International Journal of Multidisciplinary Engineering in Current Research - IJMEC
Volume 9, Issue 01, January-2024, http://ijmec.com/, ISSN: 2456-4265

# WIRELESS POWER TRANSFER

**V Pavan Venkata Kumar, Mrs. Kiran Pakmode**
[1]B.tech Student, Department Of Electronics and Computer Engineering, J.B Institute of Engineering and Technology
[2]Assistant Professor, Department Of Electronics and Computer Engineering, J.B Institute of Engineering and Technology

**Abstract:** Various circuits and designs available online can be used to build a wireless power transmission system. For example, a simple wireless power transmission circuit can be built to glow an LED. Another project involves embedding circuits in a Power Tile and placing the coil of the wireless transmitter circuit, relevant components, and electric circuitry in the tile cavity.The wireless power transmission system works by transmitting energy from the transmitter to a receiver through an oscillating magnetic field. Magnetic coupling and resonance are utilized in some systems.

## I. INTRODUCTION

There are various situations in which a permanent source of electrical energy is desired but cannot be conveniently supplied. Ishiyama (2003) documented this need in mobile applications such as notebook personal computers, personal digital assistants (PDAs), and radio frequency identification (RFID) tags. Hirai (1999) conveyed it in flexible manufacturing systems; desiring that machines be wirelessly powered to allow product variation with few constraints on power supply. Additionally, it is assumed thatthere are numerous commercial product applications that could benefit from a wireless power transfer.

This thesis focused on a commercial product need – the need to supply wireless power to household lamps. This need is considered a latent need of many homeowners because it is not widely recognized. It is estimated that in 2000, consumers spent $759.6 million on table and floor lamps (Encyclopedia of American Industries, 2006). In many instances, these table and floor lamps were placed in remote locations within the house that do not facilitate the use of power cords. For example, a lamp may be placed in the middle of a room making it inconvenient to power by cord. For the most part homeowners leave such lamps without power, providing only aesthetic benefits. These lamps are ideal candidates for wireless power. This thesis demonstrates the use of wireless power in a prototype for a commercial product.

## II. Review of Literature

Wireless power transfer has been attempted many times throughout the last century. The concept began with the experiments of Heinrich Hertz and Nikola Tesla around the 1890s and has continued until this day. Although Tesla was confident in his hypothesis to transfer power, nobody has been able to ratify it. In today's world, wireless power transfer is largely exhibited through induction. Although functional, wireless power transfer through induction is constrained to very small distances; the transfer efficiencies get increasingly worse as the distance between transmitter and receiver increases. This chapter provides a literature review of the history of wireless power transfer throughout the last century. All of the methods that have been used to achieve wireless power transfer will be reviewed along with the advantages and disadvantages of each method. The chapter will conclude with a small discussion on issues with wireless power transfer.

## III. Design of the Proposed System

### Constraints Imposed on the System

The notion of powering a lamp wirelessly brings with it many challenging implications. First, there are a number of constraints imposed on such a system by rules and regulations set by the FCC. These regulations limited the scope of this thesis, making it infeasible to transfer sufficient power (anywhere from 5 to 60 W) directly to alamp. Because of this, a storage device was used in the system to accumulate the transferred power.

In addition to the FCC regulations, others constraints were placed on the system. The system was expected to transfer and store energy 24 hours of the day. During 6 of these 24 hours, the system was expected to power a light bulb. This constraint was decided upon because it was assumed that most lamps are not used for more than six hours a day; thus, six hours of use would satisfy the needs of the average homeowner and would serve as a good benchmark.

### Building the System

After the system was designed and all the necessary parts were purchased, thesystem was built. At times, slight variations to the original design needed to be employed. This chapter documents the entire build of the system.

### The Transmitting Antenna

The trunking radio attaches to the transmitting antenna using a radio frequencyadapter; the radio has a type N output and the antenna has an SMA input. The appropriate adapter was used. The trunking radio together with the transmitting antenna can be seen in Figure 4.1.

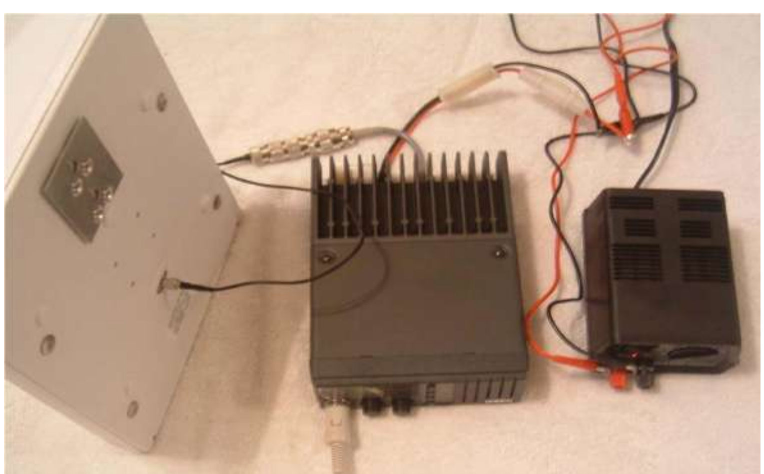


**Figure 4.1 The Transmitting Antenna, Trunking Radio, and Power Source**

**The Rectenna**

The first part of the rectenna was the receiving antenna. The same antenna as the transmitting antenna was used for the receiving antenna. As mentioned previously, the antenna has an SMA RF output. An SMA to BNC adapter was used and the BNC adapter was hooked directly into the rectifier. The rectifier was first built on a protoboard.

As the low pass and DC filters' purpose were to improve the efficiencies of the rectenna, they were initially excluded from the system in order to simplify the design.

The initial simplified rectifying circuit schematic is shown in Figure 4.2.

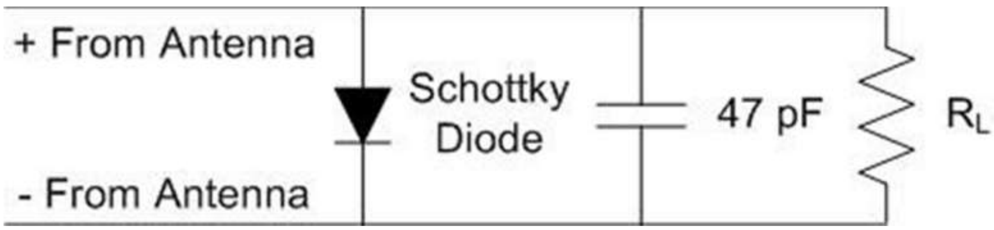



**Figure 4.2 Initial Rectifying Circuit Schematic**

The original rectenna design, as a whole, is shown in Figure 4.3.

**Figure 4.3 Original Rectenna Design**

**The Battery Assembly**

The rectenna fed DC power to the battery. The battery was charged on power at12 V DC. Because the rectenna would likely not output a constant 12 V, it would be necessary to regulate the power (if the output were more than 12 V) or boost the power (if the output were less than 12 V). Upon the initial build of the system, it was uncertain as to how much voltage the rectenna would output. Because of this, the design to charge the battery was left untouched until the initial results were established.

**The Lamp Assembly**

The lamp assembly consisted of the LED, the screw thread, and the lamp. The LED required a heat sink to dissipate the heat generated when operating. The LED was attached to the heat sink using a heat sink compound (silicone) and four screws. Wires were then soldered to the positive and negative connections of the LED which were connected to a light screw thread assembly. The resulting light assembly is shown in Figure 4-4.

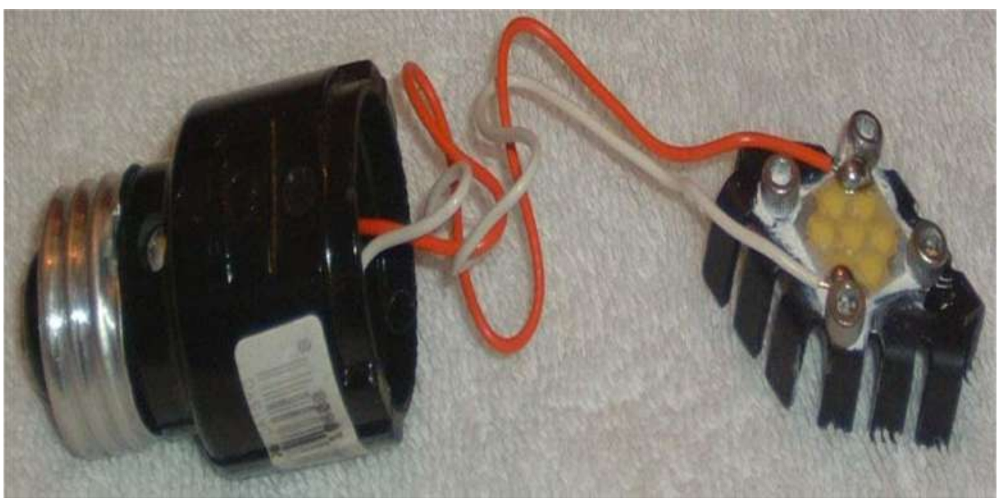


**Figure 4.4 Light Assembly**

With the LED attached to a screw thread, the light assembly could be used withany household lamp. As was decided earlier, a common table lamp was used to test thesystem against the hypotheses.

**Testing the System**

After the system was built, it was sanity tested for things such as continuity andbasic functionality. This section documents all the validation that was performed.

**The Wireless Power Transfer System**

Two tests were performed on the wireless power transfer system: one to testbasic continuity and another to test the output power of the transmitter. A basic continuity check was performed on each applicable part to make sure that every connection and adapter was properly attached.

To verify the output power of the transmitter, the amperage was measured whiletoggling the transmitter on and off. While the transmitter was off, it was pulling 0.39 amps (A) at 11.9 W. Using the power formula, the wattage can be derived:

While the transmitter was on, an amperage of 2.63 A was measured at 8.78 V. Again,using the power formula, the wattage was derived:

This is a difference of 18.45 W. This shows that 18.45 W goes into the transmitter in the transmit state. This passes the sanity test that the transmitter could betransmitting 15 W as it is rated.

**The Lamp Assembly**

The light assembly (the LED with the screw thread attached) was tested to see ifit would light while applying 12 V of power. In order to do this, the continuity of the lamp had to be measured to establish which plug prong was positive and which was negative. Once continuity was established, the light could be tested. Figure 5-1 shows the results of this test.

**Figure 5.1 Light Assembly Test**

The light assembly was then tested by applying the positive and negative leadsfrom the charged battery (rather than the power source). This test also went well; the LED lit up as it had before.

## IV. Result Analysis

The result considered as a key metric of the system was the output voltage of therectenna. This is the key metric because if the voltage is sufficient, the battery is likely to receive the power needed (if the respective current is sufficient). Many trials were executed in an attempt to get acceptable results. Changes to the rectenna were made between each trial while the rest of the system was held constant. This chapter documents these trials as well as the changes that were made between each trial.

**WPT SET-UP:**

**BEFORE WORKING**

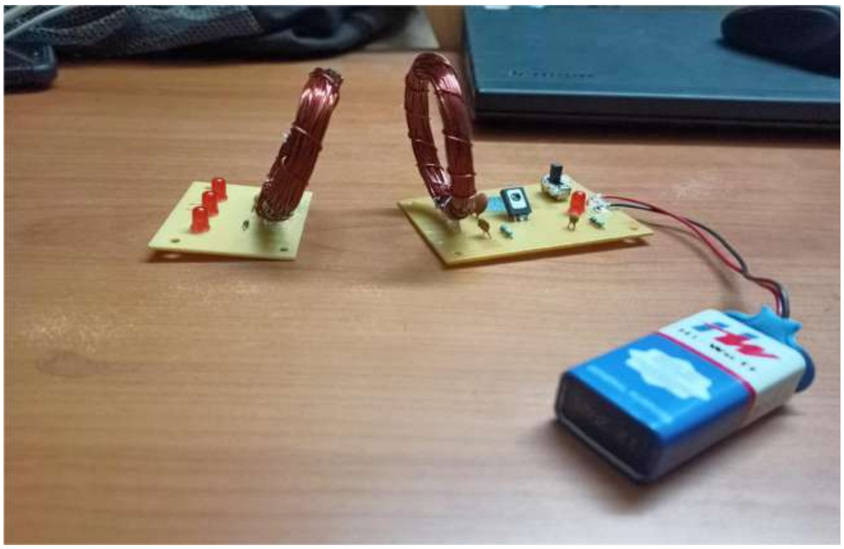
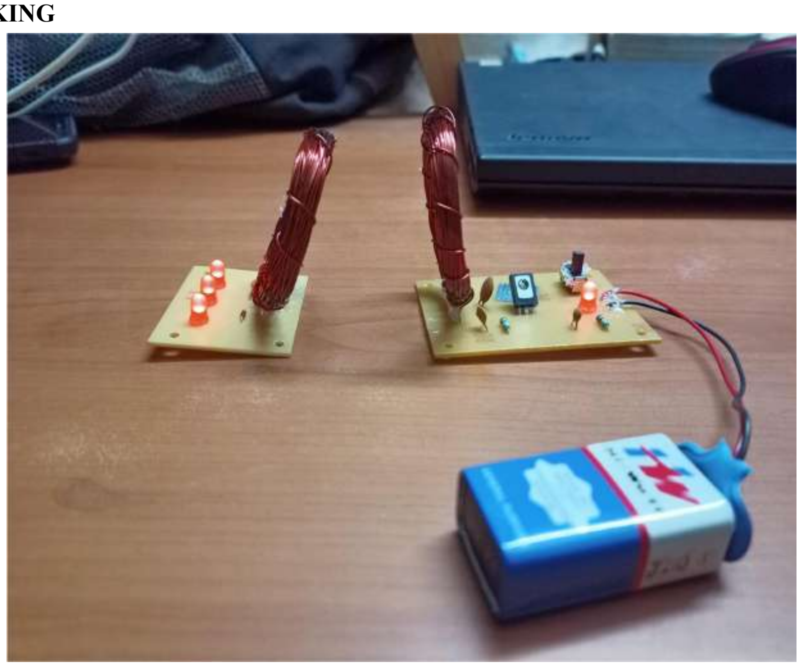


**Figure 5.2 (a) WPT Setup Before Working**

**AFTER WORKING**



## V. Conclusions and Recommendations

This chapter documents the conclusions and recommendations that were drawnfrom the results that were shown in the previous chapter. In this chapter each of the hypotheses is tested, general conclusions are drawn, and recommendations for future research are established.

**References:**

[1] A4 Technologies. Battery Free Mouse. Http://www.a4tech.com/en/product1.asp?CID=90&SCID=92. Accessed 10 July 2006.

[2] Anon. "Return of the Trolley." *Mechanical Engineering* v. 106, n. 1 (Jan 1984): 35 –39.

[3] Brown, W. "The History of Power Transmission by Radio Waves." *IEEE Transactionson Microwave Theory and Techniques* Vol. MTT-32, No. 9 (September 1984): 1230 –1242.

[4] Cree. Cree Demonstrates 131 Lumens per Watt White LED. June 20, 2006 Press Release. Http://www.cree.com/press/press_detail.asp?i=1150834953712. Accessed 9July 2006.

[5] Dench, E. "The Final Design." *IT How* (Spring 1999): 1 – 5.

[6] Dickinson, R. "Issues in Microwave Power Systems Engineering." *IEEE Aerospace andElectronic Systems Magazine* (1996): 463 – 467.

[7] Dickinson, R. "Wireless Power Transmission Technology State of the Art the First BillBrown Lecture." *Science Direct* (Aug/Nov 2003): 561-570.

[8] Economist. "A Brief History of Wi-Fi." *Economist* Vol. 371, Issue 8379 (June 12,2004): 26.

[9] Encyclopedia of American Industries. "3645 – Residential Lighting Fixtures."

[10] *Encyclopedia of American Industries* (2006).

[11] Hirai, J. and Kawamura, A. "Practical Study on Wireless Transmission of Power and Information for Autonomous Decentralized Manufacturing System." *IEEE Transactionson Industrial Electronics* Vol. 46, n. 2 (April 1999): 349 – 359.

[12] Heikkinen, J. and Kivikoski, M. "Low-Profile Circularly Polarized Rectifying Antennafor Wireless Power Transmission at 5.8 GHz." *IEEE Microwave and Wireless Components Letters* Vol. 14, n. 4 (April 2004): 162 – 164.