# Wireless Power Transfer of electric vehicle Battery Charging

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***Abstract*: Wireless power transfer (WPT) is the present innovation utilizing magnetic resonance which could set blunder free from the disappointing wires. In fact, the WPT receives similar ideas which have just been created with the term inductive power transfer. WPT innovation is growing quickly as of late. At kilowatts power level, the exchange separate increments from a few milli meters to a few hundred meters with a grinding to stack efficiency above 90%. This upgrade makes the WPT appealing to the electric vehicle (EV) charging applications in both stationary and dynamic charging circumstances. This paper evaluated the advancements in the WPT region appropriate to EV wireless charging. By presenting WPT in EVs, the hindrances of charging time, range, time and cost can be effectively alleviated. Battery innovation is never again comparable in the mass market infiltration. It is trusted that researchers could be energized by the best in class accomplishments, and push forward the further development of WPT just as the extension of EV.**

***Keywords*: Wireless power transfer (WPT), Electric vehicle (EV)**

## I. INTRODUCTION

Every customary vehicle is controlled by an internal combustion engine (ICE) only. These traditional vehicle produce exhaust gases amid activity which are hurtful for human well being. Be that as it may, electric vehicles (EVs) keep running on electricity only. They are propelled by at least one electric motors which are fueled by battery-powered battery packs. Because of this electric vehicles have a few points of interest over conventional vehicles. No harmful gas discharge. Fuel cost will be up to 70% less than conventional vehicle, maintenance cost is less, perfect for stop-begin city driving as no vitality is use when the vehicle is stationary.[6][7] Besides the high introductory cost, the long charging time of EV batteries additionally makes the EV not worthy to numerous drivers. For a single charge, it takes around one half-hour to a few hours relying upon the power level of the charger, which is commonly longer than the gas refueling process. The EVs can't prepare promptly when they have run out of battery. Along these lines, the proprietor needs to locate any conceivable chance to plug-in and charge the battery. It truly conveys inconvenience as individuals may neglect to plug-in and wind up out of battery vitality later on. The charging cables on the floor may prompt stumbling dangers. Spillage from broke old cable, especially in cold zones, can convey extra risky conditions to the proprietor. Likewise, individuals may need to overcome the breeze, downpour, ice, or snow to p[lug in with the danger of getting an electric stun. The wireless power transfer (WPT) innovation, which can wipe out all the charging inconvenience, is hence most alluring by the EV proprietors. By wireless charging to the EV, the charging turns into the least demanding undertaking. For a stationary WPT framework, the drivers simply need to leave their vehicle and leave. Additionally the battery capacity of EVs with remote charging could be diminished to 20% or less contrasted with EVs with conductive charging.

## II. ELECTRIC VEHICLE

Electric vehicles are one of the simplest forms of self propelled mechanical transport. In the basic design, the drive train of the car is made up of a battery array connected to an electric motor via a switch. [9] The amount of electricity that is allowed to pass through to the electric motor and gear systems is controlled such that the electric motor drives the wheels in the most efficient manner.

### Electric Motor

The car may run on AC or DC motors. If it uses a DC motor the car may run on any voltage between 96V and 192V of the rating around 20kW. Motors work on the principle of electromagnetic induction where change in magnetic flux causes the central shaft to rotate. In case of AC motors 3 phase motors are generally used which run at 220-240 Volts AC along with 300 Volt battery packs. AC motors have the ease of availability in various sizes, shapes and power ratings in contrast to DC motors and also have a 'regenerative braking' feature by virtue of which motor can act as a generator to charge the batteries while braking.

### Motor Controller

This is the part of the system which would control the amount of current being supplied to the motor depending on amount of pressure on the accelerator pedal. The accelerator is connected to potentiometers which act as variable resistors to provide the signal on how much power to deliver. When the pressure on accelerator is zero, no power is delivered and full power is delivered when pedal has been fully pressed. In case of DC motors the controller would chop the values of DC supply voltage to obtain a current with average value that is proportional to the amount of pressure applied to the accelerator.

### Batteries

Batteries are the parts that hold the energy reserve for the entire car operation. These store energy in the form of chemical energy and convert them back to electrical energy when required. Batteries are heavy, bulky and take a lot of time to charge and yet have limited capacity and life. Better replacements in the form of LiMH batteries do exist, which not only double the range of cars but also have significantly longer lives are present, but at present are too expensive to invest in. Fuel Cells offer the most attractive solution to all these problems along with being environment friendly but still need a lot of R&D before they enter the mainstream market

## III. WIRELESS POWER TRANSFER SYSTEM FOR ELECTRIC VEHICLE

Figure 1 represents the block diagram of proposed wireless power supply system for charging battery of electric vehicle. It consists of three parts a transmitter to generate AC signal which is to be transferred, transmitting and receiving coil to transfer power wirelessly and receiver to convert received AC signal into DC voltage for charging the battery of electric vehicle. With the help of mutual induction the primary and secondary coil are coupled to each other and the charge is transferred to the receiving circuit and the charge is stored in battery.

**Microcontroller**

A microcontroller is a small computer (SoC) on an single integrated circuit containing a processor core memory and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip as well as typically small amount of RAM. Microcontrollers are designed for embedded applications in contrast to the microprocessors used in personal computers or other general purpose applications. Microcontrollers are used in automatically controlled products or devices such as automobile engine control systems, implantable medical devices, remote controls, office machines, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, input/output devices, microcontrollers make it economical to digitally control even more devices and processes.

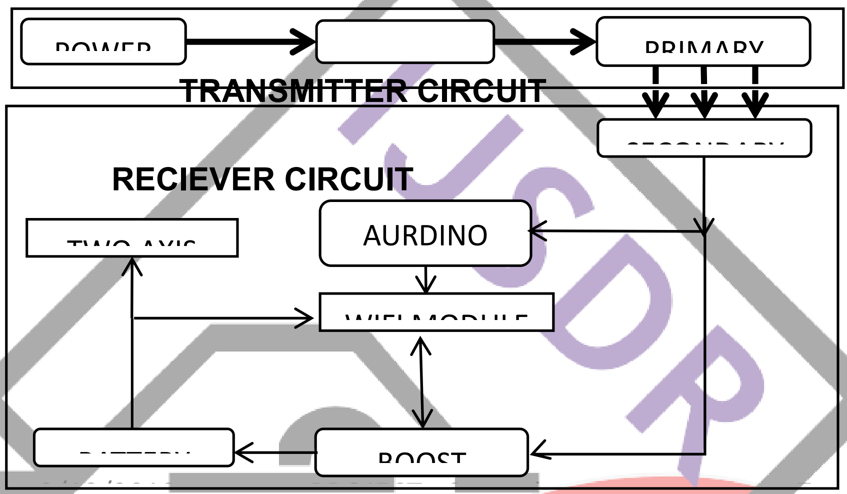


**Figure 1.Block Diagram of the Proposed System**

**DC To DC Converter**

A rectifier is a circuit that converts AC signal to DC. A rectifier circuit is made using diodes. Rectifiers have many uses, but are often found serving as component of DC power supplies and high-voltage direct current power transmission systems. The bridge rectifier is available in different packages as modules ranging from few amperes to several hundred amperes. Mostly in bridge rectifier circuits, semiconductor diode is used for converting AC since it allows the current flow in one direction only (unidirectional device).

**Boost Converter**

Boost converter is a switched mode supply can be used for many purposes including DC to DC converter with an output voltage is greater than the source voltage. A boost converter sometimes called a step-up converter. Since power (P=VI) must be conserved the output current is lower than the source current. Often, although a DC supply, such as a battery available, its available voltage is not suitable for the system being supplied. For example, the motors used in driving electric automobiles require much higher voltages, in the region of 500V, than could be supplied by battery alone. Even if banks of batteries were used, the extra weight and space taken up would be too great to be a practical.

## IV. RESONANT INDUCTIVE COUPLING

Resonant inductive coupling is a form of inductive coupling in which power is transferred by magnetic fields between two resonant circuits (tuned circuits) one in the transmitter and one in the receiver. Each resonant circuit consists of a coil of wire connected to a capacitor or a self-resonant coil or other resonator with internal capacitance. The two are tuned to resonate at the same resonant frequency. The resonance between the coils can greatly increase coupling and power transfer, analogously to the way a vibrating tuning fork can induce sympathetic vibration in a distant fork tuned to the same pitch. The concept behind resonant inductive coupling is that high Q factor resonators exchange energy at a much higher rate than they lose energy due to internal damping. Therefore by using resonance the same amount of power can be transferred at greater distances using the much weaker magnetic fields out in the peripheral regions of the near fields. Resonant inductive coupling can achieve high efficiency at ranges of 4 to 10 times the coil diameter. This is called "mid-range" transfer in contrast to the "short range" of non resonant inductive transfer which can achieve similar efficiencies only when the coils are adjacent. Another advantage is that resonant circuits interact with each other so much more strongly than they do with non resonant objects that power losses due to absorption in stray nearby objects are negligible. A drawback of resonant coupling is that at close ranges when the two resonant circuits are tightly coupled, the resonant frequency of the system is no longer constant but splits into two resonant peaks so the maximum power transfer no longer occurs at the original resonant frequency and the oscillator frequency must be tuned to the new resonance peak.

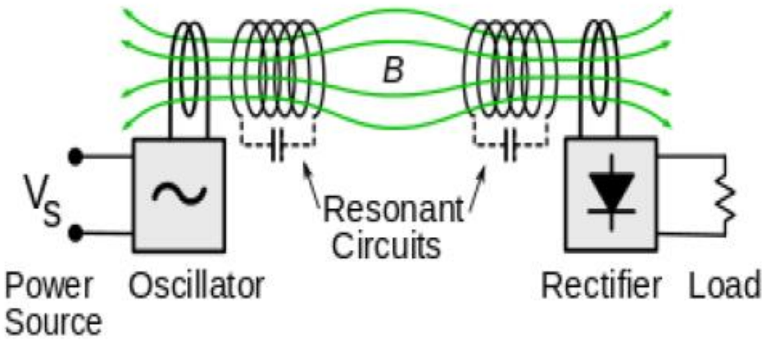


**Figure 2. Resonant inductive wireless power systems**

Resonant technology is currently incorporated in modern inductive wireless power systems. One of the possibilities envisioned for this technology is area wireless power coverage. A coil in the wall or ceiling of a room might be able to wirelessly power lights and mobile devices anywhere in the room, with reasonable efficiency. An environmental and economic benefit of wirelessly powering small devices such as clocks, radios, music players and remote controls is that it could drastically reduce the 6 billion batteries disposed of each year, a large source of toxic waste and groundwater contamination.

## V. MODEL DEVELOPED

**Transmitter Circuit**

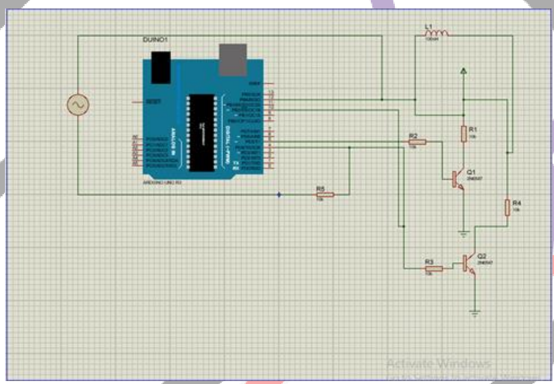

**Figure 3.Circuit Diagram of Transmitter Circuit**

The circuit forms power supply of the primary side, which transfers the energy through the coil wirelessly. It consists of step-down transformer, connected to the rectifier circuit. This circuit going to charge 12v battery so the 230v AC voltage is stepped down to 12v AC. Therefore the battery stores the energy in the form of DC only; therefore the 12v AC supply is rectified with the rectifying circuit, which rectifies 12v AC to 12v DC as shown in figure 3.
The rectified DC is the allowed to flow through the inductive coil via transistor Q1. The frequent switching of the transistor makes the strong magnetic field in the primary coil, thus it provide power supply for the secondary circuit. The charge is transferred to the secondary side wirelessly.

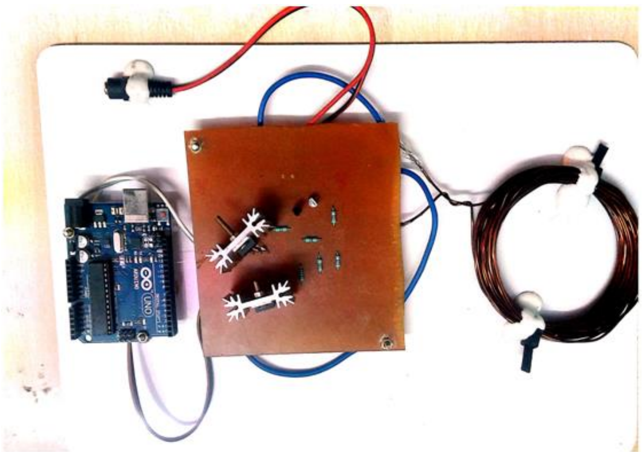

**Figure 4. Implementation of Transmitter Section**

**Receiver Circuit**

The receiving circuit forms the charging system for the battery, which provides the overall power supply for the electric automotive. It consists of copper coil of specified number of turns which can be placed on the conducting medium of the primary circuit. The energy which is transferred wirelessly is being rectified by the rectifier as the battery stores the energy in the form DC only as shown in figure 4.The rectified DC will not sufficient to charge the battery in a efficient manner so that controller design makes the appropriate work to store the energy. The reference of the DC voltage is taken by the controller so that the controller could make the required pulses for the booster circuit.

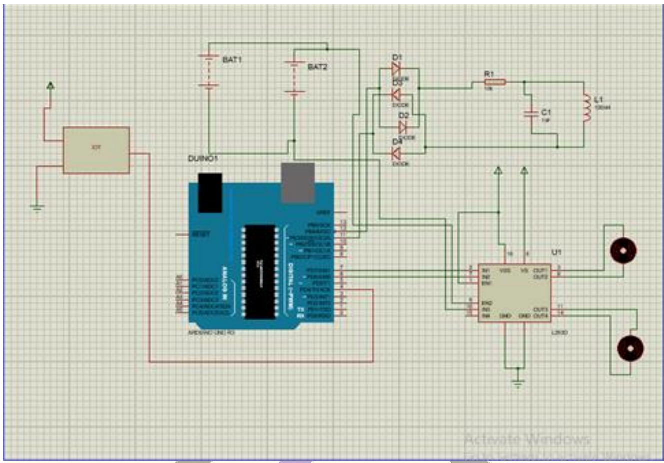


**Figure 4.Circuit Diagram of Transmitter Circuit**

The controller uses the PSO algorithm to minimize the charging time. The main aim of the algorithm is to find the fastest path of the work to be done, so it goes under several iteration and gives the required output pulses. The PWM pulses is provided by the controller and given to the booster converter. The converter design consists of MOSFET to which the PWM pulses are given. With the help of the pulses the MOSFET is switched at alternating timing period and the voltage is boosted to 12v as the battery used in circuit is 12v.The opto coupler is used in the booster circuit to isolate the lower voltage circuit from the higher voltage circuit. It isolates the controller circuit from the booster circuit. Finally the charge is boosted and stored in the battery.

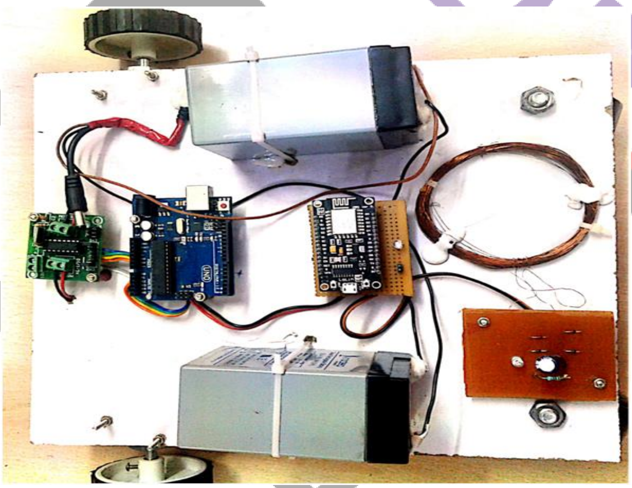

**Figure 5. Implementation of Receiver Section**

## VI. CONCLUSION

EVWC technology is growing quickly and moving forward. Charging systems are starting to become commercially available as the EV market slowly grows, and the improved infrastructure is bound to boost the popularity of EVs. Further developments are increasing EVWC efficiency, and many players in the EVWC field are competing for space in the newly formed market niche.

Wireless charging can be as efficient as a wired charging. Based on the reviewed literature and collected data, suggests that wireless power transmission could be feasible. Modern science has now made it possible to use electricity without having to plug in any wires for charging. There are three techniques for wireless power transfer. Inductive charging has lower efficiency and increased resistive heating in comparison to direct contact. Implementations using lower frequencies or older drive technologies charge more slowly and generate heat within most portable electronics. Magnetic microwave has also some limitations Signal absorption by the atmosphere. Microwaves suffer from attenuation due to atmospheric conditions and towers are expensive to build. Researchers developed inductive charging using resonance where energy is transmitted between two copper coils that resonate at the same frequency. Of these two coils, one is the power transmitter and the other, the receiver. This is more feasible than other techniques and is safer than wired charging system. In this project, wireless charging of 1050mAh battery has been focused. The circuit for this purpose has been designed, fabricated, implemented and tested

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