IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

WIRELESS ELECTRIC VEHICLE CHARGING STATION

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Abstract – *Nowadays the world is shifting towards electrified mobility to reduce the pollutant emissions caused by non-renewable fossil-fueled vehicles and to provide an alternative to pricey fuel for transportation is an Electric Vehicle. But for electric vehicles, traveling range and charging process are the two major issues affecting its adoption over conventional vehicles WPT Enabled infrastructure has to be employed to achieve a Hybrid (dynamic/ stationary) EV charging concept. The weight of the battery pack can be reduced as the required energy storage is lower if the vehicle can be powered wirelessly while driving.*

INTRODUCTION

If you are using an electronic device perhaps an electric vehicle and you need to recharge the battery then you will probably have to get a charger and connect the phone to the wire. But what if you could charge it without having to connect it to wire? Meaning power will be transferred wirelessly. This is possible through a concept called Wireless Power Transmission. Research and studies have been done ever since the 19th century but it is only recently that this concept has begun to be implemented. Currently engineers are trying to discover how to increase the efficiency of power transmitted wirelessly and also methods that that are safe to human beings and the environment and notwithstanding, methods that are cheaper and hence can be commercially viable. Though still in the early stages, several electronic companies are beginning to roll out devices that can wirelessly transmit power. Wireless power transmission (WPT) is based on the principle of electromagnetic induction. Electromagnetic induction works on the concept of a primary coil generating a predominantly magnetic field and a secondary coil being within that field so a current is induced within its coils. This causes the relatively short range due to the amount of power required to produce an electromagnetic field.

LITERATURE REVIEW

As depicted in Fig. 2.2, WPT has two coils separated by a large air gap. The coils are placed around a magnetic material to improve coupling and to minimize proximity losses. The primary coil is energized by high- frequency ac current which generates a time-varying magnetic field in accordance with Ampere' s law. A portion of the generated time-varying magnetic field is linked with secondary coil depending on the coefficient of coupling, k, to induce a voltage according to the Faraday's law in the secondary. Due to the large air gap, the circuit is inductive.

Therefore, a large current (i.e., magnetomotive force) is required to produce sufficient magnetic field to link secondary coils. In practical WPT systems, it is necessary to cancel the inductive component in the circuit using a capacitor connected such that it resonates with the primary inductance to reduce the Volt–Amp (VA) rating of the inverter.

The secondary side is also tuned to approximately the same resonant frequency to cancel the secondary leakage inductance and to maximize the power transfer efficiency. To provide high-frequency ac current to excite the primary coil, a high-frequency switching inverter is employed. On the secondary side, the induced voltage in the coil is rectified and fed to a load.

This paper presented a review of current status of wireless charging for EV applications. The development history of WPT and necessary components were discussed along with a comprehensive review of the design of coupling pads, power electronics, various compensation circuits

PROJECT OBJECTIVES:

The main objective of this project is to design and develop an efficient, reliable, and smart Wireless Power Transfer (WPT) system for Electric Vehicles (EVs). The increasing demand for electric vehicles has created a strong need for faster, safer, and more convenient charging methods. Conventional wired charging systems require physical cables and connectors, which can be inconvenient, time-consuming, and less user-friendly. Wireless charging technology provides an advanced solution to these problems by enabling EVs to charge without direct electrical connections.

With the introduction of wireless charging technology, electric vehicles can now be charged simply by parking them over a charging pad installed at parking spots, garages, homes, or public charging stations. This eliminates the need for manually connecting charging cables and reduces charging complexity for users. The system uses electromagnetic induction or resonant coupling techniques to transfer electrical energy wirelessly from the transmitter coil to the receiver coil mounted in the vehicle.

One of the most advanced features of this technology is dynamic wireless charging, where electric vehicles can be charged even while driving on specially designed roads. This innovation can significantly reduce charging downtime, increase driving range, and improve the overall efficiency of EV transportation systems. It also helps in minimizing battery size requirements, reducing maintenance costs, and enhancing user comfort and safety.

The proposed WPT system aims to achieve high power transfer efficiency, reduced energy losses, proper alignment between coils, and safe operation under different environmental conditions. Smart monitoring and control features can also be integrated to optimize charging performance, detect faults, and ensure efficient energy management. The system contributes to the development of sustainable transportation by promoting clean energy usage and supporting the widespread adoption of electric vehicles.

Overall, wireless charging technology represents the future of EV charging infrastructure by offering faster, smarter, and more convenient charging solutions, thereby transforming the way electric vehicles are powered and used in daily life.

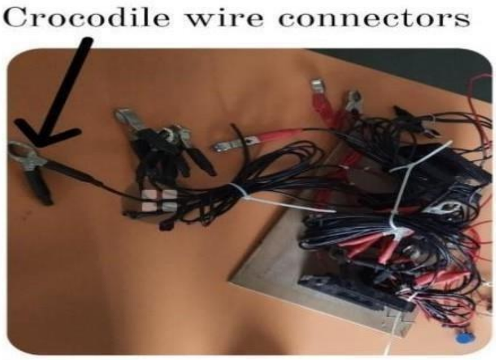
*The project will be divided into the following specific objectives: -

*Efficient Power Transmission.

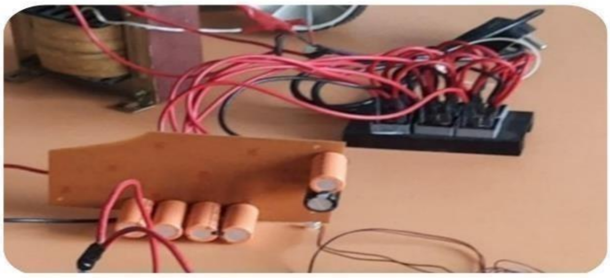
*Time required for Wireless charging.

PROBLEM STATEMENT

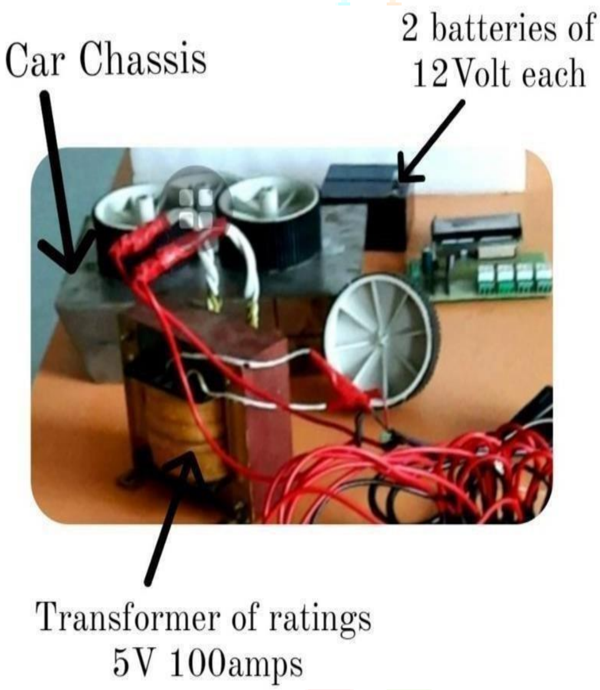
The project seeks to eliminate the use of wires in the transmission of power from the source to the device to be powered. Although WPT is based on Wireless Power Transmission for Electric Vehicles. 2 electromagnetic inductions, there are various methods that are used. Some are less efficient than others and costly while others don’t allow for a longer range of transmission. In this project, it is required to design and construct an electronic device that shall transmit power within a small range. The device can then be used to charge batteries for devices like pace makers. In the project a suitable method will be used to ensure that enough power is transmitted wirelessly so that it can then charge batteries. The major challenge will be in the coupling circuit which comprises of the coils where electromagnetic induction occurs. The number of turns of the coil, inductance.



We have developed the MOSFET circuit.
In this circuit we use 16 N-channel MOSFET.
We will used this circuit to control the current.

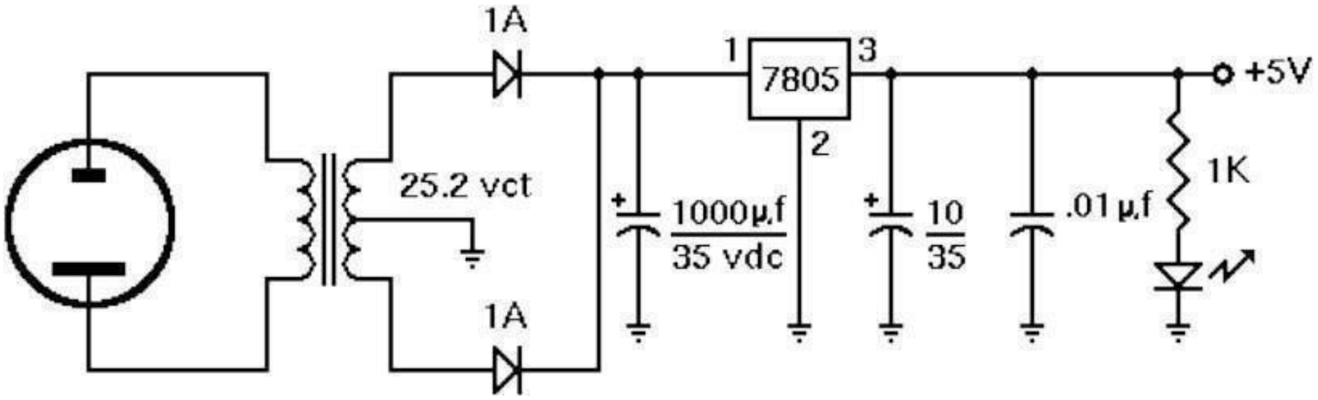


This is the filter circuit we have developed. In this circuit we connect the capacitor in parallel as well as in series
Capacitor Circuit are used to stabilize the voltage in power systems



PERFORMANCE ANALYSIS

The +5-volt supply is useful for both analog and digital circuits. DTL, TTL, and CMOS ICs will all operate nicely from a +5-volt supply. In addition, the +5-volt supply is useful for circuits that use both analog and digital signals in various ways. More importantly for our purposes, the +5-volt supply will be used as the primary reference for regulating all of the other power supplies that we will build. We can do this very easily if we use operational amplifiers as the controlling elements in the power supply circuits. We'll see how this works after completing the basic +5-volt supply.

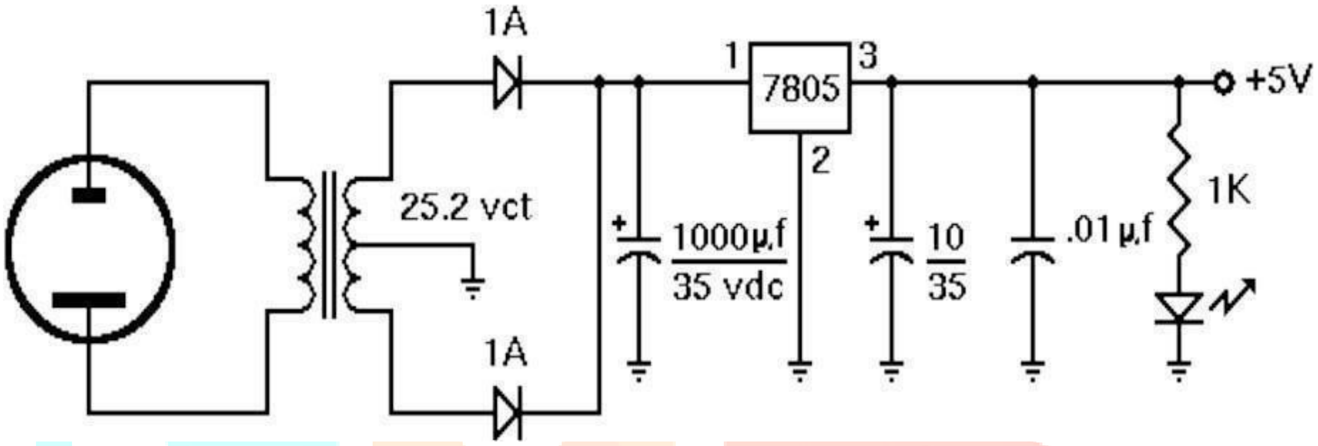


The +5-volt power supply is based on the commercial 7805 voltage regulator IC. This IC contains all the circuitry needed to accept any input voltage from 8 to 18 volts and produce a steady +5-volt output, accurate to within 5% (0.25 volt). It also contains current-limiting circuitry and thermal overload protection, so that the IC won't be damaged in case of excessive load current; it will reduce its output voltage instead.

The 1000µf capacitor serves as a "reservoir" which maintains a reasonable input voltage to the 7805 throughout the entire cycle of the ac line voltage. The two rectifier diodes keep recharging the reservoir capacitor on alternate half-cycles of the line voltage, and the capacitor is quite capable of sustaining any reasonable load in between charging pulses.

The 10µf and .01µf capacitors serve to help keep the power supply output voltage constant when load conditions change. The electrolytic capacitor smooths out any long-term or low frequency variations. However, at high frequencies this capacitor is not very efficient. Therefore, the .01µf is included to bypass high-frequency changes, such as digital IC switching effects, to ground.

The LED and its series resistor serve as a pilot light to indicate when the power supply is on. I like to use a miniature LED here, so it will serve that function without being obtrusive or distracting while I'm performing an experiment. I also use th is LED to tell me when the reservoir capacitor is completely discharged after power is turned off. Then I know it's safe to remove or install components for the next experiment.



To construct and test the +5-volt power supply on your breadboard, you will need the following parts (all available from Radio Shack):

(1) 1K, ¼-watt resistor (brown-black-red).

(1) 0.01 µf or larger ceramic disc capacitor.

(1) 10 µf, 35-volt electrolytic capacitor.

(1) 1000 µf, 35-volt electrolytic capacitor.

(2) silicon rectifier diodes.

(1) 7805 +5-volt voltage regulator IC.

(1) miniature red LED.

Black hookup wire.

Red hookup wire.

Yellow hookup wire.

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*Testing the +5 Volt Supply

Set your voltmeter to measure DC voltages up to 30 volts, and connect the black (Common or Ground) lead to the negative lead of the 1000µf capacitor. Connect the red lead to the upper end of the 0.3" red jumper wire. Turn on your voltmeter, and then turn on power to your transformer and power supply circuit.

You should measure a steady +5 volts (+4.75 to +5.25) here, at the power supply output, and the red pilot LED should turn on. If you get these results, move your red voltmeter led to the positive lead of the 1000µf reservoir capacitor. You should see about +17 volts here, possibly higher.

If you get the correct results, turn off your power supply and voltmeter, and skip down to the Discussion below. If your results are different, quickly note the results you did obtain; then turn power off and look through the following troubleshooting chart.

Output voltage is steady at +5, but LED remains off.

LED is reversed. Remove it and re-insert it in the opposite direction. Then try the power supply again. Resistor is the wrong value or connected incorrectly. Make sure it is a 1K resistor (brown-black-red) and is connected from the lower end of the red jumper to the left (anode) end of the LED. Then try the power supply again.

Output voltage rises to +5 volts, but then declines steadily.

One or both electrolytic capacitors is reversed. The reversed one will be warm or hot to the touch. If you leave power on too long, it will explode and leave a large mess to be cleaned up. Check and correct capacitor orientation, and then try the power supply again.

*Output voltage is negative.

Your main rectifier diodes are installed backwards. Refer back to the assembly diagram and install them correctly.

*Output voltage is incorrect.

7805 voltage regulator is installed incorrectly or is defective. Verify correct installation and replace if necessary. Once you are sure that your power supply is working correctly in all respects, turn off power to your circuit and your voltmeter. Then move down to the concluding discussion below.

CONCLUSION

We have successfully implemented a power supply for wireless charging for Electric Vehicle via resonant inductive coupling. We developed a car chassis with two DC motors and receiver coil mounted on it. Experimental results show that we got the desired output of power supply
i.e +5V.
In this project, we successfully designed and implemented a wireless power supply system for charging an Electric Vehicle using the principle of resonant inductive coupling. The primary objective was to demonstrate how electrical energy can be efficiently transferred from a transmitter coil to a receiver coil without any physical contact. Our prototype consisted of a transmitter section, which generated the required electromagnetic field, and a receiver section mounted on a small car chassis equipped with two DC motors.
During the development process, we carefully designed the resonant circuits on both the transmitting and receiving ends to ensure that they operated at the same resonant frequency. This matching of resonance allowed maximum power transfer and improved the efficiency of the wireless charging system. The receiver coil placed on the moving car chassis was able to pick up the transmitted energy and convert it into useful DC power.
The experimental results validate the working principle of the system. We achieved a stable output voltage of +5V, which is suitable for powering small electronic loads and demonstrates the ability of the system to charge low-power electric vehicles or similar devices. The car prototype successfully received power wirelessly and operated its motors, showing that the concept is practical and functional.
Overall, the project demonstrates that wireless charging through resonant inductive coupling is a promising technology for Electric Vehicles. It eliminates the need for wired connections, offers convenience, and has the potential to be scaled up for real-world EV charging applications. The results obtained confirm that the system works effectively and lays a strong foundation for future improvements such as increased power ratings, better efficient coils, and greater charging distances.

Future Scope

Dynamic wireless EV charging: Dynamic wireless EV charging systems allow EVs to be charged while they are driving. This would eliminate the need for EVs to stop to charge, which would significantly improve their convenience and range.

Wireless EV charging in public spaces: Wireless EV charging systems could be installed in a variety of public spaces, such as parking garages, bus stops, and taxi stands. This would make it easier and more convenient for people to charge their EVs.

Wireless EV charging for fleets: Wireless EV charging systems could be used to charge fleets of EVs, such as buses, taxis, and delivery vehicles. This would help to reduce the operating costs of these fleets and make them more environmentally friendly.

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