TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 4754 - 4757

Wireless Solar Charging System for Mobile Phones

Mr. Dileep Kumar Singh, Dept. of Engineering and Technology, JagranLakecity University, Bhopal

Article Info
Volume 82
Page Number: 4754 - 4757
Publication Issue:
January-February 2020

Article History
Article Received*: 18 May 2019*
Revised*: 14 July 2019*
Accepted*: 22 December 2019*
Publication*: 23 January 2020*

Abstract:
Charging phones using wireless media is considered to be an emerging technology in the communication system which stands to be beneficial in the field of electronic appliances as well. The electronic devices requires a power source especially a battery for providing power to the system, but the battery requires replacement which limits its usage in many appliances. Later rechargeable batteries replaced the use of one-time batteries. The paper proposes the use of solar charging system that uses inductive coupling to charge the battery of the mobile phones as well as improve its efficiency in the long run. The application improves the usage of mobile phones in terms of "standby time, power consumption, and talk time." The process of inductive coupling is considered as an effective method in charging the devices wirelessly. The paper is a comparative study of the different charging system (i.e.) general wired chargers and wireless charging system using solar energy.

Keywords:*standby time, wireless charging, solar power, power consumption, talk time, inductive coupling.*

INTRODUCTION

Due to increase in the demand of portable electronic equipment, the power consumption has increased drastically which leads to increase in the demand of renewable sources of energy like sunlight, wind, thermal, tidal, etc[1]. Among all the available resources, the use of photovoltaic cells or the solar energy is considered to be most suitable sources of energy. The solar energy generated from the sun is converted into electrical energy by using photovoltaic cells. Further the generated energy is utilized by the electronic devices in order to extend the battery life of the device as well as increase the efficiency of the device[2]. The most common method of of wireless charging that has been adopted worldwide is the method of inductive coupling. The basic components required for wireless charging using inductive coupling includes transceiver (combination of both transmitter and receiver), inductive coils for the process of inductive coupling and other components as per requirement[3]. The charging incorporates the transfer of solar energy through a wireless medium which eliminates the need to carry the chargers and adaptors for charging the mobile device. The paper evaluates the performance of a solar powered charging device (wireless mode) in terms of its standby, talk-time and power consumption[4].

LITERATURE REVIEW

In recent years the consumption of energy has increased in a tremendous amount due to increase in the demand of the existing population as well as advancement in technology. Lot of research work has been carried out which leads to the introduction of advance technologies in the field of wireless charging. In order the meet the demands of power generation researches have considered using renewable energy sources like wind, solar, etc. as the optimum source of energy for numerous application. Due to the availability of ample of solar energy and its cheap harvesting methods, it has been widely used in large applications.

Table 1: Comparative Study of different coupling methods of wireless charging

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Coupling Method	Advantage	Limitation	Charging Efficiency	Application
Inductive	Simple design Low frequency operation Low cost	High power loss Non-directionality	Efficient for shorter distance	Smart phones, RFID applications, smart cards
Magnetic resonance	Maximum energy transfer Free charging arrangement	Less appropriate for portable appliances, restricted charging distance	Comparatively longer distance	Smart appliances, vehicle chargers
Microwave radiation	Widely used for portable application	Low charging, Viewable charging pathway	Longest charging distance	LEDs, sensors, RFID technological applications

The table described herein depicts a comparative study of different coupling methods[5]. The method of inductive coupling described herein is widely used due to simple design as well low frequency cost, which results in the designing of cheaper model but the efficiency is high when short distance transmission of energy is taken into picture[6]. Magnetic resonance coupling provides long distance transmission of power but does not offer the same efficiency when applied on portable devices[7]. Microwave radiation offers the transmission of power over a longer distance as compared to any other device but does not provide high efficiency.
After comparing all the above coupling methods inductive coupling has been considered for wireless charging.

PROPOSED METHODOLGY

The paper focuses on a systematic approach for studying the performance of wireless charging device based on solar energy and evaluate the efficiency of the proposed system based on consumption of power, talk-time and standby time. The comparison of performance is based on charging of devices using solar energy and charging through cables and external sources like power banks[8]–[11].
The system works in the following ways:
The solar panels are installed in the system as per the requirements which contains PV cells. When the light from the sun incidents on the solar panels, the solar panel absorbs the heat from the solar energy through PV cells when exposed for a duration of more than 12 hours. The cells associated produces a power of 1kw and a peak voltage of 12V[12]–[16]. A battery associated with the system stores the power for wireless charging. Further a charge controller circuit is linked to the battery for controlling the flow of charge in the system and acts as an effective safety measure for overcurrent protection. The controlled charge obtained from the system is fed to a portable electronic appliance (mobile phone) with a battery of 1400 milliampere hour.

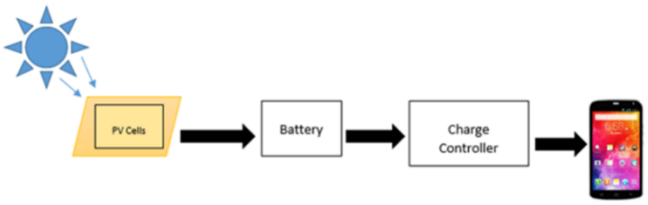

Figure 1: Solar charging Circuit

The above figure is basically used for the transmission of the power using solar energy. The above transmission of solar energy is implemented for the wireless transfer of power using inductive coupling. In the process of inductive coupling, the system consists of a transmitter, induction coils and other equipment. The induction coils thus used consists of primary and secondary coils which are coupled using the principle of mutual inductance[17]–[21].

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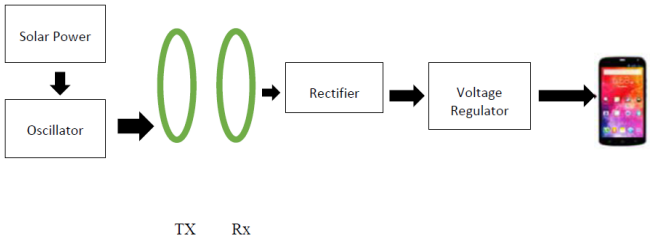


Figure 2: Proposed System for Wireless power transfer

The solar energy derived from the sun (Figure 1) is fed into the oscillator and then to theinduction coils. The first part of the induction coil is known as transmitter coil whichtransmits the AC power converted from the DC power using Oscillator circuit. Thetransmitted high power AC is received by the receiver circuit.

Transmitter: In the transmitter section, n-channel enhancement power MOSFET are used.The section further consists of inductors, resistors and capacitors. The operating frequencycan be calculated as:

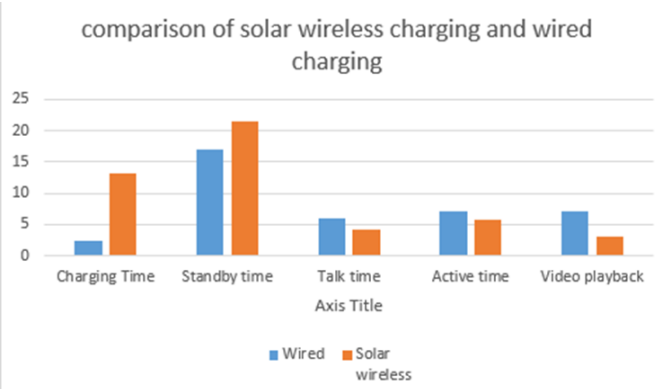
$$F = \frac{1}{2} \times \pi \times \sqrt{(LC)}$$

F- Operating frequency
Π = 3.14
L- Inductance of the coil
C- Capacitance of the coil

Receiver: The receiver section consists of a rectifier circuit and a voltage regulator. Therectifier circuits converts the transmitted AC back into DC voltage. The voltage regulator(LM7805) applied in the circuit provides a controlled voltage output of 5v to the applianceconnected.

RESULTS

The paper focuses on comparing the efficiency of the wireless charging system with the efficiency of the wired charging system. The performance is evaluated on the basis of charging time, standby time, talk-time, playback time, etc.



CONCLUSION

The performance of both the systems were studied and compared with the help of graphs. The efficiency of the systems were compared on the basis of charging time, talk-time, active user time and playback to evaluate the overall efficiency of the user. It has been concluded that the solar based wireless charging offers a greater standby time as compared to wired charging which is considered as an advantage, whereas the wireless charging based on solar power takes a larger duration for charging the appliances and detroit in case of inadequate sunlight. However the system can be widely used in remote areas as it is cheaper and requires simple designing.

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