SOLAR BASED WIRELESS EV CHARGER

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Abstract:

In today's drastically deteriorated environment, electric vehicles (EVs) are required. India's government intends to have only electric vehicles by 2030. Fast charging of electric vehicles and charging infrastructure are required to make EVs widely accepted, as charging time is the primary obstacle to EV adoption. Having an acceptable charging infrastructure is a crucial aspect of this change. With the widespread use of electric vehicles, the current power supply may experience significant instability. The "solar-based wireless EV charger" project uses renewable energy technology. Solar energy is converted to electrical energy, which is then stored in a lead-acid battery. With the battery management unit, a wireless charging system will be established. This stored energy is utilized to charge Electric Vehicles.

Index Terms: wireless power transfer module, reverse charging protection, ATmega328P.

1. INTRODUCTION

To improve charging station efficiency, electric vehicles will be the future mode of transportation. Electric vehicle charging will play a significant role in raising EV demand in the market; the lack of charging infrastructure is the primary reason for not purchasing an EV. We investigated the portable EV charger by reducing charging time with renewable energy [1]. The vehicle battery charging station developed in this work uses a hybrid power system to give a unique service to travelers who seek to travel long distances in an electric vehicle. There are no electric charging stations for such users in between motorways to recharge their vehicles. For charging their electric vehicles, the wireless EV charger is the ideal alternative [2].

2. solar-based wireless EV charger

Solar power has increasingly become popular over the past year. With its uncountable improvement and cost-effective ways, more and more people are opting to switch over to solar energy rather than their regular form of energy. Solar charging is based on the use of solar panels for converting [3].

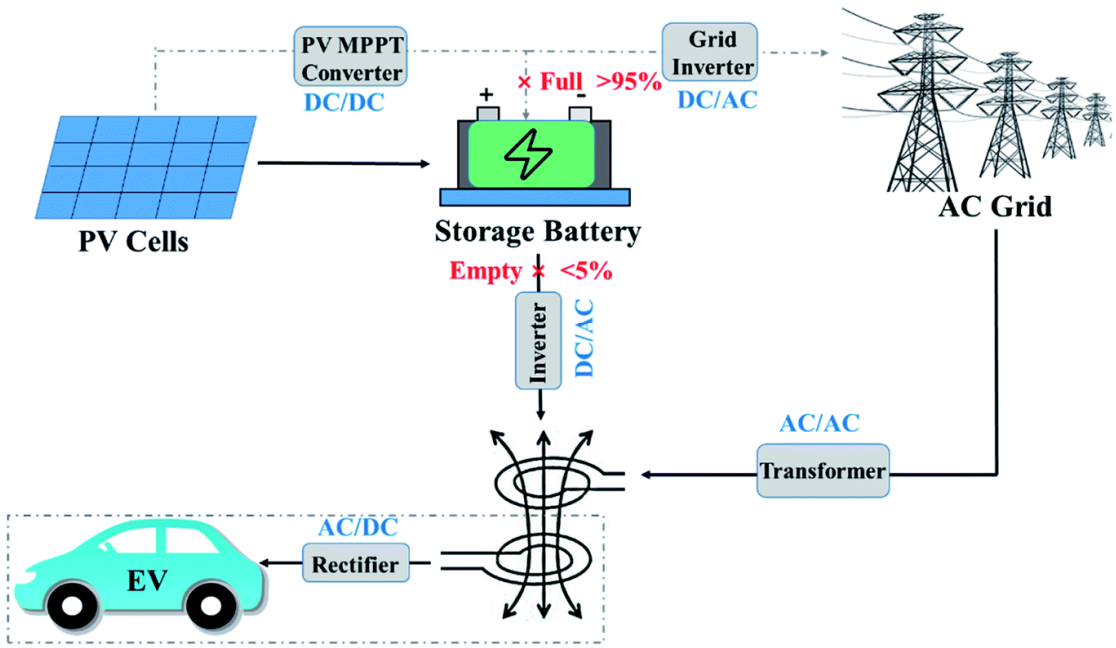

Fig.1 Block diagram of solar-based wireless EV charger

Light energy into electrical energy (DC). The DC voltage can be stored battery bank. There is Reverse charging protection circuit is provided for the backflow of energy from the battery to a solar panel. The transfer coil is located at charger side and receiver coil is placed on vehicle side [4]. A wireless power transfer module (WPT) is used for transferring electric power which is generated from the solar panel to the Electric vehicle by using the principle of Electromagnetic Induction. To measure battery voltage, a voltage sensor is used. The battery voltage will be measured by microcontroller & showed on a 16x2 LCD. It will also display battery low status, whenever battery voltage falls below a certain level. L239D is the motor driver which is used for movement of wheels of that vehicle [5].Wireless power transfer module (WPT): In electric vehicles charging of battery through a charger and wire is inconvenient, dangerous, and expensive. The existing gasoline and petrol engine technology vehicles are responsible for air, and noise pollution as well as for greenhouse gases. The implemented wireless charging system of batteries for Electric vehicles by the inductive coupling method has been studied in this paper [6]. The transmitting circuit is used between the transmitter coil & receiver coil where MOSFET is used for switching operation. The system is achieving a 61% efficiency level while providing safety, reliability, low maintenance, and long product life. This is easy to use Wireless Power Transfer Module. This module consists of Transmitter Section & a receiver Section [7]. Both the sections have a coil that acts as a transmitting/receiving antenna. This product can be used for wireless charging of mobile phones and various small electronic products. It is in a very small form factor and is extremely easy to use efficient & low costing. It can be used for wireless

charging of your product thus making the product completely sealed, dustproof & waterproof thus increasing your product's life [8].

3. Proposed method:

A. Wireless Charging Technologies: Fundamentals, Standards, and Network Applications – Xiao Lu†, Pi Wang‡, DusitNiyato‡, Dong In Kim§, and Zhu Hanؔ † Department of Electrical and Computer Engineering, University of Alberta, Canada ‡ School of Computer Engineering, Nanyang Technological University, Singapore § School of Information and Communication Engineering, Sungkyunkwan University (SKKU), Korea ؔ Electrical and Computer Engineering, University of Houston, Texas, USA.,IEEE sensor journal,(2008-2009) [9].

The integration of inductive charging with existing communication networks creates new opportunities as well as challenges for resource allocation. This research has shown the existing solutions of providing seamless wireless power transfer via static charger scheduling, mobile charger dispatch and wireless charger deployment. Among those studies, various other issues including online mobile charger dispatch strategies, schemes for nearfield energy beamforming, mobile networks energy provisioning, distributed deployment strategies of wireless charger, and multiple access control for wireless power communication networks are less explored and further investigation isrequired. Hadley, Franklin (2007-06-07). "Goodbye wires…".MIT News.Massachusetts Institute of Technology. Retrieved 2007-08-23 [10]. The advance online publication of the journal Science. MIT team experimentally demonstrates inductive. The team consists Andre Kurs, AristeidisKaralis, Robert Moffatt, Prof. Peter Fisher, and Prof. John Joannopoulos led by Prof. Marin Soljacic. They realizing their recent theoretical prediction, the team was able to light a 60W light bulb from a power source which is seven feet away; no physical connection exist between the source and the appliance. The MIT team refers to its concept as "WiTricity" [11].

Transmitter Module Input voltage: 9-12 Volts.Receives the output voltage: 5V,Receiving the output current: 350-500mA.Receiving usual distance: 3cm- 4cm,It is user friendly, as there are no cables. Different mobiles can use the same charging pad.Better product durability i.e. water proof and dustproof .Provides flexibility, where connecting cables for charging are costly.It does not have any radiation effects 1[12].**Validation and Result Analysis of Solar panel**:

Solar panels convert solar energy into electricity. They use the concept of photoelectric effect, emission of electrons when light falls on solar panel. Solar panels are made up of silicon cells, silicon has an atomic number 14. When light falls on silicon cell, the outer most electrons of silicon i.e. two electrons are set into motion. This initiates the flow of electricity [13]. Silicon has two different cell structures: monocrystalline and polycrystalline Monocrystalline solar panels are manufactured from one large silicon block and are made in silicon wafer formats. Polycrystalline

solar cells are also silicon cells, which are produced by melting multiple silicon crystals together. Mono-crystalline silicon cells are more efficient but expensive when compared to polycrystalline cells [14].

B. Batteries: Lithium ion battery is rechargeable battery. During discharging lithium ions moves from negative electrode to the positive electrode, during charging lithium ions move from negative electrode to positive electrode. Electrolyte provides conductive medium for lithium ions to move from positive electrodes to negative electrodes [15].

C. Transmitter: Transmitter section basically consists of an astablemultivibrator, power resistor, and inductor as shown in Fig.2. The obtained DC voltage from solar panel is converted into AC voltage using an astablemultivibrator.Astablemultivibrator circuit is built using IC 555 timer, it is a simple oscillator circuit that produces continue square wave pulses. The frequency of the circuit can be adjusted using R1,R2& C1.The reason for using 555 timer is that it is cheap, stable &user friendly [16].

D. Receiver Receiver section basically consists of receiving inductor coil, bridge rectifier, voltage regulator and rechargeable battery. The AC signal received by the coil should be converted into DC signal it is done by bridge rectifier and voltage form the bridge rectifier is unregulated and this should be converted into regulated constant voltage, voltage regulator IC 7805 is used to convert the unregulated DC voltage to regulated constant DC voltage [17].

E. Receiving inductor coil: The receiving coil has the dimensions 24.2*9.38*5.36 mm and receiver coil inductance 14uH. It converts magnetic from primary coil to electrical signal.

F. Bridge wave rectifier: Bridge rectifier is used to convert the alternating current into direct current. It offers high rectification efficiency (82%) and also low cost to implement when compared to centre tapped full wave rectifier. The diode used is 1N4007.

Due to the limited availability of resources, it has become essential to develop different methods to generate approaches to noiseless, cost-efficient, and convenient charging. It is estimated that losses incurred due to wires are about 20-30%. Hence WPT attempts to minimize these losses along with a reduction in pollution levels caused due to resources used presently. But for electric vehicles, traveling range and charging process are the two major issues affecting their adoption over conventional vehicles. The method of dynamic wireless charging allows keeping the vehicle charged while running. To overcome the problem of the charging process, a wireless charging & battery management unit for an electric vehicle is designed. The basic working principle of inductive WPT Charging is that there are two parts to the inductor. The primary winding is at the charger side and the other secondary winding is placed at the vehicle side. If an EV vehicle is stopped on the road because of battery

is dead and there is no charging station around it then a movable charger is the most suitable method for charging that vehicle at that place with less effort and without wasting our time.

Reverse charging protection (RCP):

Many batteries powered applications use diodes for reverse battery protection. However, a diode does not always protect a battery charger. Sometimes when the battery is fully charged from the solar panel then to have proper protection, inserted backward it can cause a large amount of current to flow through the charging circuitry, possibly destroying both the battery and solar panel. A diode and resistor are placed in series with the battery. The diode in series with the main supply is to block current from the battery into the solar panel. Two resisters are in series with the battery to prevent reverse charging.ATmega328 Arduino: A microcontroller is the heart of every automation system. It is a small, low cost and self-contained on- chip computer. Microcontrollers usually must have low-power requirements since many devices they control are battery- operated.

The following parameters are mainly conceded formicrocontroller selection:Number of input-output pins, Amount of memory required, Need for inbuilt ADC & DAC, Processing speed &capacity,Power requirement for operation,Programing language,Software & hardware tools required.

As per our requirements, the microcontroller ATMEGA328P matches perfectly. Atmega328P is a high-performance yet low- power consumption 8-bit AVR microcontroller that can achieve the most single clock cycle execution of 131 powerful instructions thanks to its advanced RISC architecture. It can commonly be found as a processor in Arduino boards such as ArduinoFio and Arduino Uno. Atmega328P is one of the high-performance AVR technology microcontrollers with a large number of pins and features. It is designed with 8-bit CMOS technology and RSIC CPU which enhance its performance and its power efficiency get improved by auto sleeps and an internal temperature sensor. This Atmega328P IC comes with internal protections and multiple programming methods which helps the engineers prioritize this controller for different situations. The IC allows multiple modern era communications methods for other modules and microcontrollers themselves, which is why the microcontroller Atmega328P usage has been increasing every day. The hardware consists of a 24V Solar panel which is connected to the voltage ripple circuit. The voltage ripple circuit removes the ripples and gives out a constant voltage output. This output from the voltage ripple circuit is used to charge the battery which is used as source to charge the battery using wireless power transfer. The battery serves as the input for the primary coil which is present in the charging pad. ICPT uses the principle of electromagnetic induction for transmission of energy from primary to secondary coil, but due to a huge air gap between the primary and the secondary coil lot of flux doesn’t link the secondary coil. To save this flux loss and hence the energy, resonance condition can be used and hence obtain the maximum

power transfer between the primary and the secondary for a given distance. For this compensators are used which consist of ac capacitors connected with the respective coil in series and parallel. Depending on this connection the basic compensation topologies are 5 : Series-series topology, Series-parallel topology, Parallel-parallel topology. Parallel-series topology. The capacitor C1 in primary is used to cancel reactive part of the circuit seen by the source, achieving zero displacement. Thus the inductive power in the primary coil is being cancelled by the capacitive power, thus the primary coil impedance is equivalent to the net resistance in the primary circuit. The capacitor C2 in the secondary side is chosen to operate in resonating condition, thus the net inductance in the secondary coil is cancelled by the secondary compensator, and hence achieving maximum power transfer.

5.Validation and Result Analysis

of Compensation to understand the importance of compensation the uncompensated system is studied first. Figure 5 and Figure 6 shows the primary and secondary voltage waveform of an uncompensated system on both the sides respectively. The waveform shows peaky spikes and consists of distorted waveform consisting ripples. Figure 7 and figure 8 shows the waveform of a compensated system on both the primary and secondary circuit, the waveform is obtained at resonating condition and the harmonics are removed. To achieve maximum power transmission resonance condition must be achieved, thus compensation is provided on both the sides and its corresponding waveform is being obtained. Figure 9 and figure 10 shows the compensation only on the primary and secondary side respectively and its corresponding output voltage. The variation of the secondary rectified voltage at three constant input voltages (14V, 18V and 22V) at variable distance is being studied. From the Table 1 it is concluded that at 22V input supply, considerable rectified and hence regulated voltage can be obtained up to 35mm distance.

6.CONCLUSION

Transportation is a major concern in the development of any country. Whereas electric vehicle is the future of the transportation industry. While a lot of research has been done on this topic in the previous decade, a large part of it is yet to be explored. From our project, we conclude that a wireless charging system is implemented by our group. Along with this, a battery management unit is designed, which shows the battery voltage. Battery voltage is measured by the microcontroller & displayed on a 16x2 LCD. We have used inductive coupling technology for wireless power transfer, but it is useful only for low power applications and where the distance between receiving and transmitting coils is less. But for realworld applications, the power requirement is high and the distance between receiving and transmitting coil should also be increased. So for this purpose, Magnetic Resonant Coupling technology is appropriate and suitable. Also, we conclude that the wireless charging method requires more time to charge a battery than the other types of charging methods. Our

project only represents the prototype of Automation in the wireless charging of electric vehicle systems.

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