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# WiTRICITY: A POWER TRANSMISSION METHOD FOR WSN

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***Abstract: Wireless Sensor Nodes (WSN) is powered by small batteries and the limited energy supply has constrained the lifetime of a sensor network. This has been a long lasting, fundamental problem faced by sensor networks that are designed for long term operation. The issue in energy constraint problem in WSN and as a solution, WiTricity (Wireless Electricity) is proposed. Energy will be shifting back and forth between magnetic field surrounding the coil and electric field around the capacitor. Primary and secondary coils (helical shape) are used to transfer the energy from energy station to sensor nodes.***
***Keywords: Wireless Power Transmission, Wireless Electricity, Wireless Sensor Networks, Hartley Oscillator, Radio Frequency, Resonant Inductive Coupling***

## I. INTRODUCTION

Wireless power transfer (WPT) accomplishes the same objective yet without the hassle of wires WPT advances are reforming the way energy is exchanged and can possibly make our lives really "wireless ". Magnetic field as well as electric field might be utilized for coupled resonant WPT. Magnetic coupled resonant WPT is not influenced by human body. On account of the direct fed type, power source and load is specifically connected to the resonant structure. Then again, feeding loop is utilized for indirect fed type. A power source and load is associated with the loop structures, which have not sharp frequency characteristics. The loop structure and the resonant structure are coupled by magnetic induction. For event of resonance, same amount of inductive reactance and capacitive reactance is important. For the self-resonant type, inductance and capacitance are acknowledged by indistinguishable structure. Currents along the spiral structure causes inductance and charges at the end of the coil causes capacitance. Resonant happens at the frequency at which the inductive and the capacitive reactance get same. On alternate hands, external resonant type has different structure to acknowledge capacitance and inductance. WiTricity is viably attained by RIC. Essential and auxiliary coils are utilized to transfer the energy that coils were in helical shape. This innovation is focused around the well-known standard of resonant coupling, i.e., by having magnetic resonant coils work at the same resonance frequency so that those are unequivocally coupled by means of non radiative magnetic resonance induction. Under resounding coupling, energy might be exchanged proficiently from a source coil to a receiver coil while losing little energy to unessential off resonant objects. It could be viewed as a unique instance of inductive coupling where the primary and secondary coils are tuned in resonance by adding compensation capacitors [1].

## II. SYSTEM OVERVIEW

### A. Existing System

Contrasting and sensor node or battery substitution approaches, the wireless charging innovation permits a mobile charger to exchange energy to sensor nodes remotely without obliging correct restriction of sensor nodes or strict arrangement between the charger and nodes [4].
The system consists of

- A moving vehicle charger (MVC): a portable robot convey a wireless power charger, a system of sensor nodes outfitted with wireless power receivers, and an energy station that screens the energy status of the system and steers the MVC to charge sensor nodes.
- A system of sensor nodes outfitted with wireless power receivers: Sensor nodes perform requisition errands, for example, environment observing, create tactile information, and occasionally report the information to the sink. Also, that additionally screen the voltage readings of their own batteries, gauge energy utilization rates, taking into account which infer their own particular lifetime, and afterward report the data to the sink occasionally.

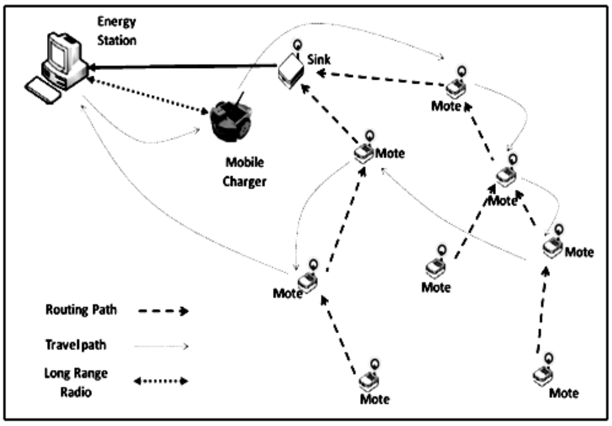


Fig. 1: Energy Transfer through Mobile charger

- An energy station: it is in charge of observing the energy status of sensor nodes, choosing the power charging sequences to be executed by the portable charger (as demonstrated in the figure (1)).

### B. Problem in Existing System

The current framework has the overhead of controlling and keeping up the MVC. The MVC takes more than 30% of energy for going between the sensor nodes and charging. The separation between MVC and sensor node is excessively little (in 5-40cm).

## III. PROPOSED SYSTEM

The framework comprises of transmitters and collectors that hold magnetic loop antennas basically tuned to the same frequency. Because of working in the electromagnetic near field, the accepting gadgets must be close to around a quarter wavelengths from the transmitter. The WiTricity devices are coupled very nearly totally with magnetic fields (the electric fields are to a great extent bound to capacitors inside the devices), which is contended to make them more secure than resonant energy transfer utilizing electric fields (most broadly as a part of Tesla coils, whose high electric fields permit them to be utilized as lightning generators), since most materials couple pitifully to magnetic fields. The WiTricity devices are additionally guaranteed to be unexpected in that support efficient energy transfer for "mid-range" distances several times larger than the diameter of the resonant objects. Not at all like the far field wireless power transmission frameworks focused around traveling electromagnetic waves, WiTricity utilizes close field resonant inductive coupling through magnetic fields like those found in transformers with the exception of that the primary coil and secondary winding are physically separated, and tuned to resonate to expand their magnetic coupling. These tuned magnetic fields produced by the primary coil could be organized to connect vivaciously with matched secondary windings in far off supplies however significantly all the more pitifully with any surrounding objects or materials, for example, radio signals or biological tissue.

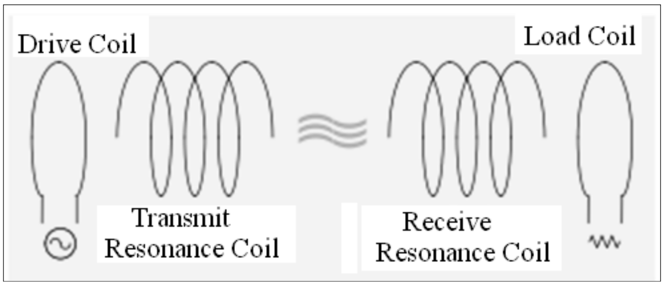


Fig. 2: Wireless Energy Transfer Systems

Figure (2) shows the basic coil system made out of four coils: drive, transmit resonance, receive resonance, and load coils. The transmit resonance coil is coupled to the drive coil which is connected to a power amplifier that supplies energy to the framework. The receive resonance coil is coupled with the load coil to give the ability to an external load.

## IV. SYSTEM IMPLEMENTATION

As shown in figure 3.1, a simple structure of energy transfer system by means of magnetic resonance is proposed. The energy supply of source is given by power convert module; inductor Ls and capacitor Cs constitute a resonance source circuit to create an alternative non radiative magnetic field.
The resonance frequency of LC circuit is fs. The control signal for power switch tube T is produced by switch drive circuit, and its frequency is fk. In principle, when f t is close or equivalent to fs, the oscillation of source resonance circuit is strongest, the estimation of resonance current is most noteworthy, and the magnetic field intensity is additionally strongest.

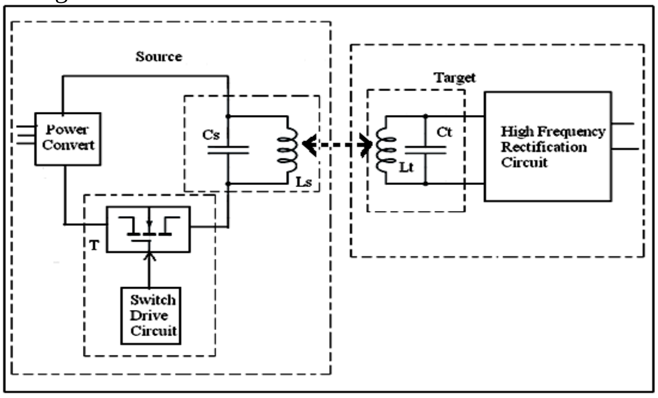


Fig. 3: System Circuit Diagram

Inductor Lt and capacitor Ct constitute the receiving resonance circuit to produce resonance with the magnetic field which created by source resonance circuit to receive energy. The frequency of receiving resonance circuit is ft, the parameters of Lt and Ct needn't be in full accord with the source resonance circuit. What the receiving resonance circuit must need is to guarantee fs = ft, that is the essential condition for energy transfer. Figure 3 shows the circuit diagram of the transmitter. This circuit is focused on Hartley oscillator, because Hartley oscillator has stability in the frequency. Here, 4.7nF capacitor and the coil windings used to form a LC tank circuit.

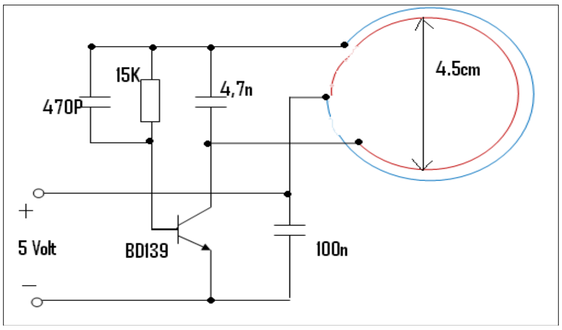


Fig. 4: Transmitter Circuit Diagram

Figure 3.3 shows the circuit diagram of the receiver. Here, diode 1N4148 and 4.7nF capacitor was used as the rectifier that converts the AC signal into DC signal. The DC signal is used to glow the LED.

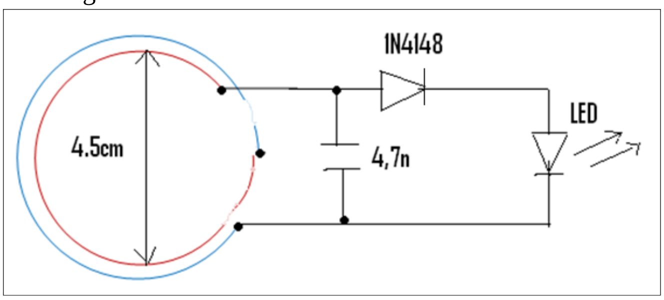


Fig. 5: Receiver Circuit Diagram

  

Input of about 6-12V DC supply is provided to the Electronic Ballast using Battery or Eliminator. Inside Electronic Ballast, Inversion process takes place resulting in conversion of DC to AC signals. AC signals, thus produced are of low frequency. Due to the transistor switching action taking place inside Electronic Ballast, Low frequency AC signals are converted into high frequency AC signals. High frequency AC signals obtained from Electronic Ballast are fed as Input to the Transmitting coil. Due to the process of Magnetic Induction along with resonant principle, an EMF is induced in the Receiving Coil. Output from the Receiving Coil is fed as input to the Cell Phone Charger Circuit. In this manner, Wireless Power Transmission empowers glowing of LED**.**

## V. RESULT

Input is given to the system is 5 V and the output in the LED is measured as 3 V in the distance of 20 cm. When the distance is increased, voltage level is decreased and vice versa.

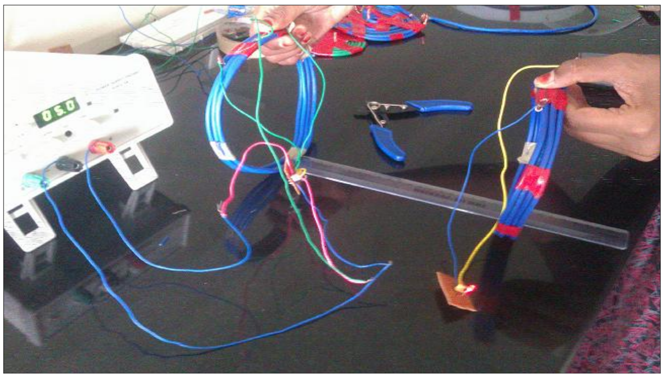

Fig. 6: Output Snapshot

Details:
Diameter of the coil (D) = 17cm
Radius of the coil (r) = 8.5cm
Radius of the cross-section (a) = 0.4cm
Number of Turns (N) = 2 turns

Theoretical Calculation:
Inductance of the Winding
Inductance of a circular coil = $N^2\mu0\ \pi r^2 / l$ = 3.8 uH

Resonant Frequency:
f = 1/2π sq.rt of LC
L = 3.8 uH, C = 4.7nF
f = 1.2 MHz
Resonance Condition:
For Resonance to occur, XL = XC
XL = Inductive reactance (Reactance of Coil)
XC = Capacitive Reactance
XL = 2π x f x L = 28.6 Ω
XC = 1/2π x f x C = 28.24 Ω
Thus, XL = XC and so Resonance occurs resulting in transfer of power wirelessly.

Table. 1: System Specification

| | | |
|---|---|---|
| Transmitter | Number of Turns | 2 |
| | Diameter | 17 cm |
| | Inductance | 3.8 uH |
| | Current | 384 mA |
| | Voltage | 11 V |
| Receiver | Number of Turns | 2 |
| | Diameter | 17 cm |
| | Inductance | 3.8 uH |
| | Current | 140 mA |
| | Voltage | 4 V |

### *A. Advantages*

Wireless Power Transmission Using Inductive coupling also offers a few focal points over different choices that are as takes after,

*1. Simple Design:* The design is extremely straightforward in principle and additionally the physical usage. The circuits constructed are not unpredictable and the segment number is low as well.

*2. Lower Frequency Operation:* The operating frequency range is in the kilohertz range. Furthermore there is low risk of radiation in the LF band.

*3. Low Cost:* The whole framework is composed with discrete parts that are promptly accessible. No extraordinary parts or custom request parts were essential for the configuration. Consequently it can keep the expense of the whole framework low.

*4. Practical for Short Distance:* The composed framework is exceptionally handy for short separation as long as the coupling coefficient is enhanced. The configuration additionally offers the adaptability of making the receiver much more diminutive for practical applications.

### *B. Applications*

The voltage transferred between primary and secondary coil is nearly 4-6V. So this system is very suitable for sensor nodes which have low power rechargeable batteries.

Table. 2: Applications

| Sensor Name | Voltage | Current |
|---|---|---|
| Metal Object Detecting Sensor | 10 - 30 V | 500mA |
| Soil Moisture Sensor | 3.3 - 20 V | <7mA |
| Smoke Detecting Sensor | 12 - 24 V | Standby Current: 50 uA Alaram Current: 130 mA |
| Air Contaminants Detecting Sensor | 4.8 - 5.2 V | 38 - 46 mA |
| Traffic Management Sensor | 8 - 26 V | 900 mA |

  

## VI. CONCLUSION

WiTricity for wireless sensor nodes project propose a wireless charging system for sensor networks. This project presents the design and implementation of the system, especially study the charging planning problem. Experiments are conducted on an implemented prototype of the proposed system to evaluate the feasibility and the effectiveness of the system on prolonging the sensor network lifetime. The results verify that the proposed system can extend the sensor network lifetime significantly. The software which will be implemented in central station is used to control the sensor nodes and energy station. The software will be developed using vb.net. Using this software, monitoring the battery level of all sensor nodes, monitoring the energy level of the energy station, instructing the energy station to transfer the energy to the sensor node which contains low battery level and indicating the user with energy level of the energy station which contains low energy level will be done. The software will be implemented in energy station to process the instruction from the central station and to control the amount of energy to transfer to the sensor nodes. The database is used to store the information about the each sensor that contains name, position and distance of the sensor node from the energy station.

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