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Wireless Electricity Transfer System Design and Implementation

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Abstract: Wireless power transmission (WPT) has covered a wide range of subjects in many fields and become a highly active research area for students, scientists, and many others because of their potential to provide new technology to our daily lives. Wireless power transmission will have a bright future because this technology is used in the transmission of electrical energy from a power source to an electrical load across an air gap without any wires. This paper presents a design implementation and working principle of wireless power transfer. The paper describes different studies of existing technologies in wireless power transmission. Also, the working of the circuit has been described along with the results.
Keywords: Wireless power transfer, transmitter module, receiver module, MOSFET, Inductive coupling

I. INTRODUCTION

After Wi-Fi gained widespread acceptance, there has been an increase in interest in studying and developing wireless power technologies. This will eliminate the cables. We could just forget about USB cables, chargers, and converters when we travel. Numerous applications employ inductive power transfer to wirelessly transfer power. According to [1], inductively coupled chargers are used to wirelessly charge mobile phones, MP3 players, and other handheld gadgets.

This System is divided into 3 parts. First, transmitter which electromagnetically transfers power using inductive coils and then supplies a wireless transfer of power to the receiver. Second,

Inductive coupling, behave as an antenna and forward to the bridge rectifier. It is used to convert the induced AC voltage to the DC voltage. Third, the rectifier. The rectifier finally will supply DC voltage to the load.

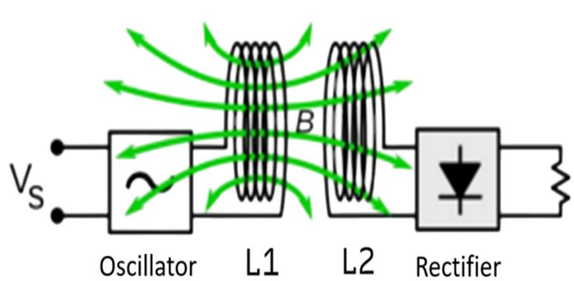
The goal of this project is to test the operation of a contactless power transfer system that uses inductive coupling between two coils to efficiently power future systems with WiTricity (wireless energy) and the effects of various design parameters.

A. Principle of Wireless Power Transfer Using Inductive Coupling

The fundamental of power transmission includes:

the inductive energy that can be transmitted from a transmitter coil (L1) to a receiver coil (L2) through an oscillating magnetic field (B, green) which reaches out to the secondary coil in the receiver unit and induces a voltage in it by faraday's law of induction, the DC current supplied by a power source is changed into high frequency AC current by a particularly designed oscillator embedded into the transmitter in which the

yield is provided to the push pull circuit then to the transmitter coil (L1) which acts as the primary coil (L1) therefore the power gets transferred through the primary coil (L1) to the receiver coil (secondary coil L2) that are separated by certain distance, the power being received by the secondary coil (L2) is then rectified and regulated before the output is supplied to the load.



Wireless power transfer vi inductive coupling

II. LITERATURE REVIEW

Famous scientist and inventor Nikola Tesla made an attempt to prove that electricity could be sent to a load without the use of a wire in 1891 by employing the electrodynamics induction theory and using air as a medium to burn a light bulb [2]. NFWPT (Near Field Wireless Power Technology) and FFWPT (Far Field Wireless Power Technology) are the two subfields of wireless power transfer. Since NFWPT depends on the coupling of the magnetic fields between the two coils, which accounts for its limited range, it is additionally categorized as electromagnetic induction [4]. Additionally, this near-field method is better suited to studying the near-field transmission of power via the magnetic field [3]. The FFWPT is another. The best uses for it are long-range ones. However, it is considerably less efficient because of the power losses [4]. Numerical studies show that mid-field wireless powering achieves much higher power transfer efficiency than traditional inductively coupled systems [15].

Researchers have employed a variety of techniques, including microwave, capacitive coupling, resonant inductive coupling, and inductive coupling. Based on efficiency and distance, each of these strategies yields a different result [7]. The inductive coupling approach summarizes the findings of an experimental study on WPT using this technique. 72% efficiency was attained in this process [4].Efficiency falls off as distance grows. Therefore, the most effective distance for wireless power transmission is 0 cm. The presence of impediments in the transmitter and reception parts, such as plastic, etc., is a way to evaluate the effectiveness of wireless transmission [6].

Wireless charging is an application of witricity. By using Inductive Coupling. The effective charging distance is generally within 20cm [8]. A proposed wireless-power-transfer system via inductive coupling

And capable of 295 W of power delivery at 75.7% efficiency .This is the highest power and efficiency of a loosely coupled planar wireless-Power-Transfer system reported to date [9]. Another method is by using Magnetic resonance coupling in which the capability to transfer power over a longer distance than that of inductive coupling, with higher efficiency [10]. A design of wireless power charging pad based on magnetic resonance coupling is introduced. For highly efficient operation of the overall charging pad system, the efficiency of RF TX is very important so that the 6.78 MHz, 30W, 91% [11].

WPT is based on the IPT concept for biomedical applications. The delivered power to biomedical devices reported in the collected papers ranges from few mW to 48 W, with maximum efficiency of up to 95% for 20 mm range [12]. Electrical engineering could experience a significant shift thanks to wireless power transfer, which does away with the need for traditional copper connections and current-carrying wires. No more tangled wires will result from this, and if used widely enough, expensive batteries may also be eliminated [7] [13].

III. METHODOLOGY/EXPERIMENTAL

The main concept of this project is to design a device for the concept of wireless power transfer to eliminate the use of conventional copper cables and current carrying wires.

The basics of wireless power transmission include the inductive energy that can be transmitted from a transmitter coil to a receiver coil through an oscillating magnetic field. The DC current supplied by a power source is changed into high-frequency AC current by particularly designed electronics built into the transmitter.

In the TX (transmitter) section, the AC current increases a copper wire, which creates a magnetic field. Once an RX (Receiver) coil is located near to the magnetic field, then the magnetic field can induce an AC current in the receiving coil. Electrons in the receiving device convert the AC current back into DC current, which becomes working power.

The required components of this circuit mainly include

1) Z44 MOSFET
2) COPPER WIRE (25 gauge)
3) 4007 DIODE
4) 1000UF CAPACITOR
5) 7805 REGULATORS
6) CHARGING PIN
7) LED
8) 2 QTY 1 K OHM RESISTOR

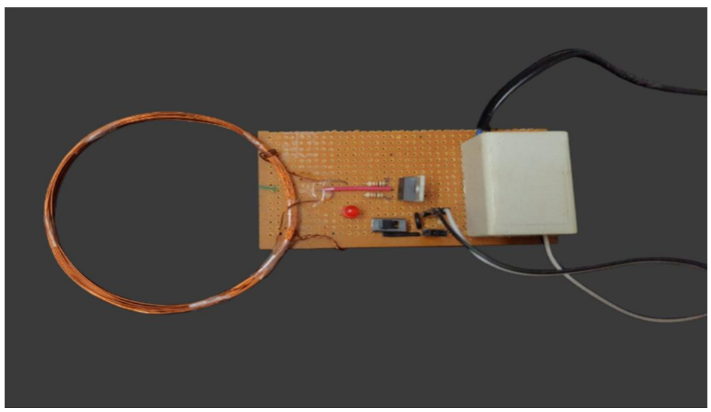
The wireless power transmission can be defined as the energy that can be transmitted from the transmitter to a receiver through an oscillating magnetic field.

To accomplish this, the power source (DC current) is changed into high-frequency AC (Alternating Current) by particularly designed electronics erected into the transmitter.

The AC boosts a copper wire coil in the transmitter, which produces a magnetic field. When the receiver coil is placed in proximity to the magnetic field, the magnetic field can make an AC (alternating current) in the receiving coil. Electronics in the receiving coil then alter the AC back into DC which becomes operating power.

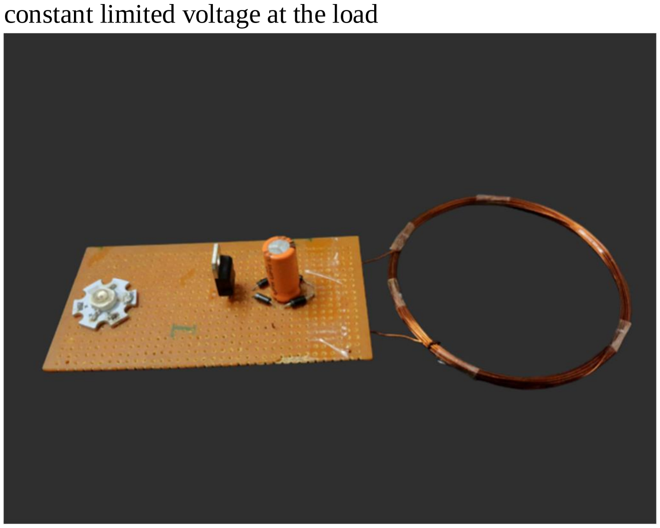
A. At Transmitter Circuit

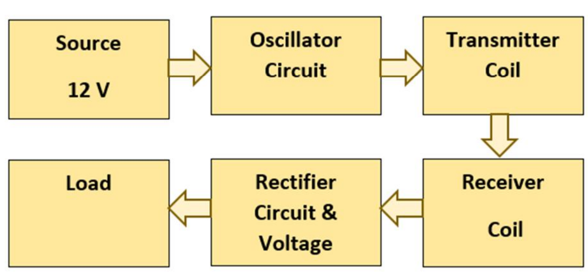
The transmitter module of our project is made up of a receiver coil with turns,



B. At Receiver Circuit

The receiver module of our project is made up of a receiver coil with turns, a rectifier circuit and a voltage regulator IC. An AC. voltage is induced in the receiver coil. The rectifier circuit converts it to DC and the voltage regulator IC helps to maintain a constant limited voltage at the load





Block Diagram of the System

IV. RESULTS AND DISCUSSIONS

Distance (cm)	Input voltage (V)	Output voltage (V)	Efficiency (%)
0	12	8.58	71.5
2	12	7.51	62.5
4	12	6.12	51
6	12	4.98	41.5
10	12	3.09	25.75

V. CONCLUSION

In this study, the goal of the project was to design a wireless power transfer system via inductive coupling were achieved It was observed that these factors had a direct effect on the power transfer as follows: separation of coil (distance), oscillating frequency, number of turns, length of coil, cross sectional area of coil determines the power efficiency. From analysis at 0cm separation of distance, the power transferred was most efficient as seen by the brightness of the test lamps but after a distance of 8cm the power transferred drops significantly, result analysis clearly shows that inductive coupling can be used to deliver power wirelessly to each receiving device simultaneously.

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