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Wireless Power Transfer in Electrical Vehicle by Using Solar Energy

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Abstract **- Wireless Power Transfer[WPT] using the magnetic induction technology which could avoid human from the hazardous accident caused due to the using of cables. By the using of MOSFET switches in the inverter, it creates the output with high frequency improves the efficiency of power transfer between the coils. Due to this creation of output with higher frequency the charging of battery will be very fast and efficient. By connecting the solar panel to the supply battery, it will be charged continuously using this panel. This will helps the users for the non-stop driving. These advances make the WPT very attractive to the electric vehicle charging application in both stationary and dynamic charging. By introducing WPT in electric vehicle, the obstacles of charging time, range, and cost can be easily managed. WPT technology is developing rapidly in recent years.**
Keywords: **Static charging, Dynamic charging, Solar panel, High frequency output by using inverter, Wireless Power Transfer (WPT), Safety guidelines**

I. INTRODUCTION

Now-a-day the world facing the most serious problem is the energy demand. Instead of this we had various techniques for the generation of energy which should be hazardous to our environment. So we step into the Non-renewable energy which will be eco-friendly to our environment. Our main demand will be the fuels used in automobiles and it causes the major impact to our environment, so we introduce the hybrid version of Non-renewable energy in the vehicle as electric vehicle which acts eco-friendly to our environment.

We use both the combination of wireless power transfer and the solar energy which helps us the user for non-stop driving. In an electric vehicle the battery is too tough to design due to its high energy density and power density. Now-a-days there are many types of batteries used in the instruments but the lithium-ion batteries gives the most suitable solution for the electric vehicles. Recently the Wireless Power Transmission has been a most effective topic in the transportation system. This paper starts with a basic concept of Wireless Power Transfer and it gives a brief overview of Wireless Power Transfer system and it includes the Magnetic induction principles, Existing and Proposed system, High frequency power output, Solar panel and some other issues like safety considerations. By introducing the latest achievements in Wireless Power Transfer, we hope that this will achieve in all over the world.

II. LITERATURE REVIEW

Alanson P. Sample has given the knowledge about the adaptation of the magnetically coupled circuits in the Electric vehicles [EV] and its efficiency in the power transfer wirelessly [1]. C. Kainan and Z. Zhengming, analysed the spiral coil using the circuit which makes the process will be much efficient and will be suitable for the adaptation of different voltages [2]. S. J. Gerssen-Gondelach and A. P. C. Faaij, analysed the battery stand by time will be the most important task in designing the Electric Vehicle because it will decide the standardization of the vehicle [3]. The good backup power will be needed in the interpretation of solar radiation. This paper gives knowledge about the designing of batteries.

III. SIGNIFICANCE OF THE STUDY

Now-a-day the term ‘wireless’ becomes the most advanced and innovative research field. This will help the people to free from annoying wires and to avoid them from exposing to hazardous accidents which occur due to the using of cables. It will help us the user for using the electronic devices without any interpretation and limitations. It will be hybrid with the solar energy and implemented in the automobiles will made the vehicle eco friendly to the surrounding. This wireless power transfer also has the advances of both stationary and dynamic charging of the batteries.

IV. SCOPE OF THE STUDY

Global warming becomes a most dangerous problem in now a day. This increases the heat in the earth surface and makes the ice peaks to melt down this increases the sea level will be dangerous to the entire world mainly because of the pollution. The main polluting factor is the automobiles which emit the carbon monoxide had a very harmful impact to the environment. So we had introducing the electric vehicle with the combination of ‘wireless’ power transfer made the EV high efficient and it will create the pollution free environment. It also protects the people from inhaling of hazardous carbon monoxide and leads a people to live in a healthy environment.

V.BLOCK DIAGRAM

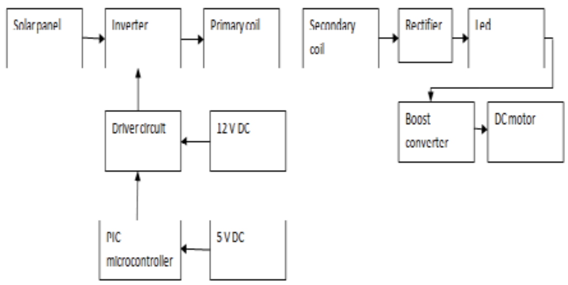

Fig. 1 Block of Wireless Power Transmission

In our project, block diagram consist of two types namely,

1. Primary side
2. Secondary side

A. Primary Side

The photo voltaic (or) Solar panel will be used in the initialization process of the circuit which generates the power for the whole operation. It absorbs energy from the solar radiation and this heat energy will be converted into electrical energy, this will be supplied throughout the circuit. Inverters will be used for converting the DC to AC, power generated by the solar panel will be the DC, these DC power will convert into AC power which it is given to the coil. The inverters consist of four n-channel MOSFET switches these switches needs the triggering pulses for the ON and OFF process, these triggering pulses will be generated using the PIC controller. This PIC controller will generate a triggering pulse of 5v DC. But the MOSFET switches needs a minimum of 10 – 12v DC for operating the voltages. For the amplification process the driver board will be used. Output of the PIC controller will be given to the driver board, it starts amplifying the triggering pulse that the output of the driver board will be given to the inverter. This driver board output will be connected to the gate terminal of the MOSFET switches. After the conversion of power it will be transferred to the coil through the compensation network.

B. Secondary Side

The coil from the primary side gets energize and it creates the magnetic field around the coil. Due to the using of high frequency output, the creation of magnetic flux will be very strong. The flux from the primary coil links the secondary coil. Hence the power will be transferred between the coils through the magnetic field. Next the power from the secondary coil given to the rectifier. After the rectifier the LED which indicate the power transfer to the coil. By using the rectifier AC supply will be converted into DC supply and then it is given to the booster circuit responsible for the steady output. After that it will be filtered by using the compensation network and finally connected to the DC shunt motor (Toy car motor). The solar panel power supply will be given to the motor. Due to the continuous generation of power via solar panel, it helps for non-stop driving.

VI. PIC CONTROLLER BOARD

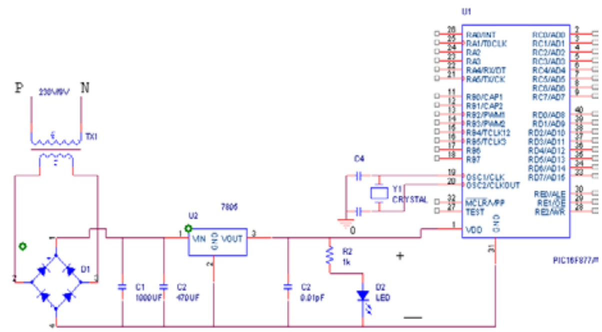

Fig. 2 PIC BOARD

In our project the PIC (16F877A) controller will be act as a brain of the controlling device in the set up. It will only generate the triggering pulse for the ON and OFF process of the MOSFET switches. We use the 12V dc adapter for giving power supply to the controller board. The regulator IC is soldered on the board which regulates the 12V DC to 5V DC. Power given to the board will be indicated by the LED and it will be filtered using the filter circuit harmonics generated will be ignored. Then the power from the filtered circuit will be connected to the PIN 1(VDD) of the PIC controller. Next the PIN 31(GND) will be grounded to the supply side. The PIN 19, 20 is the crystal oscillator which could be inbuilt in the PIC controller sets the operating frequency for the controller. In this controller we use the PORT C as the output for the controller. It is the serial communication port consist of 8 pins [RC0- RC7]

VII. DRIVER BOARD

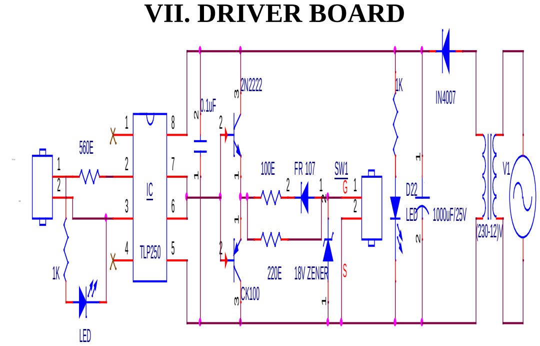

Fig. 3 Driver Board

The Driver Boards will be mainly used for the amplification purpose, isolation and impedance matching in the circuit. Input for the driver boards will be taken from the output of the PIC controller. Because the output gate pulse generated from the controller will be insufficient to activate the MOSFET switches. Hence the output of the controller will be given to the Driver Board. Power supply for the Driver Board will be given by using the step down transformer. The current flown through the boards will be indicated by the LED's. Input terminal will be firstly connected to the Diode IN4007 and pin [8] of the opto coupler. The transistor also connected and various resistances are connected to the input terminals for the regulation of power supply to the components. The PIC output will be connected to the pin [2], [3] of the opto coupler IC's and the output will be drawn from the pin [6], [7] of the coupler IC. These will be connected to the base of the transistors consist of both the NPN transistor and the PNP transistor. In which the NPN will be used for creating the positive pulse and the PNP will be used for creating the negative pulse. And then it will be connected to the zener diode which allows both the values of NPN and PNP transistors. Then it will be finally connected to the output port of the Driver Board. Triggering pulse will given to the MOSFET switches individually which is responsible for their ON and OFF process.

VIII. CIRCUIT DIAGRAM

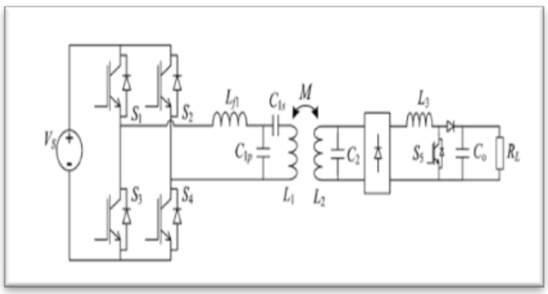

Fig. 4 Circuit of Wireless Power Transfer

The photovoltaic panel (PV) will be used as the power source for the whole operation of the circuit. DC power will be generated by the solar panel will not suitable for transferring in the coil. Hence the DC power will be given to the inverter. The inverter will consist of MOSFET switches activate using the trigger pulse and convert DC to AC power. It will give the high frequency output to be filtered using the compensation network and then the energy will be transferred to the primary coil. Primary coil get energize which creates the flux in the coil these flux which links the secondary coil and current will transferred be between the coils. Then it will be filtered and after given to the rectifier which converts the AC power to DC power. Power transferred will be indicated by the LED and moves to the booster circuit which gives out the steady output conducted by the diode and compensating network. Finally the desired output will be given to the DC motor (Toy car motor).

IX. MAGNETIC COUPLER DESIGN

Magnetic coupler mainly used for transfer the power wirelessly; these are two types magnetic coupler in WPT system. One is sending side called as primary coupler and other one is receiving side called as pick up coupler. It mainly used for increasing efficiency and coupler is designed in pad form. The magnetic coupler depends on the coupling coefficient K and quality factor Q. When K & Q value increases magnetic coupler efficiency will increases. By increasing dimension and material high efficiency can able to achieve. But it is not good for engineering approach. It preferred to have higher k a nd Q with minimum dimension cost. Huge couplers were employed in two designs. Modern WPT system uses at least 10 kHz frequency. As the technical progress of power electronics.100 kHz could achieved at high power level. At this frequency, to reduce the ac loss of copper coils wire is usually adopted

Besides the frequency, the coupling coefficient k is significantly affected by the design of magnetic coupler. A better coupler design may leads to a 5 0%-100% improvement compared with some no optimal designs. Coupler can be charged by two modes.

A. Coupler in Stationary Charging

In a stationary charging the coupler is designed in pad form. The very early couplers are just like a simple split core transformer. Usually this kind of design could only transfer power through a very small gap. According to magnetic flux distribution area the coupler could classified as the double side and single side type. For the double sided type the flux goes to both sides of coupler. When the shielding is added, the quality factor of a flux pipe coupler reduce from 260 to 86. Double sided coupler having half of the main flux at the back. This makes the shielding effort.

Two typical single side flux type pad. One is a circular pad. Another one is rectangular bipolar pad proposed by University of Auckland; a single sided pad is composed of three layers. The top layer is coil, bellow the coil, a ferrite layer is inserted for the purpose of enhancing and guiding the flux. At the bottom is a shielding layer. To transfer power, the two pads are put closed with coil to coil.

The flux path height of a circular pad is about one-fourth of the pad's diameter; DD pad has a significant improvement in the coupling. The charge zone for a DD pad could be about two times larger than a ci rcular pad with similar material cost. The DD pad good tolerant in the y direction. There is null point for DD pad in the x direction. A variant of a D DQ pad which is called as new bipolar pad. By increasing size each D pad and having some overlap between the two D coil, at this coupling level efficiency above 90% could be achieved.

B. Coupler in Dynamic Charging

The dynamic charging also called OLEVs or road way powered electric vehicles. It is two way to charge the EV while driving. Dynamic charging ca also solves the EVs range anxiety. In dynamic charging system the magnetic component are composed of a primary side of the coupler. Which is usually buried under the road and secondary side pickup coil? When EV with a pickup coil is running along with the track and it can able to transfer the power continues. The track can be simple as just two wires and adoption of ferrite with U or W type to increase the coupling and power transfer distance.

The total width of W type should be about four times the gap between track and pickup coil. The relation between track width and transfer distance is decoupled and track can be built at a very narrow form. With narrow design the construction cost could be reduced. The problem of the track design is that pickup coil cover small portion of track, which make coupling coefficient very small. The excitation of each segment can be controlled by the switches ON-OFF state. The EMF above the inactive segments is reduced significantly. The published system efficiency is about 70%-80%, which is lower than the efficiency achieved in stationary charging. When each segment is short enough the track become like a p ad in stationary charging, which is other kind of primary magnetic coupler. The primary pad can selectively excited without a h igh frequency common current and also energized pad is covered by the vehicle.

X. WIRELESS POWER TRANSFER

Wireless Power Transfer or Electromagnetic power transfer is the transmission of electrical energy without using the wires. Wherever the interconnecting wires are inconvenient in such places Wireless power transfer is more compactable. This wireless power transfer system which gives the advantages of using cables and that could avoid the short circuits, flux leakage and fire accidents. Wireless Power System consists of two sides, transmitter and receiver. Mainly the Resonant coils are used in the power transfer. The two coils are tuned to the same resonant frequency and the power is given to the transmitter side, resonant coils get energized and create the magnetic flux or field that links the coil. By the magnetic resonance technology the power will be transferred due to the magnetic vibration for the required distance.

XI. HARDWARE RESULT

This figure shows the whole experimental setup which includes the solar panels, controller boards and the various hardware parameters of the hardware setup. After the completion of the hardware we moved to the further testing process for checking the efficiency of the hardware. It gives nearly good results compared to the existing system. We use the solar energy as the input source for getting a quick result solar panel will exposed to the solar radiation for a certain time. The panel gets heated up and the power collected from the panel will be transferred to the inverter block. The inverter consists of MOSFET switches which includes in the power conversion. When the MOSFET switches activated using the triggering pulse generated from the PIC controller and the power will be transferred from DC to AC. The AC supply will be given to the primary coil gets energize creates the magnetic field or flux in the primary side. Flux created in the primary side links the secondary coil and the EMF will be transferred wirelessly between the coils. Transferred power in the secondary coil will be indicated by using the LED after it will be moved to the rectifier circuit AC converted to DC will be injected to the booster circuit and the various harmonics will be neglected by the compensation networks and finally the power will be given to the Electrical Vehicle [EV} motor.

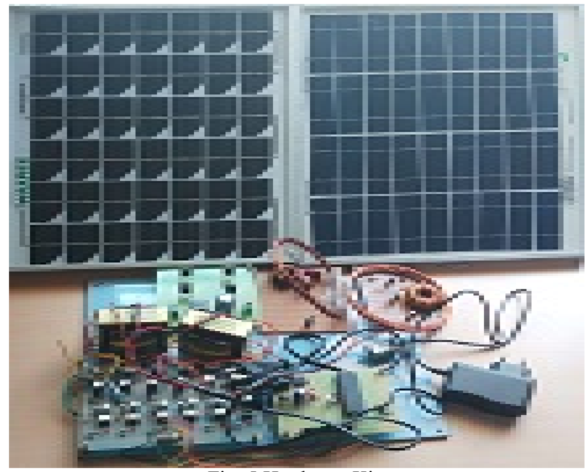

Fig. 5 Hardware Kit

XII. CONCLUSION

In this study, we are presenting the various technologies related to Wireless Power Transfer system, which is used to avoid the flux leakage and short circuits occurred due to the cables. This will be helpful for those who are doing research in the area of wireless power transmission. The wireless Power Transmission is used to operate the cars with high efficiency and improve the quality parameters. This project is in the progress of generating power source through renewal energy.

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