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WIRELESS POWER TRANSMISSION USING NEAR-FILED TECHNOLOGY

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Abstract:-

The main target of this project is to build up a device to transfer power wirelessly . The idea of wireless power exchange was first thought by Nikolas tesla. Wireless power transfer can roll out an exceptional improvement in the field of the electrical designing which takes out the utilization conventional copper cables and current conveying wires. In view of this idea, the task is produced to exchange power inside a small range. This project can be utilized for charging batteries those are physically impractical to be connected electrically, for example, pace producers (An electronic gadget that works instead of a faulty heart valve) embedded in the body that keeps running on a battery. The patient is required to be operated every year to replace the battery. This project is designed to charge a rechargeable battery wirelessly for the purpose. We are using a DC fan that runs through wireless power.

This project is based after utilizing an electronic circuit which changes over AC 230V 50Hz to AC 12V, High frequency. The output is fed to a tuned coil forming as primary of an air core transformer. The secondary loop builds up a voltage of HF 12volt. hence the exchange of power is finished by the primary(transmitter) to the secondary that is isolated with an extensive distance(say 3cm).Therefore the transfer could be seen as the primary coil transmits and the secondary coil receives the power to run load.

Additionally this system can be utilized as a part of number of uses, as to charge a cell phone, iPod, workstation battery, propeller clock remotely. And furthermore this sort of charging gives a far lower risk of electrical shock as it would be galvanically segregated. This idea is an Emerging Technology, and in future the distance power transfer can be upgraded as the research all over the world is as yet going on.

Keywords:-Wireless power exchange, Copper Coils(Induction), Wireless Power Transmission(WPT)

I. Introduction

Wireless Power Transmission (WPT) is a technology that allows electrical power to be transmitted from a power source to an electrical load without the need for physical connections. The technology has been around for over a century, but recent advances in technology have made it possible to transmit power over longer distances and at higher efficiencies than ever before. WPT has the potential to revolutionize the way we think about power transmission, enabling us to create more efficient and sustainable power systems.
History:
The concept of WPT has been around since the late 19th century when Nikola Tesla conducted experiments on wireless power transmission. Tesla believed that WPT could be used to transmit power over long distances, potentially revolutionizing the way we think about power distribution. However, it wasn't until the 1960s that WPT was first demonstrated in a practical application, when William C. Brown successfully transmitted power over a distance of 1.5 miles using microwave technology.

Uses:
There are numerous applications for WPT, including electric vehicles, medical devices, consumer electronics, and more. For example, WPT can be used to charge electric vehicles without the need for physical connections, allowing for more efficient and convenient charging. In medical applications, WPT can be used to power implanted devices such as pacemakers, eliminating the need for surgical replacement of batteries.
Principles:
The principles of WPT are based on the concept of electromagnetic induction, which is the process of generating an electric current in a wire by moving it through a magnetic field. In a WPT system, an electrical current is passed through a transmitting coil, generating a magnetic field. This magnetic field then induces an electrical current in a receiving coil, which can be used to power an electrical load.
Components:
The main components of a WPT system include a power source, a transmitter coil, a receiving coil, and a rectifier. The power source provides the electrical energy that is converted into a magnetic field by the transmitter coil. The receiving coil then converts this magnetic field back into electrical energy, which is rectified to provide DC power for the load.
Challenges:
Despite its many benefits, WPT also presents some challenges, such as efficiency and safety concerns. For example, WPT systems can be less efficient than traditional wired systems, and the magnetic fields used in WPT can pose a potential health risk to humans and animals.

II. Literature

Wireless Power Transmission (WPT) is a technology that has gained renewed interest in recent years due to the increasing need for efficient and sustainable power transmission. WPT has the potential to revolutionize the way we think about power transmission by eliminating the need for physical connections, increasing efficiency, and reducing the environmental impact of power transmission.The concept of WPT has been around for over a century. In the late 19th and early 20th centuries, Nikola Tesla conducted experiments on wireless power transmission and believed that it could be used to transmit power over long distances. However, it wasn't until the 1960s that WPT was first demonstrated in a practical application, when William C. Brown successfully transmitted power over a distance of 1.5 miles using microwave technology. Since then, there have been many developments in WPT technology, including the use of magnetic resonance and induction, and the development of new materials and circuits to improve efficiency and reduce costs.According to

William C. Brown [1] In 1961 Brown published the first paper proposing microwave energy for power transmission, and in 1964 he demonstrated on Walter Cronkite's CBS Evening News a microwave-powered model helicopter that received all the power needed for flight from a microwave beam.Between 1069 and 1975 Brown was technical director of a JPL-Raytheon program that beamed 30 kilowatts over a distance of 1-mile (1.6 km) at 84% efficiency. He continued to make important contributions to this emerging technology until his retirement from Raytheon in 1984.

Professor Soljačić’s[2] experiments and work in wireless energy transfer are related in spirit to the work of Nikola Tesla in the early 20th century, but also have significant differences: unlike Tesla's long-range wireless energy transfer in Colorado, the Soljačić group focuses only on short-range transfer, and unlike Tesla coils which resonantly transfer power with electric fields (which couple strongly to surrounding matter, most famously inducing artificial lightning) the Soljačić proposal uses coupling primarily via magnetic fields. This work is currently being pursued in Soljačić's

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WiTricity company. Soljačić believes that low-power commercial application of this technology, such as charging of mobile phones, is several years away.

WiTricity's technology [3] allows wireless power transfer over distance via magnetic resonance. Alternating current (AC) electricity runs through an electromagnetic coil within a charging station to form an oscillating electromagnetic field. Another coil resonating at the same frequency captures the field's energy and a rectifier delivers direct current (DC) current to a battery management system.The technology works through various materials, such as stone, cement, asphalt or wood, and has an energy conversion efficiency end-to-end above 90 percent, equivalent to plugging in.[citation needed] By 2013–2014, electric power output had reached 10 W for mobile devices, 6 kW for passenger vehicles, and 25 kW for fleets and buses.WiTricity's EV has charging rates from 3.6 to 11 kW, and the technology scales up to hundreds of kilowatts for heavy duty vehicles such as buses.

III. Proposed Methodology

Electronic transformer works on half bridge and double line frequency. The AC power is given as an input to the bridge rectifier where it is converted into DC through resistor capacitor gets charged .in one half cycle Q1 (collector to emitter) starts conducting, F1 provides biasing for this Q1 transistor.Current flows from P1 to P2 of primary coil. Then current passes through capacitor C4 and reaches ground. In another half cycle Q2(collector to emitter) starts conducting and F2 provides bias for this transistor. Then current flows through C3 and then P2 to P1 reaches Q2 and then negative. So in one half cycle flow of current is from P1 to P2,inanother half cycle flow of current is from P2 to P1. Biasing for F1, F2 is done automatically i.e. we can't say that when which coil gets bias. so current flowing in the primary coil in both half cycles generates A.C in secondary coil. As the transistors are fast switching devices frequency of A.C becomes 25KHz.This is fed copper windings L1 which are connected to secondary of transformer.L1 transfers the 25 KHz A.C. to L2 by means of EMF(Principle of transformer).

Voltage inducedL2 coil is fed to 4 diodes forming a Bridge Rectifier that delivers dc which is then filtered by an electrolytic capacitor of about 1000microf. The filtered dc being unregulated IC LM7805 is used to get 5v constant at its pin no 3 irrespective of input dc varying from 9v to 14v.

The regulated 5volts dc is further filtered by a small electrolytic capacitor of 10 microF for any noise so generated by the circuit which can be used for battery charging. One LED is connected of this 5v point in series with a resistor of 330ohms to the ground i.e. negative voltage to indicate 5v power supply availability. The 5v dc is used for other applications as on when required.The output of bridge rectifier i.e., +12V is taken to drive the 12V DC Fan.

The line voltage is rectified by the full-bridge rectifier, generating a semi-sinusoidal voltage at double theline frequency.

The frequency of oscillation then depends mainly upon the size and maximum flux density of the ferrite core used in the feedback transformer, and the storage time of the transistors. When the cycle has started, the current in the feedback transformer increases until the core saturates. At this point the feedback drive of the active transistors is therefore removed, and, once its storage time has passed, it turns off. In this application the oscillation frequency would be around 25kHz.The dependence upon the storage time is minimized by the RC network at the base of the transistor, which increases the rate of charge extraction from the base at turn-off. The network also serves to decouple the base from the oscillation caused by the base transformer at turn-off, preventing spurious turn-on of the device.

Voltage rating

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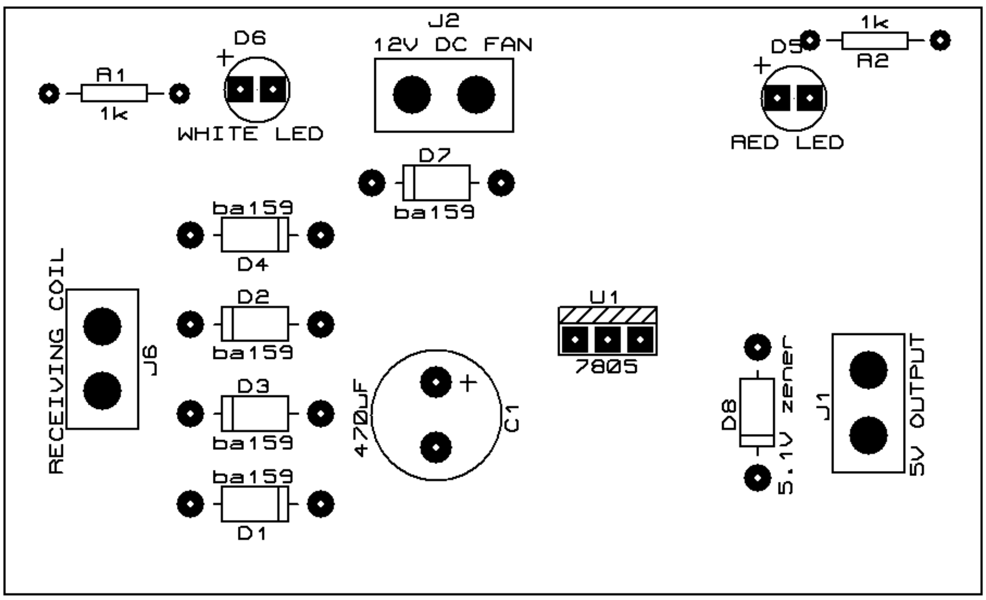
The required voltage rating of the devices is defined by the half-bridge topology. Supplying the circuitwith 220V RMS A.C. mains, calculating peak value, and adding a safety margin, gives a maximum supply
voltage VCC of:
VCC(max)= 220V x √2 + 10%
= 310V + 10%.
≈ 350V.
To this figure must also be added the overvoltage generated by the input filter at turn-off. In practice,devices are used with a rating of:
VCE(max) = 450 - 500V

Current rating

The nature of the half-bridge topology is such that in normal operation, half the supply voltage is dropped across each device, so from the above figures VCE in the steady state is 310V /2, 155V. Hence the collector current in the steady state can be calculated using.
POUT = IC(RMS) . VCE(RMS)
VCE(RMS)= 1/2 . Vmains
IC(RMS)=2. POUT / Vmains
IC(RMS) =IC(peak)/ √2
IC(peak)= 2 . √2 . POUT / Vmains
= 2 . √2 . 50W / 220V
IC(peak) = 0.64A
As stated above, when the circuit is first turned on, the low initial resistance the load causes a large current to flow through the transistors. This current can be up to ten times the current in the steady state, and the devices must be selected to withstand this. In this example then it is recommended that the device used is bipolar transistor, rated at 450V and around 2A ie Q1 and Q2. Storage and fall times are decided by the R 330k and C3,C4 & fall time, t fall , of the transistors influences the losses of the circuit, while the storage time, ts , is important as it affects the switching frequency of the converter. The nature of the processes used to produce bipolar transistors means that the storage time between batches of transistors may vary considerably. The t transistors used must be manufactured, tested and selected to have storage times within certain limits. Transistors with too large a storage time may cause the circuit to oscillate below the operating limits of the output transformer, causing saturation of the core towards the end of each cycle. This will cause a spike in the collector current of the transistors every cycle, which will eventually cause them to overheat and be destroyed.

PCB Operation



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IV. Result

The voltage at different terminals is according to the requirement or not. We take a multi meter and put it in voltage mode. Remember that this test is performed without ICs. Firstly, if we are using a transformer we check the output of the transformer; whether we get the required 12V ACvoltage (depends on the transformer used in for the circuit). If we use a battery then we check if the battery is fully charged or not according to the specified voltage of the battery by using multimeter.

Then we apply this voltage to the power supply circuit. Note that we do this test without ICs because if there is any excessive voltage, this may lead to damaging the ICs. If a circuit consists of voltage regulator then we check for the input to the voltage regulator (like 7805, 7809, 7815, 7915 etc) i.e., are we getting an input of 12V and a required output depending on the regulator used in the circuit.
EX: if we are using 7805 we get output of 5V and if using 7809 we get 9V at output pin and so on.

This output from the voltage regulator is given to the power supply pin of specific ICs. Hence we check for the voltage level at those pins whether we are getting required voltage. Similarly, we check for the other terminals for the required voltage. In this way we can assure that the voltage at all the terminals is as per the requirement.

V. Conclusion

The experiment has helped us to understand the challenges involved in designing and optimizing a WPT system, such as the need to balance efficiency, range, and safety considerations. We have also gained hands-on experience in assembling and testing a WPT system, which has enhanced our practical skills and knowledge.

Overall, the WPT experiment has been a valuable learning experience that has broadened our understanding of electrical engineering and exposed us to an exciting and rapidly developing field of research. We hope that this experiment will inspire us and future generations of electrical engineers to continue exploring the possibilities of WPT and other innovative technologies.

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