Maximum Power Point Tracking and Wireless Power Transfer for Mobile Battery Charging

Abhishek Kote[1], Ashish Mhankale[2], Akshay Wankhede[3], Prof.Neelam Labhade[4]
Department of Electronics And Telecommunication
[1, 2, 3, 4] Imperial College Of Engineering and Research, Wagholi Pune

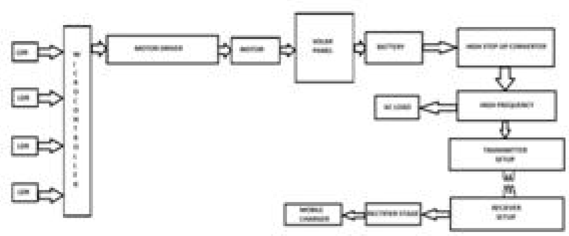
Abstract-*This paper presents a maximum power point tracker along with wireless power transmission for mobile battery charging. Maximum Power Point Tracking is based on solar energy harnessing purpose. During unclear sky and unusual climate conditions the solar panel is not able to harness complete power available from the sun because the solar panel is immovable thus delivering very less power. Maximum Power Point Tracking helps in tracking the direction in which maximum power from the sun is available. The transfer of electrical power from a source to load at a certain distance without any conducting wires is called as Wireless Power Transmission. Wireless power transmission is possible with conventional AC supplies. This paper presents a model that uses renewable energy source like sun as a source of power for wireless power transmission. The output from the renewable source of energy is very low thus there is a need to use proper step-up converters. The output is boosted and then by using proper transmitter and receiver properties electrical energy gets transferred due to magnetic resonance. The transferred power is converted back to dc and given to the mobile charging unit.*

Keywords-character recognition, character segmentation, Number plate detection, Toll collection, Vehicle number recognition.

I. INTRODUCTION

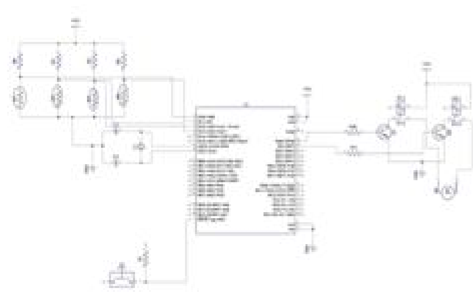
Solar energy is a renewable source of energy but sometimes it may not be available during cloudy weather or monsoon season when the sun rays falling on the solar panel are very low. Harnessing solar energy is a very tedious process because the rotation of earth does not provide a fix location of the sun. This in return constantly changes the point where there is maximum radiation from the sun. Due to this the total energy harnessed from this renewable source of energy is very low as compared to the total available energy. The solar energy is a green energy naturally taken from the sun which is a never ending source of energy. This kind of energy does not create much pollution as compared to other conventional energy sources. The best example of solar energy usage is the solar water heater. It is the most simple and known to all application. But it is important to have wider look at harnessing solar energy and in today's world with everything electrically powered it becomes necessary to look for better energy sources rather than depending on conventional energy sources. The solar panel installed on the rooftop is a way to harness the solar energy. The energy harnessed from the sun is directly proportional the radiation from the sun falling on the panel. During bad weather conditions the direction of installed solar panel may be different from the direction in which maximum radiation is available. So as to overcome this problem and to have a dependable power supply the Maximum Power Point Tracking is used along with the solar panel to track the maximum radiation from the sun. As the amount of radiation from sun varies, the load characteristic that gives the highest power transfer efficiency changes, so that the efficiency of the system is optimized when the load characteristic changes to keep the power transfer at highest efficiency. This load characteristic is called the maximum power point and MPPT is the process of finding this point and keeping the load characteristic there. Electrical circuits can be designed to present arbitrary loads to the photovoltaic cells and then convert the voltage, current, or frequency to suit other devices or systems, and MPPT solves the problem of choosing the best load to be presented to the cells in order to get the most usable power out. There are many ways in which wireless power can be achieved as inductive coupling, resonant inductive coupling, coupling, magnetodynamic coupling, microwaves and light wave. The technique used in this model is inductive coupling. A boost converter is used to boost the signal before wireless transmission. A boost converter is a DC-DC power converter that steps up the voltage for wireless power transmission.

Figure shows the block diagram for the model. It consists of LDR's used for detecting the direction of radiation, microcontroller, relays solar panel, wireless power transmission kit.

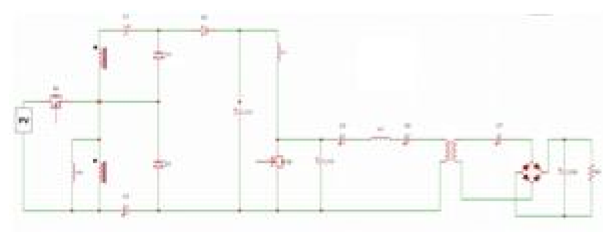


The wireless exchange of energy can be accomplished by three ways which are attractive coupling mode, electric field coupling mode and electromagnetic radiation mode. The magnetic coupling mode is characterized into short range electromagnetic acceptance and mid-extend firmly coupled attractive reverberation. The power exchanged and the exchange effectiveness on account of electromagnetic acceptance is high however the separation to which the power is exchanged is less. In the instance of firmly coupled magnetic resonance strategy, the power can be exchanged for a more extended separation with diminished productivity when contrasted with short range electromagnetic induction sort. The primary rule on account of electric field coupling mode is the redistribution of the surface charge on any object. The transmitter is energized with a high voltage and high recurrence source to create an exchanging electric field which couples with the thunderous collector. The power moved in this mode is less and the productivity of the power exchange is to a great extent influenced by the encompassing medium. In conclusion on account of electromagnetic radiation, the electric energy is changed over into electromagnetic energy, for example, laser pillars or microwaves, which can be transmitted over a more drawn out separation. At that point recieved electromagnetic energy is changed over again into electric energy. With the expanded separation of energy transmission in electromagnetic radiation mode, the exchange effectiveness is decreased. The dc-dc converters are fundamentally utilized as a part of switch mode managed control supply and furthermore in dc engine drive applications. These converters have numerous functional applications, for example, sunlight based cell energy frameworks, power module energy change framework, uninterruptable power supply framework and so forth. The DC-DC converter requires expansive boost voltage from the board's low voltage to the voltage level of the apparatus. A few converters increment turns proportion of the coupled inductor acquire higher voltage than regular boost converter. A few converters are powerful mix fly back and boost converters. They are a scope of converters mix created to finish high voltage pick up by utilizing coupled inductor method. Blends of auxiliary resonance circuit, dynamic snubber synchronous rectifiers, or exchanged capacitor based full circuits thus on, these circuits did dynamic switch into zero voltage exchanging (ZVS) or zero current exchanging (ZCS) operation also, enhanced converter productivity. The primary rule for accomplishing remote power transmission is era of substituting signs in the transmitter. Regularly control enhancers are utilized to create these substituting signals, however there is an expansive power misfortune related with power intensifier for remote power transmission. Class E control amplifier which can accomplish productivity up to 100% with higher yield control and lessened warmth sink prerequisites

II. DESIGN OF PROPOSED SYSTEM



The circuit diagram of the Maximum Power Transfer block is as shown in figure. It consists of a microcontroller, photoresistors, DC Motor. The Light Dependant Resisters are used to sense the direction of the radiation from sun. The DC motor is used to rotate the solar panel in the direction of radiaton. The wireless power transfer circuit diagram is as follows.



Circuit configuration of the proposed wireless power transmission system. The two main stages of the proposed system. The first stage is the high step-up dc-dc converter which converts the low input voltage from the PV Cell to a higher value. The step-up converter has following advantages:

I. The converter has a high step-up conversion ratio because of the connection of the coupled inductors, diodes and the capacitors.

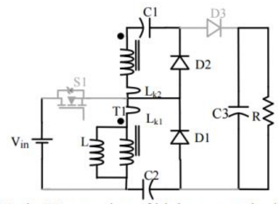
II. It has very high efficiency and lower stress on the switches as the leakage inductor energy can be recycled.

It consists of a coupled inductor T1 with the switch S1.The primary side winding N1 of a coupled inductor T1 is identical to the input inductor of the traditional boost converter, and diode D1, capacitor C1 receives leakage inductor energy from N1. The secondary side winding N2 of coupled inductor T1 is connected with another pair of diode D2 and capacitors C2, which are in series with N1 in order to increase the boost voltage. The rectifier diode D3 is connected to output capacitor C3. The second stage is the class E amplifier which receives the dc input from the high step-up converter and converts to high frequency ac. The class E amplifier is a high efficient switch mode resonant converter.

The high efficiency results from the reduced power losses in the transistor. The higher efficiency of the switch can be achieved by:

I. Using the transistor as a switch to reduce the power

II. Reducing the switching losses which result from finite transition time between ON and OFF states of the transistor.

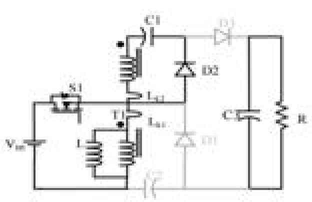


Mode IV operation of high step-up dc-dc converter

Light Dependant Resisters are used to sense the direction of the radiation from sun. The DC motor is used to rotate the solar panel in the direction of radiaton. The wireless power transfer circuit diagram is as follows.

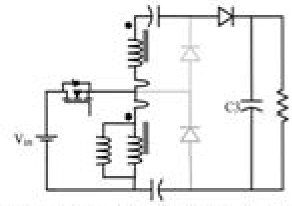
The Class E amplifier consists of a RF choke L1 and a parallel-series resonator circuit consisting of C4, C5 and L2. The output of the class E power amplifier is connected to the tank circuit formed by C6 and the transmitting coil as shown in the fig 2. The receiver consists of a tank circuit formed by capacitor C7 and the receiving coil and a simple full bridge diode rectifier to convert the ac power transmitted from the transmitter coil to dc and a filter C0 is used to reduce the harmonics and then given to the load R1. The power gets transferred resonant frequency is achieved between transmitter and receiver pair.

A] Modes of Operation of high step up converter



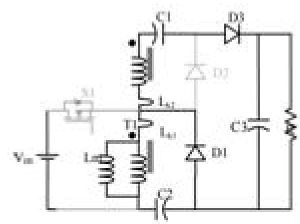
Mode I operation of high step-up dc-dc converter

Mode I (t0 – t1): The mode I operation of the step up converter. At the point when the turn S1 is off, the capacitor C2 gets totally charged by the magnetizing inductor Lm. The magnetizing inductor current ILm diminishes as the input voltage Vin crosses the charging inductor Lm and the spillage inductor Lk1. Lm still keeps on exchanging energy to the capacitor C2 yet this energy is diminishing. The current through the diode D2 and the capacitor C2 are additionally diminishing. The optional spillage current iLk2 is additionally diminishing with a slant of iLm/n. This mode closes while expanding iLk1 is equivalent to the diminishing iLm at t=t1.



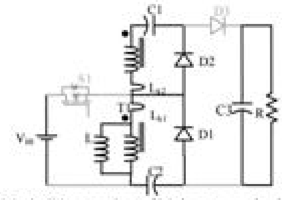
Mode II operation of high step-up dc-dc cor verter

Mode II (t1 – t2):The mode II operation of the step up converter. Amid this mode, the input source voltage Vin gets series associated with N2, C1 and C2 which charge the yield capacitor C3. The current iLm, iLk1 and id3 increments as Vin crosses Lk1, Lm and N1. Lm and Lk1 stores energy from Vin likewise C1 and C2 release their energy toC3. Henceforth id3 and the releasing currents ic1 and ic2 likewise increment. The turn is killed at t=t2 and this mode closes.



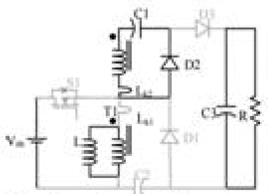
Mode III operation of high step-up dc-dc converter

Mode III (t2 – t3): The mode III operation of the step-up converter. During this mode the secondary leakage inductor Lk2 keeps charging the outputcapacitor C3 when the switch is turned off at t=t2. Diodes D1 and D3 will be conducting. The stored energy in Lk1 flows through D1 to charge the capacitor C1. Also, the stored energy in the leakage inductor Lk2 is in series with C2 to charge the output capacitor C3. Since the inductances of Lk1 and Lk2 are very small compared to Lm, iLk2 decreases rapidly but iLm increases as the magnetizing inductor Lm receives energy from Lk1. This mode ends when iLk2 decreases and reaches zero at t = t3.



Mode IV operation of high step-up dc-dc converter

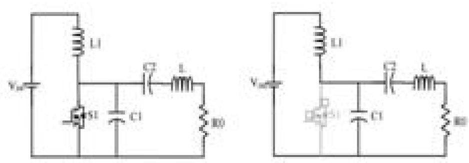
Mode IV (t3 – t4): The mode IV operation of the step-up converter. The magnetizing inductor Lm discharges its energy to C1 and C2. Diodes D1 and D2 are conducting in this mode. The currents i0 and iD1 are decreases continuously as the leakage energy charge the capacitor C1 through the diode D1. The magnetizing inductor Lm discharges its energy to charge the capacitor C2 through T1 and D2. The energy stored in C3 is continuously discharged to the load R. These energy transfers decreases the currents iLk1 and iLm but increases the current iLk2.This mode ends when iLk1 reaches zero at t=t4.



Mode V operation of high step up dc dc converter

Mode V (t4 – t5):The mode V operation of the step-up converter. During this mode of operation, Lm continuously discharges its energy to C2 and diode D2 will be conducting. The current iLm decreases as it charges the capacitor C2 through T1 and D2. This mode ends when the switch S1 is turned on at the beginning of the next switching period.

B] Modes of Operation of Class E Power Amplifier:



The two exchanging phases of the switch S1 which is ON for a half cycle and off for another half cycle. The switch S1 is turned ON at zero drain voltage and zero drain current to decrease the switching losses when the transistor is turned ON. Ideal Operation Mode: When the switch is killed, there will be a bounce change in the drain current yet the drain voltage begins to increment gradually from zero hence decreasing the switching losses. This will be the ideal method of operation of class E enhancer as ZVS and ZCS has been accomplished which gives the most elevated proficiency. Sub-Optimum Operation Mode: Class E amplifier can be worked in a sub-ideal operation mode, where the capacitor C1connected over the switch S1 is released to zero preceding turning ON the switch S1 by legitimate entryway signals. For this situation the drain voltage winds up noticeably negative and the antiparallel diode of the switch S1 leads just the negative current and keeps up the drain voltage near zero preceding the switch S1 is turned ON, therefore diminishing the switching losses

III. RESULTS

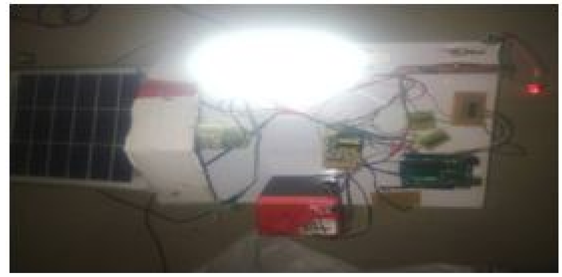


Fig: Output from solar panel and implementation of MPPT algorithm

Fig: Wireless power transfer for mobile battery charging

IV. CONCLSION

The MPPT enables proper and efficient use of solar energy. The MPPT extracts maximum power from the panel it forces the panel to operate at voltage close to maximum power point to draw maximum power available.MPPT reduces the complexity of the system while output of system is high. MPPT’s are useful during cloudy, winter, hazy days.The Power point tracker is a high frequency DC to DC converter. They take the DC input from the solar panels, change it to high frequency AC, and convert it back down to a different DC voltage and current to exactly match the panels to the batteries. MPPT's operate at very high audio frequencies, usually in the 20-80 kHz range. The advantage of high frequency circuits is that they can be designed with very high efficiency transformers and small components. MPPT finds its application where per day consumption of power is very high and efficient trapping of solar energy can reduce load on traditional power supply. The advantages of wireless power transfer are that it will eliminate the high tension power transmission line cables. Loss in power or transmission is negligible in wireless power transfer. Problems such as power failure due to short circuit fault on cables will never happen in transmission also power theft is impossible. The transmitter can charge existing receivers at some distance providing flexibility. The Wireless Charging Technology can be further applied to wireless mobile charging. Solar panels can be integrated into smart phone for more efficient charging along with wired charging. Wireless charging for smartphones can be implemented by using efficient wireless power transmission systems.

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