The Future of Mobile Charging: Wireless Infrared Charger

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Abstract - **Mobile devices have become ubiquitous and the circuits within them have been optimized to consume an extremely low amount of power, such portable electronic sets are in constant use and frequent recharge is required; using contraction wired mechanisms have hindered the mobility of users. Since the days of tesla and since then many theorem and methods has been invented for Wireless transmissions of energy to power up devices. In this paper the infrared based photovoltaic (PV) cell wireless charger is simulated using proteus 8 software to charge multiple devices within specific distance.**

keywords - **Photovoltaic cell, Wireless power Transmission, Power Converters.**

I. INTRODUCTION

The idea of wireless power transfer (WPT) is not exactly new development. The transmission of energy without cords with the intent of charging or supplying power to remote. Electronic devices have been underway. Since the time of tesla. The technology of WPT can eliminate the use of the wire and batteries thus, increasing the mobility. Nowadays, when speaks about wireless charger, you immediately think about inductive coupling as it's implemental in charging mats [5]. Recently WPT technology has been paid attention for the portable electronic device and is necessary to provide fast charging times, high efficient, long range and safety.

WPT based on beam seems promising therefore power can be transmitted by converting electricity into infrared beam and transmit PV cell which convert back
it back to electricity. This mechanism is generally known as power beaming. The power beaming is required to be in of sight for better operation as shown in fig.1 and to avoid interruption for the wireless process. Although infrared beam are to be powerful and need to be safe.

The mobile and portable devices charger are designed by using an optical antenna, GaAs Solar cell with DC-DC converter and the results were compared with the optical wireless energy transfer system[2]. In order to achieve a reliable and high speed wireless IR communication in Life-fidelity (LiFi), the author proposes an omnidirectional transmitter and receiver[3].In [4], the author briefs about available technology to transfer the energy without any cord or wire. The author mainly focused on microwaves- electricity, laser beam to electricity and mutual coupling between two coils. The WPT can be classified into two categories: near field and far field. the Wi-Charges's is one who working on far field energy transfer and they used IR laser technology for constant charging of portable electronic devices[7].

In [8], the authors focuses both on laser based WPT and wireless information transfer (WIT) for 6G communication and suggested a safe resonant beam communication system (RBCom) which can improve the simultaneous wireless information and power transfer(SWIPT). The different WPT for near field transfer and far field transfer is discussed and also spread light on future applications of WPT starting from electronic equipments to electric train[9]. The sigma-delta control technique is used to control WPT to match with load variations for charging IR laser based multi modulators in near-field [10]. The dynamic or moving object charging technique is proposed with optical WPT (OWPT) using light technology under both visible and invisible lights for both ground and aerial vehicles and it is more efficient in charging small electronic devices [11].In the Proposed method an Infrared based photo voltaic (PV) WPT mobile charger is designed to charge multiple devices simultaneously and the simulation studies is carried out using proteus 8 software.

The rest of this paper is organized as follows: section II explains the different WPT technology for charging small electronic devices, the design of proposed technique and its working is discussed in section III. The results are discussed in section IV and conclusion in section V.

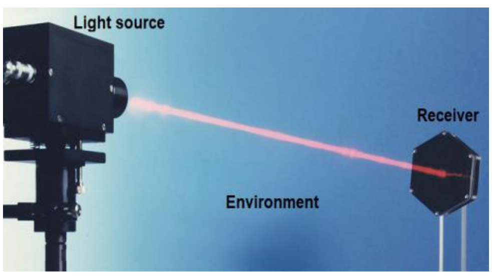

Fig.1 line of sight from source to receiver [12]

II. INFRARED BASED WIRELESS CHARGER

Wireless power transmission [WPT] is the transmission of electric power without power cord or wires. WPT consists of two categories, these categories are done by determining the distance between transmitter and antenna. If the distance of antenna is near to the transmitter then it is called near field WPT. If the transmitter distance is more or far from the antenna then it is called far field WPT. The different technologies are divided as shown in fig 2.

Near field technology consists of two induction and capacitive coil. These coils are invented in early 1890s by Nikola Tesla therefore these coils are called Tesla coils. First coil is called primary coil and other coil called secondary coil. These coils transmit power from one coil to another using principle of transformer i.e. electromagnetic induction, electric power by using spark-excited ratio frequency resonant frequency. Secondary coil will conduct by varying magnetic field and by passing on oscillating current through primary coil. Primary coil which will have an oscillatory current and hence will produce a carrying magnetic flux around it. These coil wound around secondary coil and hence a voltage will be induced in secondary coil. The medium used by this method to deliver power in electromagnetic induction then maximum distance can be no higher than 5cm. This is because loss of magnetic flux increases exponentially with an increase in distance between primary and secondary coil which leads to high power loss.

Far field technologies also called radioactive technology are used for achieving long range wireless applications where distance will be more often multiple kilometer range. Commonly there are two methods used for long range transmission i.e. microwave and lasers. The transmitter are directed towards the receiver with wavelength and diffraction limit is used in radio frequency design which helps to achieve this application safe from electromagnetic radiation hazards and to achieve almost 100% transmission efficiency.

In microwave WPT microwave spectrum of electromagnetic radiation is used as a wireless transmission medium to deliver power to load. In this process the power is taken from outlet and given to krypton or magnetron which converts to microwave and transmitted through antenna. The microwave travels through air without any interruption to reach to receiver. By appropriate convertors and controller the received microwave can convert into electrical energy and given to grid. In laser WPT the transmitter will be light it is pointed towards the receiver will be photovoltaic cell, Once this focused light reaches the solar panel of the receiver module (or load), it converts the light energy into electric power which is the original goal of wireless power transmission setup.

The proposed technique uses infrared rays to charge the mobile without any cord or wire. The system consisting of two circuits, one is the transmitter and other one is the receiver. The basic idea is that transmitter is to convert electrical energy into light and should transmit that over area or zone. The transmitted light is captured by the receiver automatically without plug in and converts that light into electricity to charge the mobile battery. It is based on simple concept of transmitter as sun and the receiver as the solar panels in earth which we use for daily power consumption. By knowing basic knowledge the following shows that how these wireless process works. The process can be explained using the block diagram as shown in the Fig 3.

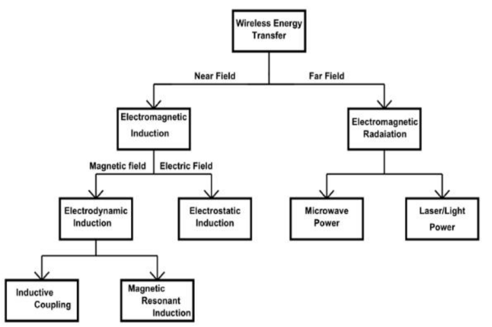

Fig 2 different concepts in wireless transmission

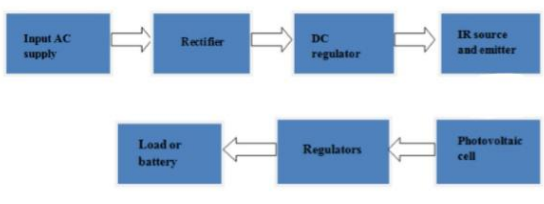

Fig 3. Basic block diagram of Proposed Method

A. Transmission System

The transmission system which is designed is to convert electricity into infrared rays to transmit. The system consisting of 230V AC supply, Transformer, rectifier, DC regulator, and IR-LEDs. The input supply to the system is 230V ac which is stepped down to 24V using a transformer. The stepped down voltage is then converted into DC to obtain 19V using uncontrolled bridge rectifier and the output of the rectifier is regulated to supply constant 12V dc by using 7012 regulator. The IR-LEDs are supplied by the regulator with constant 12V dc. The capacitor filters are placed both at the input and output side regulator to remove the ripple in DC. The number of LEDs to be used can be calculated based on the size of the transmitter and the transmitter is covered with convex lens which can able to cover the given space. The transmitter circuit is designed and simulated in the software proteus 8 shown in Fig.4.

In domestic house or restaurant or hospital normally the voltage will be 230V AC because we use led the 230 V is step downed using transformer. The step downed voltage then converted to DC using bridge rectifiers because the ir led required dc input for emission of ir light. The converted voltage is regulated to 12v using 7012 regulator which gives constant voltage to leds as shown in fig.3 which is simulated circuit in proteus 8 professional. The circuit is done in shape of oval or round in shape. In the circuit there are 100 leds which is constructed in circular shape, the number of leds depends upon the size of the transmitter. Number of ir leds depends on required luminous and that is 1000 lumens (minimum). Due to invisible in nature we can't directly calculate the luminous by any formula, so we use a lux light meter app to calculate it. Until, we get our required lumens, we need to keep adding ir leds to achieve this.

Luminous=candle power*solid angle

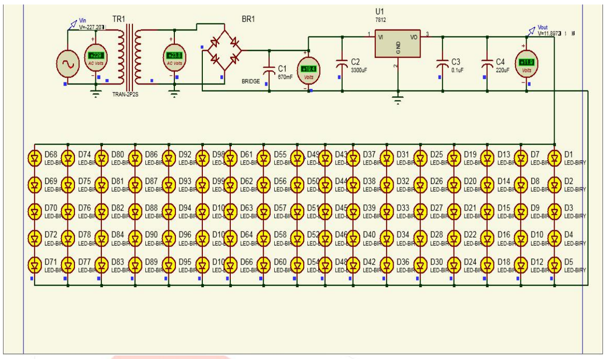

Fig. 4 The simulation circuit transmitter done in proteus8.

B. Receiving System

The receiver will receive the infrared rays and converts that to electricity to charge the mobile battery. The receiver equipped with PV cells, photo diode, DC-DC booster with voltage regulator, and blocking diode. The IR rays which is emitted by IR-LEDs will be received by solar panel there by generates required electricity to charge the mobile battery. Here two 5V solar panel are used which are interconnected in series to obtain 10V. The photo diode is used as switch which is operated by infrared light. DC to DC step up booster can also connect depend upon the requirement. If the output of the solar is not sufficient for the load these can be used to boost required voltage and can vary using POT (manual operation). Mobile battery required constant voltage for continuous charging is supplied by using voltage regulator-7806 which regulates the voltage to 6V. A diode is connected between the regulator and load which used as blocking diode which allows the flow of current from a solar panel to the battery but prevents/blocks the flow of current from battery to solar panel thereby preventing the battery from discharging. The voltage drop at diode is 0.8V so the load battery gets 5V to charge. The circuit of receiver is as shown in Fig 5.

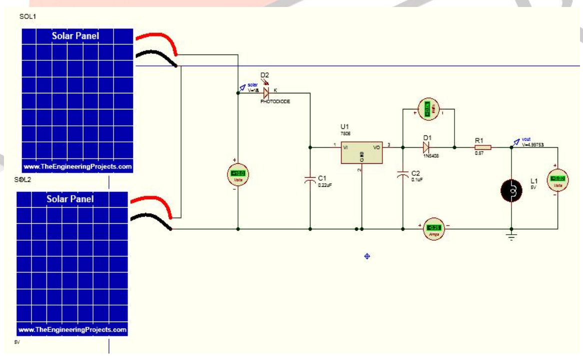

Fig 5. The simulation circuit diagram of receiver.

III. RESULTS AND DISCUSSION

The Infrared wireless charger circuit is designed and simulated using proteus 8 software. The transmitter and receiver circuit are simulated separately. The input for the transmitter circuit is 230V ac and the output of the transmitter circuit is IR-light beam. The input for the transmitter and the output of the regulator i.e., 12V DC is measured using an oscillator and the same is shown in Fig.6.

The solar panel in the receiver can able to generate 5V dc supply since two solar panel are connected in series the output from the solar panel is 10V dc and is shown in Fig 7 (a). The regulator is able to supply constant 5V DC supply continuously to charge the mobile battery which is shown in Fig.7(b).

Infrared technology can deliver watts of power (enough to charge a phone) to a small receiver at room-sized distances and the cost to construct a receiver module is approximately Rs. 200 and transmitter module may cost Rs. 2000.

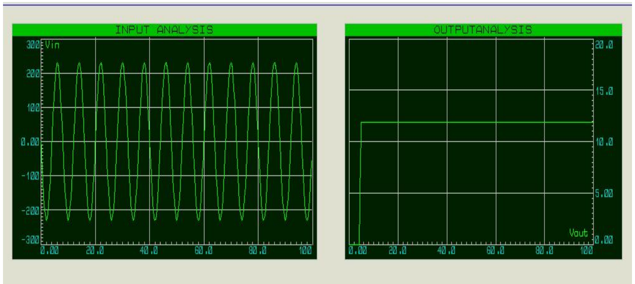

Fig 6 analysis graph of input and output of the transmitter

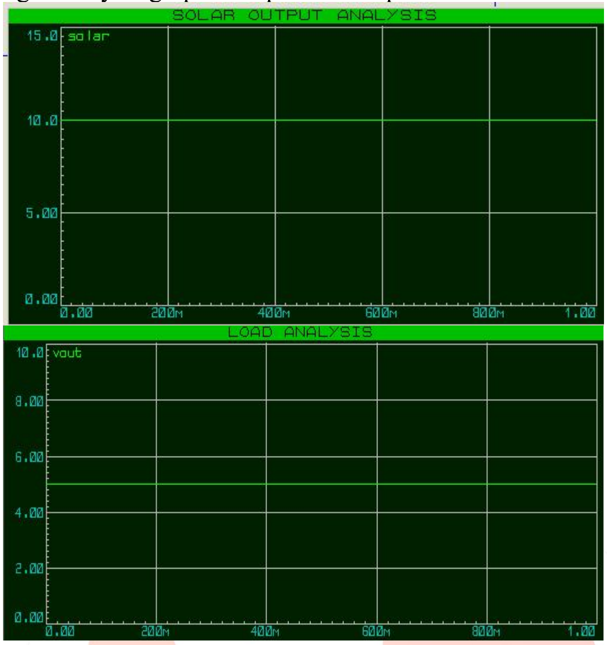

Fig 7(a) solar output and Fig7 (b) load side analysis of receiver circuit

IV. CONCLUSION

As cell phones and communication become more powerful and more widely deployed, the demand for high speed wireless communication is increasing. The wireless charging of electronic portable devices like mobile for a short distance attracting consumers. In this context, the Infrared based wireless charger is a promising technology which gives an opportunity of charging multiple devices using multiple receivers with one transmitter continuously for a specified distance. The proposed technology is able to supply constant 5V dc supply and the approximate cost for each module will be Rs. 2200/- and to charge another mobile extra receiver is required that cost additional Rs. 200/- which is more economical.

In future the receiver can be embedded in a phone case and the same technology can be extended to small electronic portable devices like Bluetooth, radio, etc., the efficiency of the solar panel will increase the efficiency of the receiver

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