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A noval approach on resonant wireless charging system

Sarwesh Kumar Swarnkar[1] Vivek Kumar Choudhary[2], Ritesh Kumar Patel[3], Manish Kumar Patel[4], Binita Choudhary[5]

[1]Lecturer, of Et&T Engineering, Kirodimal Institute of Technology, Raigarh (C.G.)
[2, 3, 4, 5,] Students of Et&T Engineering, Kirodimal Institute of Technology, Raigarh (C.G.)

ABSTRACT

Wireless charging is a technology of transmitting power through an air gap to electrical devices for the purpose of energy replenishment. The recent progress in wireless charging techniques and development of commercial products have provided a promising alternative way to address the energy bottleneck of conventionally portable battery-powered devices However, the incorporation of wireless charging into the existing wireless communication systems also brings along a series of challenging issues with regard to implementation, scheduling, and power management. In this article, we present a comprehensive overview of wireless charging techniques, the developments in technical standards, and their recent advances in network applications. In particular, with regard to network applications, we review the static charger scheduling strategies, mobile charger dispatch strategies and wireless charger deployment strategies additionally, we discuss open issues and challenges in implementing wireless charging technologies. Finally, we envision some practical future network applications of wireless charging.

The wireless charger will convert the RF/ microwave signal at a fixed particular frequency into a DC signal, and then store the power into an AAA battery. The project is divided into 3 parts: transmitter, antenna, and charging circuit.

I. INTRODUCTION

The advantage of this device is that it can wirelessly charge up the batteries which can save time and money in a long run for the general public. Base on this concept, the design team has come up with a new way to charge the batteries wirelessly. The project is to make a prototype device that converts microwave signals to DC power. Once the prototype has been proved to be working, it is possible to implement this prototype into other applications such as in television remote control, fire alarm, clock, and places that are far to reach to change battery. Wireless charger can be divided into 3 parts components. First, transceiver. The transceiver electromagnetically transfers power via inductive coils which supply a wireless transfer of power to receiver units.

This paper implies wireless transmission of power using RF waves. A suitable charging circuitry is demonstrated which can capture high frequency signal and convert it into DC signal. The application scenario considered in this paper is as follows. A low noise AC signal at 915MHz is to be generated using a signal generator. At receiver end printed monopole antenna tuned at same frequency will capture signal transmitted, output of which is to be given to charge pump circuit which is multi stage voltage multiplier. Finally output is to be measured at output of voltage doubler. It would be convenient not having to worry about charging or changing the batteries and still have a working device.

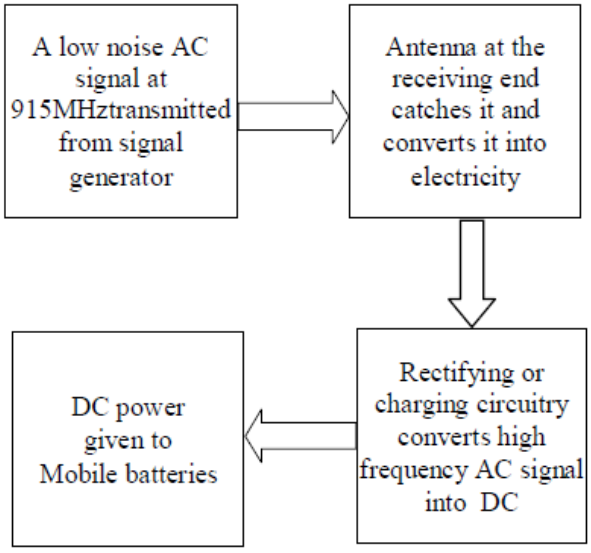

Figure 1: block diagram of wireless charger

II. CHARGING CIRCUIT

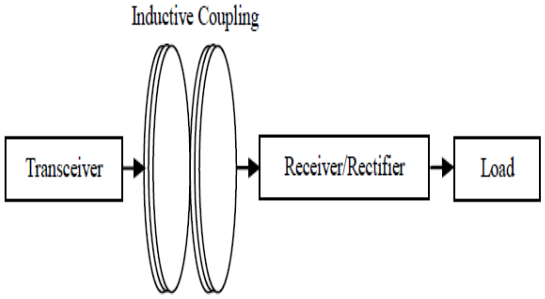

Figure 2: Block Diagram of wireless charging equipment

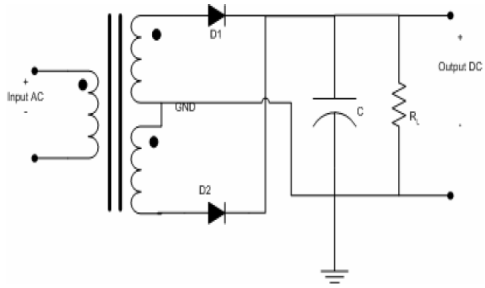

Figure 3: Full wave rectifier

A. Transmitter

Since the group does not design the transmitter, therefore the design is mainly focus on the receiver side. A power transmitter is bought from a commercial website. It is a 900 MHz video/audio transmitter.

B. Antenna

The antenna plays a very important role. To charge a battery, a high DC power signal is needed. The wireless battery charger circuit must keep the power loss to the minimal.
Taking the above design spec in consideration, the team found Yagi antennas that fit our spec. Below is a picture of the Yagi antenna.

The higher of the antenna gain yields a better result of the design. However, higher gain will also increase the cost and the size of the antenna. This becomes a major factor in choosing the antenna due to the group's limited financial resources. After consideration, a 9 dBi Yagi antenna is chosen for the design

C. Receiver

Microwave signal is an AC signal with a frequency range of 1 GHz – 1000 GHz. 900 MHz is in between the RF/ Microwave range. No matter how high the frequency is, AC signal is still AC signal. Therefore, the signal can also be treated as a low frequency AC signal. In order to get a DC signal out of the AC signal, a rectifier circuit is needed.

The receiver's main purpose is to charge an AAA battery. A simple battery charging theory is to run current through the battery, and apply a voltage difference between the terminals of the battery to reverse the chemical process. By doing so, it recharges the battery. There are other efficient and faster ways to charge the battery, but it requires a large amount of energy which the wireless battery charger can not obtain, yet. Therefore, in our design, we use a straight forward method to charge the battery.

A full-wave rectifier is chosen for the project due to its simplicity and efficiency in converting the AC signal. The full-wave rectifier is consisted of four diodes. Since the power received by the receiver will be relatively low and the signal frequency is high, the diodes are required to have a very low turn on voltage and operating frequency at 900 MHz. For this reason, a Schottky diode by Skyworks is chosen for the design. (SMS3929-021 Bridge Quad Schottky Diode)
At the output of the rectifier, the signal is not a fully DC signal yet. Thus, by adding a capacitor and a resistor can smooth out the output to become DC signal. However, the time constant produced by the capacitor and the resistor should be calculated carefully to fit the desired time constant.

III. DESIGN DESCRIPTION

This wireless battery charger is designed to operate at 900 MHz. In this project, a power transmitter acts as the power source. It will transmit power to the receiver side. And then, the rectifier circuit in the receiver will convert the RF/ microwave signal into DC signal. After the DC signal is produced, the charging circuit will store the power into the battery. Here is the block diagram of the overall design. Signal generator transmits a low noise AC signal at 915MHz into space while the antenna of the receiver captures it to convert it into electricity. The radio waves cannot be captured fficiently if the length of an antenna is not accurately right for the frequency used. It should not be too long, or too short. A good transmitting antenna is always a good receiving antenna, and for ordinary uses, one antenna can be served for both functions. Output of receiving antenna is to be connected to charging circuitry which converts high frequency AC signal to DC, to get more of output voltage doubler circuit is to be connected which rectifies as well as doubles the voltage present at input, number of stages used is directly proportional to number of timesvoltage doubles. Finally required output is to be takenat multi stage voltage doubler's end.

IV. DESIGN SPECIFICATIONS

The design is separated into three subsystems: the transmitter, the antenna, and the charging circuit. This charger will charge the battery by utilizing the microwave signal at 900 MHz frequency. It will convert the microwave signal to DC signal, and then it will use the DC signal to charge the battery. Below are the design specifications of the charger circuit.

Table 1: Specification of the Wireless charger

DESIGN SPECIFICATION	
Source Frequency	900MHz
Charging Distance	1 Ft
Voltage Output	4.0 volt
Power Output	60mW
Battery type	BL-5C

V. FUTURE IMPROVEMENTS

The future studies mainly concentrate on reducing physical size of antenna and embed it in mobile itself to give high efficiency and less loss. Also designing high level power transmission system for charging laptops have good scope of work. There are several possible ways to improve our design in order to increase the power output. Here are several suggestions:

a. High Gain Parabolic Antenna

Another way is to use a high gain parabolic antenna (See Appendix). This parabolic antenna will be able to transmit power from the transmitter with a much higher gain, and receive approximately seven times greater power than the 9 dBi Yagi antenna. The disadvantages of using this parabolic antenna are the size and the fixed direction of the antenna.

b. Multiple Rectifiers

One way is to use multiple rectifiers. By doing so, more power is getting rectified by these the multiple rectifiers in the circuit. However, this design will need to use multiple antennas separated by a certain distance. This problem can be solved by using a spiral antenna array, which is difficult to design.

CONCLUSION

In conclusion, It is a hassle to charge or change the battery after a while, especially when there is no power outlet around. This wireless battery charger is designed to operate at a particular Power Rating and frequency. In this project, a power transmitter acts as the power source This wireless battery charger is expected to eliminate all the hassles with today's battery technology.. It will transmit power to the receiver side. And then, the rectifier circuit in the receiver will convert the RF/ microwave signal into DC signal. After the DC signal is produced, the charging circuit will store the power into the battery. This report covers the basis and design of the wireless battery charger.

References

1. (RF/ Microwave to DC Conversion) ,Dec 02, 2005
2. Mi, Minhong, Personal Interview. 2003
3. Daniel W. Harrist, BS, University of Pittsburgh, 2001,
4. Piyush Kumar Department of Electronics and Communication Engineering, Vidya Vihar Institute of Technology, Purnea, Wireless Charging Of Mobile Phones Using Microwaves
5. Aakib J. Sayyad, Electrical Engineering Department, VJTI, Mumbai, India, Wireless Power Transmission for Charging Mobiles, (IJETT) – Volume 12 Number 7 - Jun 2014
6. J. A., Kustera, D. and Sridhar, S., Cell-Phone Battery Charger Miniaturization. IEEEJournal 2000.
7. http://www.seas.upenn.edu/~jan/spice/spice.overview.html
8. WIRELESS BATTERY CHARGING SYSTEM USING RADIO FREQUENCY ENERGY HARVESTING,