Solar Based Wireless Charging

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***Abstract*— Wireless charging is a type of charging method which uses an electromagnetic field to transfer energy through electromagnetic induction. Energy is transferred between devices (transmitter and receiver) through the process of mutual induction. Power from solar is given as input to transmitter inductive coil, the receiver inductive coil receives the power and converts it into electric current to charge the battery.**

Keywords—Wireless charging; Inductive coupling.

I. INTRODUCTION

Wireless charging is an emerging technology now a days. Wireless charging is also known as wireless power transfer; here the power is transferred to load without interconnecting cords. In 2015 Samsung introduced wireless charging into galaxy s6 mobiles. Wireless charging is also called as inductive charging. Wireless charging mainly eliminates the cable required for charging. It reduces the wear and tear of the hardware ports.

Compared to wire charging, wireless charging has more benefits as follows.

- 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

Wireless charging technology is gradually advancing towards two major directions, i.e., radiative wireless charging or radio frequency (RF) based wireless charging and inductive charging or coupling-based wireless charging. Radiative wireless charging adopts electromagnetic waves, generally microwaves and RF waves is used to deliver energy in a form of radiation. The energy is transferred based on the electric field of an electromagnetic wave, which is radiative. Further due to the safety issues raised by RF exposure, radio frequency based wireless charging operates in a low power region. Inductive charging is based on mutual induction concept where magnetic field couples between two coils. Also the magnetic field of An electromagnetic wave attenuates much faster than the electric field hence the power transfer distance is largely limited. Due to safety and implementation the inductive charging is used in our day today life.

II. BLOCK DIAGRAM OF THE SYSTEM

Proposed system as shown in the Fig.1 consists of solar panel which acts as a DC power supply and is used to charge the battery. The output of battery is a direct current signal. Wireless power transfer is based on mutual induction where current carrying conductor produces magnetic field.

The direct current is converted to alternating current by passing dc to 555 timer.AC current is generated and transmitted through transmitter coil.

The current is received by receiver coil and converted to direct current by passing the receiver coil output to rectifier circuit. The rectifier circuit used in the system is bridge rectifier. Output of bridge rectifier is a unregulated dc current which is regulated by passing through voltage regulator which maintains a constant voltage. The output of voltage regulator is used to charge low power devices like mobile, iPod, wearable devices etc.

III. LITERATURE SURVEY

A. Wireless Charging Technologies:

Fundamentals, Standards, and Network Applications – Xiao Lu†, Pi

Wang‡, Dusit Niyato‡, Dong In Kim§, and Zhu Hanᵡ † 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 ᵡ Electrical and Computer Engineering, University of Houston, Texas, USA.,IEEE sensor journal,(2008-2009).

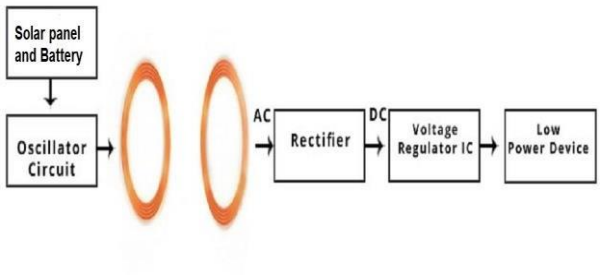

Fig.1 Block diagram of solar based wireless charging

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 is required.

Hadley, Franklin (2007-06-07). "Goodbye wires…". MIT News. Massachusetts Institute of Technology.

Retrieved 2007-08-23. The advance online publication of the journal Science. MIT team experimentally demonstrates inductive. The team consists Andre Kurs, Aristeidis Karalis, 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".

IV. WORKING

A. 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.
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.

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.

C. Transmitter:

Transmitter section basically consists of an astable multivibrator, power resistor, and inductor as shown in Fig.2. The obtained DC voltage from solar panel is converted into AC voltage using an astable multivibrator.Astable multivibrator 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

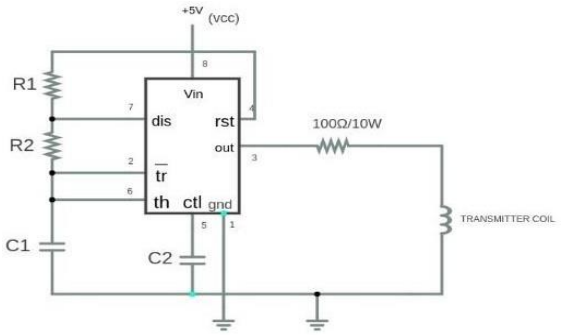

Fig. 2 Transmitter circuit using IC555 timer

Working of Astable multivibrator:
Fig .3 shows Astable multivibrator.When the power is turned ON, the flip flop will be RESET. The capacitor C1 which is connected to pin 7 will discharge through transistor. Voltage across capacitor is same as trigger voltage, so during discharge when the capacitor voltage becomes less than 1/3 Vcc output of comparator 2 will be high, This will SET the flip-flop and output at pin 3 high.
This high output will turn the transistor OFF then capacitor C1 starts charging through resistors R1 and R2. When capacitor voltage crosses 2/3 Vcc, comparator 1 output becomes high. This will RESET the flip-flop and output at pin 3 low.
Power resistor: Power resistor is the resistor which can withstand and dissipate large amount of power. They are Made from materials which have high thermal conductivity. They have a power rating of at least 5w.they are often coupled with heat sinks to dissipate large amount of power. Power resistors are mainly built to dissipate power keeping their size as small as possible. There are many types of power resistors such as wire wound resistor, grid resistor, chip resistor, water resistor, and liquid rheostats.

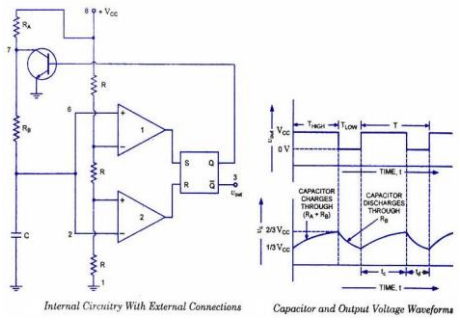

Fig. 3 Astable multivibrator

Bridge rectifier has 4 diodes D1, D2, D3, D4 connected as shown In the Fig.4 and a load. The output of rectifier is given to voltage regulator.

Voltage regulator: The function of the voltage regulator is to maintain the constant voltage across any device Voltage. The voltage regulator used in this receiver coil is IC LM7805.it provides a constant voltage of +5 volts. The input voltage range is 7v – 5v.current rating IC=1A.the output voltage range is from 4.8v -5.2v.

E. Application

There are two inductors i.e. transmitting coil and receiving coil. The circuit mainly works on the principle of mutual induction. The transmitting coil has the dimensions 22.1*13.1*3.2 mm and transmitter coil inductance 3.7uH.

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.

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.

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.

- Consumer electronics
- Transport
- Heating and ventilation
- Industrial engineering
- Electric vehicles

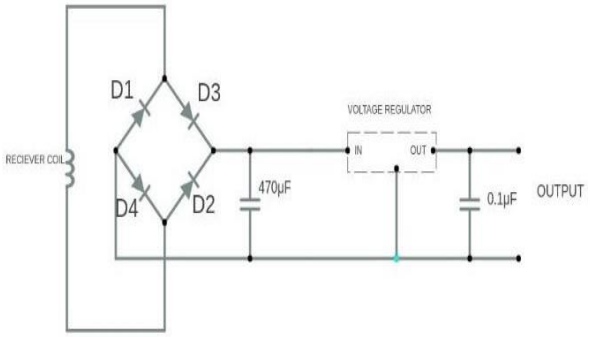

Fig. 4 Receiver circuit using bridge rectifier

V. CONCLUSION

This paper successfully demonstrates the building of wireless charger using solar energy. Wireless charging technology gradually eliminates the use of wired cords. It is more convenient and easy method. This technique eliminates the wear and tear of the hardware ports. This technology mainly provides portability to the user. Wireless charging seems a good idea and has been introduced to many mobiles iPhone 7(Apple), galaxy S5 (Samsung), Lumia 930(Microsoft), and xperia z3 (sony).These mobiles are built on the concept of inductive charging.

ACKNOWLEDGEMENT

Thanks to the National Institute of Engineering Assistant Professor Sharmila B S and HOD Rohini Nagapadma for showing great support, encouragement, and guidance inthis project.

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