Wireless Power Transfer by Incorporation of Solar Energy

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Abstract - *With the increase in the consumption of electrical energy day by day the various countries now prefer renewable sources such as solar, wind, tidal, geothermal etc. Also with the use of these renewable energy sources the pollution, global warming and other such natural disasters can be prevented. In this presented disclosure, solar panels are used as a main role in providing renewable source of energy instead of other non renewable sources. The panels take sunlight from the sun and convert it into electrical energy which can be stored in batteries. This stored energy charged in battery is further converted into AC source by the inverter. Transmitter receives energy from the inverter, which transfers power in the form of electromagnetic waves through Transmitter and Receiver coil. Further, Receiver converts electromagnetic waves into voltage form which is same as applied at transmitting end. This whole arrangement is connected with solar system. Further, if the efficiency of wireless power transmission is increased slightly, then wireless power transmission could become a standard means for charging an electronic gadget, and also if this transmission of power is done by the means of a renewable and a clean power source such as solar energy it would be a cherry on top of the cake.*

Key Words**: Wireless, Power, Transfer, Solar Panel, PWM Charge Controller, ARDUINO.**

1. INTRODUCTION

We live in world of technological advancement new technological emerge each and every day to make our life simpler. Despite all these, we still rely on the classical and conventional wire system to charge our everyday use low power devices such as mobile phones, digital camera etc. and even mid power devices such as laptops. The conventional power system creates a mess when it comes to charging several devices simultaneously. It also takes a lot of electric sockets and not to mention the fact that each device has its own design for the charging port[2].

Wireless power transmission is the efficient transmission of electric power from one point to another through vacuum or an atmosphere without the use of wires or any other substance. This can be use for application where either an instantaneous amount or a continuous delivery of energy is needed, but where conventional wires are unaffordable, inconvenient, expensive, hazardous, unwanted or impossible. The power can be transmitted using inductive coupling for short range, resonant induction for mid range and electromagnetic wave power transfer for high range. WPT is a technology that can transfer power to locations, which are otherwise not possible or impractical to reach[4]. The objective of this project is to design and construct a method to transmit wireless electric power through space and charge designated low power devices. The system will work by using resonant coils to transmit power from an AC line to a resistive load. Investigation of various geometrical and physical form factors evaluated in order to increase coupling between transmitter and receiver[3].

A success in doing so would eliminate the use of cables in the charging process thus making it simpler and easier to charge low power devices. It would also ensure the safety of the device since it would eliminate the risk of short circuit[1].

1.1 Solar PWM Charge Controller

The PWM Charge Controller is basically an electronic circuit which indicates and regulates the flow of charge from the solar panel to the battery, preventing the battery from the perils of overcharging. When the battery is fully charge the device detaches the battery from the charging process, protecting it from over charging.

The charge controller also comprises of the voltage regulator to regulate the input charging voltage given from the solar panel to the battery in order to give a stable constant output voltage.

1.2 INDUCTIVE COUPLING

Inductive or magnetic coupling works on the principle of electro magnetism. When a wire is proximity to a magnetic field, it generates a magnetic field on that wire transferring energy between wires through magnetic fields in inductive coupling.

If a portion of the magnetic flux established by one circuit interlinks with the second circuit, then to circuits are coupled magnetically and the energy may be transferred from one circuit to another circuit.

This energy transfer is performed by the transfer of magnetic field which is common to the both circuit. In electrical engineering, two conductors are referred to as mutual-inductively coupled or magnetically coupled when they are configured such that change in current flow through one wire induces a voltage across the end of the other wire through electromagnetic induction.

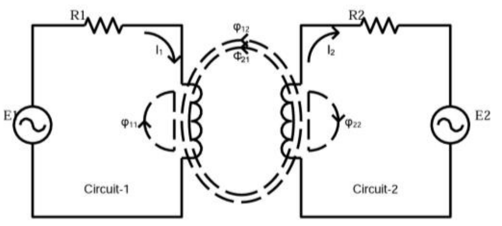

Figure 1- Inductive coupling with four Component Fluxes

The amount of inductive coupling between two conductors is measured by their mutual inductance. Power transfer efficiency of inductive coupling can be increased by increasing the number of turns in the coil, the strength of the current, the area of cross-section of the coil and the strength of the radial magnetic field. Magnetic fields decay quickly, making inductive coupling effective at very short range.

2. BLOCK DIAGRAM OF WIRELESS POWER TRANSFER VIA SOLAR ENERGY

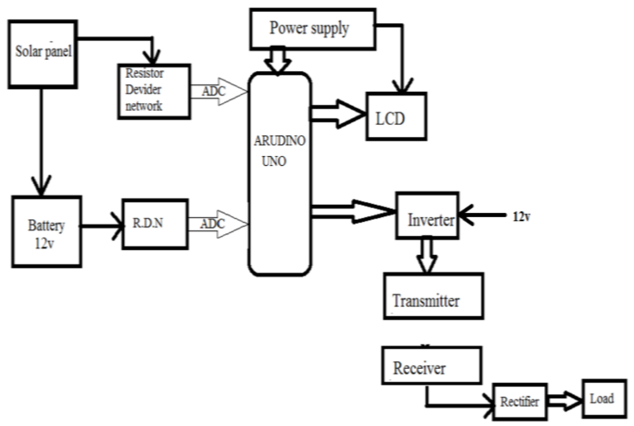

Figure 2- Block diagram for wireless power transmission via solar energy

The solar panel supply electrical energy which is stored in a rechargeable battery of 12v via charge controller. LCD is used to indicate solar panel & battery status. For that 12v supply is divided to 3 to5 volt for arduino controller by using Resistor divider network .

Here, we used Arduino controller for providing switching pulses to the MOSFET inverter. The output from the inverter is given to the transmitter coil.

Energy transfers by electromagnetic induction to the receivers are via inductive coupling. The inductive coupling is used as the antenna to wireless power delivered from the transmitting to the input of a receiver. Receiver unit, the bridge rectifier is used convert ac voltage to produce dc voltage and produce dc output. A capacitor is included in a circuit to act as a filter to reduce ripple voltage.

Wireless power or wireless energy transmission is the transmission of electrical energy from a power source to an electrical load without man made conductors. Wireless transmission using solar energy is wireless are in convenient, no hazardous and green technology. A wireless power transmitter emits a magnetic field with help of the coil with the same frequency emitted by wireless power receiver. In order for optimal impedance, cable reels used on both sides.

3. CIRCUIT DIAGRAM

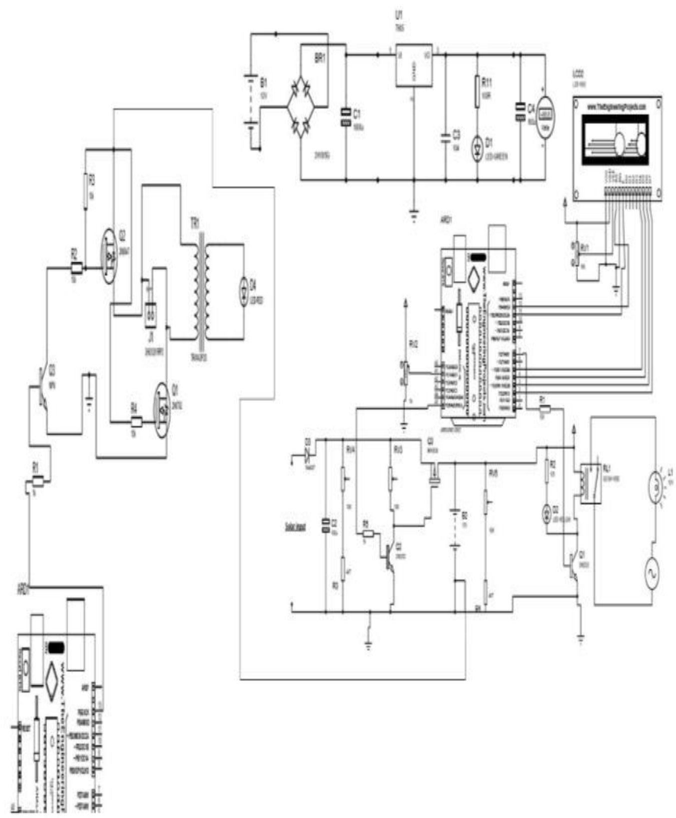

Figure 3- Circuit Diagram

The above figure shows circuit diagram of solar PWM charge controller and inverter circuit with inductive coils.

The charge controller circuit is divided in 6 sections for better understanding.

1. Voltage sensing
2. PWM signal generation
3. MOSFET switching and driver
4. Filter and protection
5. Display and indication
6. Load On/OFF

The main sensors in the charge controller is voltage sensors which can easily implemented by using a voltage divider circuit. We have to sense voltage coming from solar panel and the battery voltage. As the ARDUINO analog pin input voltage is restricted to 5V, we designed the voltage divider in such a way that the output voltage from it should be less than 5V. we used a 5W (Voc=12v)solar panel and a 12v and 1.3Ah SLA battery for storing the power .So we have to step down both the voltage to lower than 5V. we used R1=10k and R2 =4.7K in sensing both the voltages(solar panel voltage and battery voltage). The value of R1 and R2 can be lower one but the problem is that when resistance is low higher current flow through it as a result large amount of power (P = I^2R) dissipated in the form of heat. So different resistance value can be chosen but care should be taken to minimize the power loss across the resistance. Here, we have used PWM controller. PWM (pulse width modulation) is a technique by which we simply control a digital output signal by switching it on and off very quickly, by varying the width of the on/off duration, it will give the effect of varying the output voltage. In this charge controller we used two MOSFETs one is for controlling the power flow from solar panel to battery and other is to drive the load.

The capacitor(C1) used after the solar panel at the input side is used as filter which removes any unwanted ripple/noise signal. A 16X2 char LCD is used for monitoring solar panel voltage and battery voltage. It also show the % of charge. The output from the charge controller is given to the inverter circuit for conversion of D.C to A.C.

In the inverter circuit we have used two MOSFET IRF630 & IRF9630. For switching of IRF630 we have used Transistor 2N2222. Arduino controller is used to provide gate signal to the MOSFET through transistor. Output of the inverter is given to the transmitter coil which is in the form of alternating signal. Receiving coil receives signal by inductive coupling.

4. CONCLUSIONS

Our project has mainly focused on both the technologies Solar power generation and Wireless Power Transfer together, as this would be a major advancement in the field of technology of using a renewable and wireless technology together. If we can overcome this constrains, then we could implement this technology in various applications such as airports, home appliances, office environment and any other public spaces.

REFERENCES

[1] Sourabh pawade, Tushar Nimje, Dipti Diwase. Goodbye wires.. Approach to wireless power transmission. IJETAE.2012; 2(4).

[2] M. Fareq, M. Fitra. Solar wireless power transfer using inductive coupling for mobile phone charger. IEEE conference publications. 2014:473-476 Doi:10.1109 /PEOCO.

[3] T.S. Hasarmani. Wireless power transmission for solar power satellite. Department of electrical Engg. Bharati Vidhyapeeth university's collage of Engg. 2011.

[4] http://www.instructables.com/id/ARDUINO-SOLAR-CHARGE-CONTROLLER-PWM/

[5] http://www.bristolwatch.com/k150/port5.htm

[6] Yungtaek jang, Senior Member, IEEE, and Milan M. Jovanovic, Fellow, IEEE A Contactless Electrical Energy Transmission System for Portable-Telephone Chargers.

[7] Suja, S., Sathish Kumar, T., Dept. Of EEE, Coimbatore Inst. of Technol., Coimbatore, India "Solar based wireless power transfer system" Published in Computation of Power, Energy, Information and Communication(ICCPEIC), International Conference on 17 April 2013