic Induction

[1]Akume Saaondo, [2]Ibrahim Adabara, [3]Chisenga Paul & [4]Abdurrahman S Hassan
School of Engineering and Applied Science, Department of Electrical and Telecommunication Engineering, Kampala International University- Uganda, Kasanga, Uganda.
Email:saaondodave@gmail.com[1], adabara360@gamail.com[2], paulsther@gmail.com[3] & abdurrahmanshuaib54@gmail.com[4]

Abstract: With the fast development and advancement of the technological world, several efforts by researchers are being made on the improvement of power transportation in the power grid system. Wireless power transfer is one of the main ideas that have being consistently researched upon. No doubt, as it is a total game changer for the transmission and distribution of electric power in the power grid system. Being a fact that it's more effective, safe, and comfortable and requires no cable to transfer power to the consumer saving cost, which may occur from cable connection length, maintenance and installations. Conscious of the effects and challenges faced in other to commercialize the concept of wireless transmission, via Wireless power transmission technology. The research attempts to design a cheap and safe wireless power transmission system for simple indoor applications. MultiSIM is the software used to design the project and run simulations to test project functionality and get required outputs of the system. This lead to the actualization of our circuit design which showed that distance between coils has a critical effect on the performance of the system in addition to frequency, load, and current. However, measurement of the results also reveals satisfactory agreements with the simulations and illustrates the WPT system.

Keywords: Wireless Power Transfer System (WPTS), Electromagnetic Oscillations, Transmitter Circuit & Multism Software (MultiSim)

1. INTRODUCTION

In our present electricity generation system we waste more than half of its resources. Especially the transmission and distribution losses are the main concern of the present power technology. 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. The transmission and distribution of power without wires may be one noble alternative for electricity transmission and distribution [1].

The realization of a transmission and distribution of power without wires has not yet being realized though a lot of research and experiments are being made on the technology. This project outlines the research, design and implementation of a simple and cost effective wireless power transfer system for which is able to safely and efficiently transfer power without the use of cord or cable from the transmitter circuit to the receiver circuit at a 50mm distance.

2. MATERIALS AND METHODS

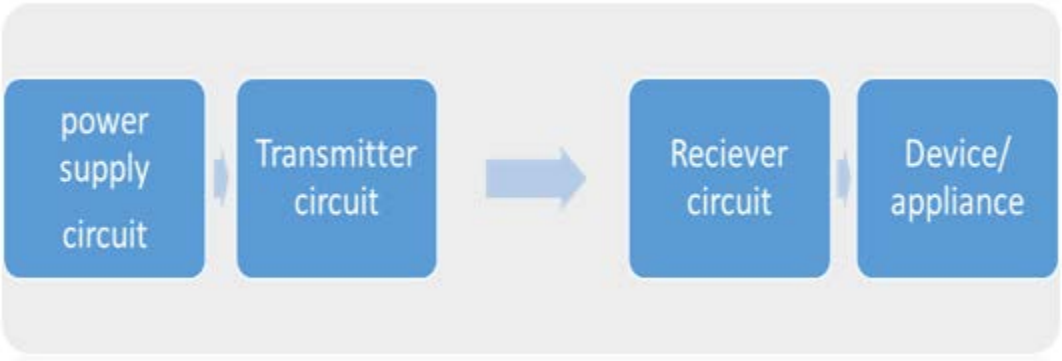

Figure 1: *Shows Block Diagram of the power supply system*

The design and the implementation of each of the key circuit units was how the project was implemented to achieve wireless power transfer functionality.

2.1 Power Circuit

The power supply circuit of the wireless power transfer system makes use of step down transformer that converts from the main supply 230V AC to 12V AC. However, the input ac varies dropping and increasing from 160V to 270V. Given the ratio of the transformer primary voltage Vp to secondary voltage Vs (12V at 220V) formula given below, a step down between 8V to 15V is gotten which is sufficient to supply the transmitter circuit.
Formula is given as;

International Journal of Academic Engineering Research (IJAER)
ISSN: 2000-001X
Vol. 2 Issue 6, June – 2018, Pages: 1-5

$$(\frac{V_p}{V_s}) = (\frac{N_p}{N_s})$$

2.2 Transmitter Circuit

The next stage is the transmitter circuit of the wireless power transfer system. It this circuit that transforms the supplied power into electromagnetic wave form that is then transmitted. The electromagnetic wave is generated and transmits using the tank circuit which is the combination of inductors and capacitors that is shown in the bellow circuit diagram. The inductor value is calculated using the following formulae;

$$L(in\ micro\ Henrys\ (\mu H)) = \frac{[(D \times D) \times (N \times N)]}{[(18 \times D) + (40 \times W)]}(Approximately)$$

In this formula, D is the diameter of the coil,

N is the number of turns, and W is the width of the coil from end to end.

The formulae are used to determine the number of turn required in the making of the required inductance.

Also the transmitter core is used together with the transmitter circuit coil to increase the electromagnetic wave generated and also chokes are used which induces magnetic wave to the main inductor and also permits the flow of a DC current.

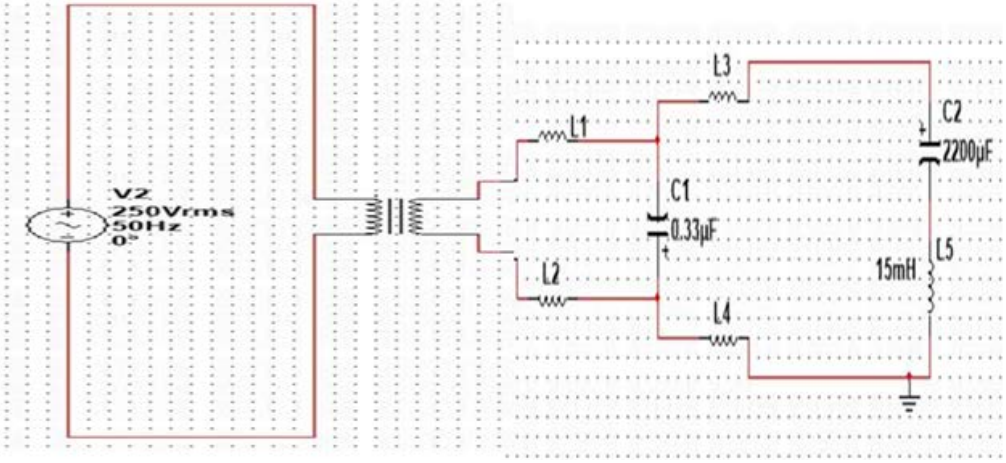

Figure 2. *shows power supply and transmitter circuit connected*

2.3 Receiver Circuit

The receiving circuit of the wireless power transfer system receives the electromagnetic wave induced by the transmitter circuit. It consist of the receiver coil inductor which is to receive the induced electromagnetic wave from the transmitting circuit which is then connected to a couple of capacitors, diodes, resistor and a voltage regulator which serves as a rectification and voltage regulation for the output device/appliance in this case a LED and USB port output is used.

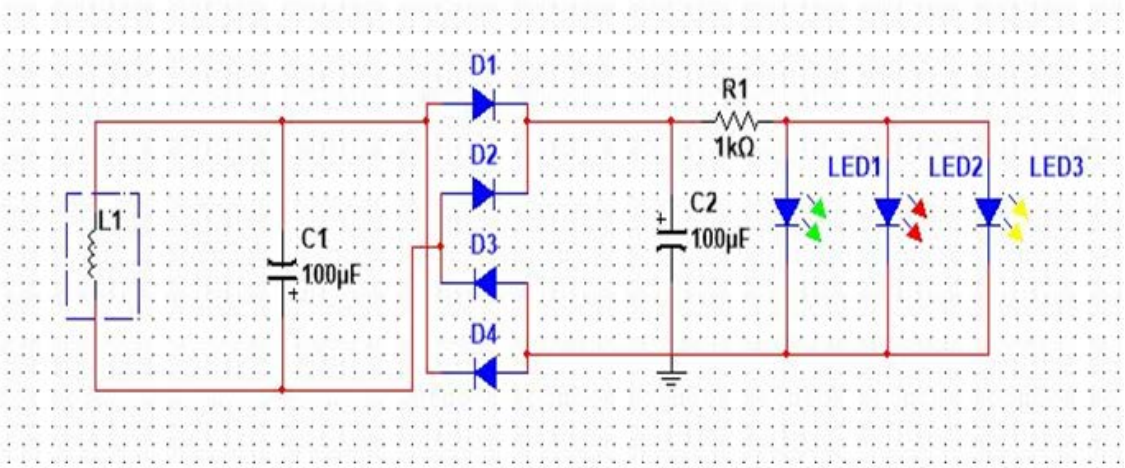

Figure 3*. Shows the receiver circuit diagram*

3. WORKING PRINCIPLE

Here the working process of the implemented system is going to be discussed. The following working process indicates or shows how the implemented system actually work.

The design and implemented system is connected to a 240volts power supply, the power source should give a total of 240volts at a frequency of 50 Hz which is the input of the system.

The input power is connected directly to the power circuit which converts the received power into 12Vs and supplies it to the transmitter circuit. The 12v is then connected directly to the transmitter circuit which consist of the combination of the inductor, capacitors, resistors and a transistor which has being built placed together to generate an induction/electromagnetic waves which is transmitted, in order words we connect our transmitter circuit to a power supply and switch on then power is transmitted through electromagnetic waves wirelessly with the help of transmitter circuit.

The power that is transmitted is received using a receiver circuit which receives the power via wirelessly and it output is then connected to the device in this case a LED that glows.

2.4 Flow chart of project

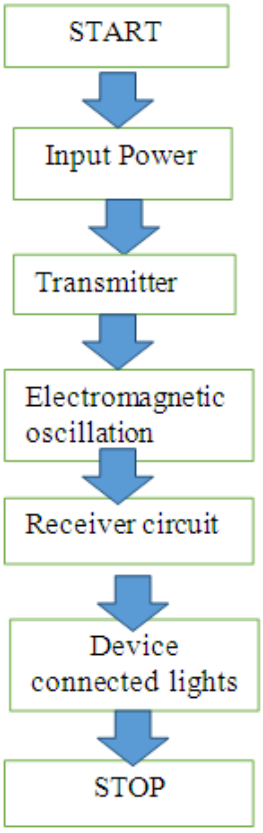

Figure 4*. Shows flow chart Diagram of the System*

4. RESULT AND DISCUSSION

4.1 Constructions

The construction of the project was done based on the circuit design as the component layout, components assembly on bread board for testing and later a permanent Vero board where soldering process was followed on making up the circuit to make sure that all components are permanently mounted.

4.2 Testing

Three major test were carried out on the project;

a) Voltage test;

In the test of voltage, we considered for the measurement of the DC voltage input or supply voltage by which the source of power so as to know our input power that is supplied into the system.

Also, we also considered the oscillating voltage/ AC voltage which is generated by the sender/oscillator circuit where we measured so as to know how much output power is being transmitted from the transmitter circuit.

The consideration of the power output that is being received by the receiver circuit over the wireless transfer system to know how much power is being transferred by our system circuit.

b) The distance test

In the distance test we were concerned about knowing the distance the wireless power transfer system can be able to transfer power effectively and not effectively and its distances limits to which power cannot be transferred.

c) The frequency test

In the transmission of power, the frequency at which is transmitted is important as it determines how strong and how far the signal or power can travel over a given distance. However, there is a safe and dangerous range which the IEEE electrical safety board recommend so as to ensure there is no hazardous radiation from power that can affect human or life forms in the environment. This frequency check was carried out using while in the design stage using the simulation software Multism.

4.3 Result and Discussion

After the above test was carried out, the following were the discovered result;

Voltage test: in the voltages test, the input voltage measured was 12v used by the oscillation circuit to generate oscillation. The measurement of the output voltage that received by the receiving circuit was up to 5v max. However, the voltage varied with the distance which the receiver circuit was placed. The closer it was placed, it was noticed that the voltage received via wirelessly was more but at a 50mm it could still transfer power wirelessly.

Distance test: the measured maximum distance at which the receiver circuit of the wireless power transfer system was able to receive power from the transmitter circuit was 50mm.

Frequency test: this was tested on the simulation software Multism as our wireless power transfer system circuit was run and simulated the frequency measured was 50HZ. Which the system was able to run and function properly.

International Journal of Academic Engineering Research (IJAER)
ISSN: 2000-001X
Vol. 2 Issue 6, June – 2018, Pages: 1-5

Also, during the research it was observed that if an iron was placed as a core in the induction coil, there was as increase in the electromagnetic wave generated which increases the distance and also the voltage across the distance of the wireless power transfer system. Hence, the use of a core was added to the induction coil of the transmitter to increase the distance and voltage supplied.

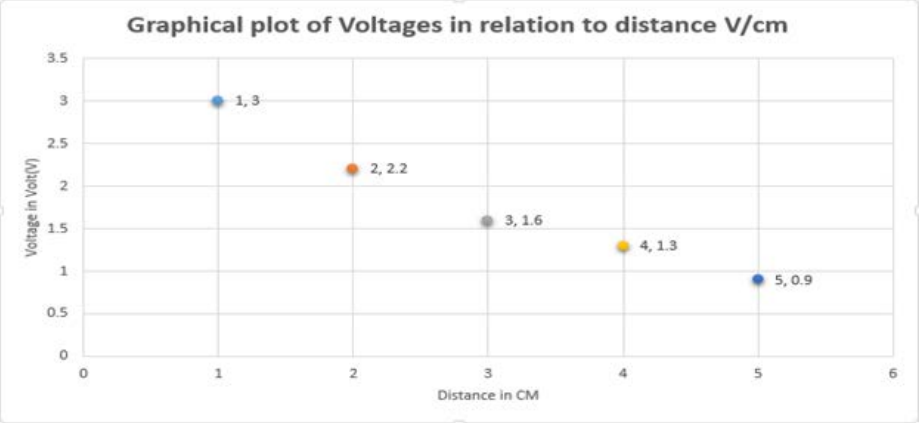

Figure 5*. Shows the graphical relation of applied voltage to measured distance.*

The following is a graphical representation of the voltages relation to voltages that is transmitted across the wireless power transfer system.

The above graph represents the distance in relation to distance an iron core is not placed at the induction coil of the receiver circuit.

However, when a core is added to the induction coil of the receiver circuit, the output is increased greatly, as seen in the graphical representation bellow;

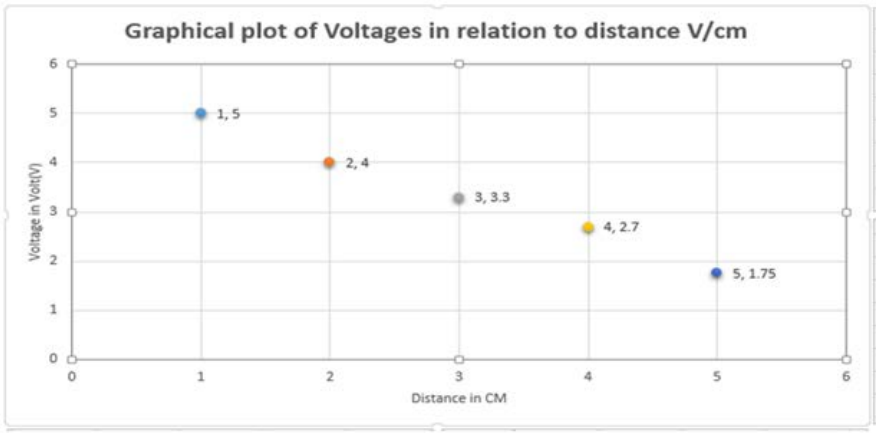

Figure 6*. Shows relation of voltage to distance of system using an iron core*

Figure 7*.Shows the transmitter circuit of the project system.*

Figure 8*. Shows the receiver circuit of the project system*

6. CONCLUSION

This project of 50MM WIRELESS POWER TRANSFER SYSTEM USING MAGNETIC INDUCTION is safe, cheap and affordable and can be used to supply or charge small home device for indoor usage such as phone, Bluetooth devices etc. Also apart from small device, with some modification, this can also be used in other field of application such as the medical sector and industrial sector where needed for example, it can be used for the easy charging of patient with artificial heart etc.

REFERENCE

[1]. Tanuj Kumar Mandal (2012), *Wireless Transmission of Electricity – Development and Possibility*, article from department of Electrical & Electronics Engineering, Dr.M.G.R. Educational & Research institute, Chennai, Tamil Nadu (India), E- mail:tanujmandal@sify.com. Reviewed; 26-01-2018.

[2]. P. Apoorva, K. S. Deeksha, N. Pavithra, M. N. Vijayalakshmi, B. Somashekar, D. D Livingston,. (2015). *Design of a Wireless Power Transfer System using Inductive Coupling and MATLAB programming*. International Journal on Recent.

[3]. K.M.E. Celik and E. Aydin (2017) *An Efficient Inductive Coil Link Design for Wireless Power Transfer to Visual Prostheses*, Special issue of the 3rd International Conference on Computational and Experimental Science and Engineering, Vol. 132. Pg.2.

[4]. L. Xie, Y. Shi, Y. Hou, and A. Lou, 2013. "*Wireless power transfer and applications to sensor networks*," *IEEE Wireless Communications*, vol. 20, no. 4, pp. 140–145.

[5]. S. K. Rahman, O. Ahmed, S. Islam, A. H. M. R. Awal, S. Islam, (2014). *Design and construction of wireless power transfer system using magnetic resonant coupling*. American Journal of Electromagnetics and Applications 2(2): 11-15.

[6]. K. Miwa, H. Mori, N. Kikuma, H. Hirayama, and K. Sakakibara, (2013). "*A consideration of efficiency improvement of transmitting coil array in wireless power transfer with magnetically coupled resonance*," IEEE Wireless Power Transfer (WPT), pp. 13–16.

[7]. Ajay Kumar Sah. (2013). *Design of Wireless Power Transfer System via Magnetic Resonant Coupling at 13.56MHzProceedings of IOE Graduate Conference*, Vol. 1. Pg 202-210.

[8]. Jolani, J. Mehta, Y. Yu, and Z. Chen (2013). *Design Of Wireless Power Transfer System Using Magnetic Resonance Coupling For Implantable Medical Devices*,Progress In Electromagnetics Research Letters,Vol. 40, 141-151.

[9]. Tarun Agarwal, (2014). *Wireless power Transfer circuits and its Working*, article from The Budding Electronic Engineers' Knowledge. Retrieved at:www.elprocus.com reviewed: 26-01-2018.

[10]. TDK product center tech notes article: *wireless power transfer products*. Retrieved at: https://product.tdk.com/info/en/products/wireless-charge/technote/tpo/index.html reviewed: 21-01-2018.

[11]. Charles Platt (2009) "*Make: Electronics* ". First edition Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472. ISBN: 978-0-596-15374-8. Reviewed 21-01-2018.

[12] All About Circuit. "*A World Without Cords: An Overview of Wireless Charging"* article published June 23, 2015 Retrieved from: https://www.allaboutcircuits.com/technical-articles/an-overview-of-wireless-charging/.