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Laser Based Solar Power Transfer for Low Power Applications

[1]Pranjal Chavle, [2]Harshad Gaikwad, [3]Rutuja Kadam, [4]Omkar Kakad, [5]A.V. Sutar

[1,2,3,4]Student, Dept. of Electronics and Telecommunication, Bharati Vidyapeeth College of Engineering, Navi Mumbai, India
pranjalchavle88@gmail.com, ggaikwadharshad@gmail.com, rutuja223kdm@gmail.com, omkarkakad1524@gmail.com
[5]Asst. Prof., Dept. of Electronics and Telecommunication, Bharati Vidyapeeth College of Engineering, Navi Mumbai, India
Email id: avsutar@gmail.com

***Abstract* - We never thought that wireless charging will be a thing in existence but it is now and quite pricey. Since it is the latest innovation, individuals will take time to adapt to this technology. Now more mobiles and companies are adopting this feature so in a few years it will completely replace the standard chargers. we all know how important it is to ensure that the surrounding is neat and clean and separate chargers and cables for each device create a huge mess. But with wireless chargers, you can charge all the devices through these single charges without any cables. Doing so will make your surrounding look clean and hence create a soothing and cosy environment. For wireless charging principle of Laser is used to transfer power between transmitter and receiver wirelessly. We can also very voltage of input side using voltage regulator is used at input side. To use natural resources, we provide power using solar panel and store its energy in battery. To collect more and more voltage at output side we are going to use photodiode. This technology is mainly use to generate high power applications like power transmitters in ruler areas or we can also use this technology in low power applications like mobile charging.**

Keywords: Solar panel, battery, voltage regulator, laser, photodiode.

I. INTRODUCTION

There is a huge difference in people's who are using technology in rural areas verses peoples using technology in metropolitan areas. In big city's people are always relay on technology in there day to day activities. But in rural areas peoples always faced different problems due to lack of technology. Like in rainy season power cuts in different Remote location due to breakdown of power connecting wires. According to our project if we use high intensity laser, we can easily transfer power from base station to receiver station without any tolerance or in any weather condition. Also, now the world is expanding with new technologies, in that we are using rechargeable battery vehicles. So using our project we can also charge this car too. Also, in economic crisis like limitation of energy production, we are generating power using renewable source like solar energy. Although our main intension to transmit power using laser, we are using a smaller number of components as you can see further. So it helps to reduce the cost. Hence, we can easily reach to maximum peoples.

II. RELATED WORK

Solar Energy based Mobile Charger Using Inductive Coupling Transmission. (ICICCS 2020): In this paper they show energy transmission using Inductive coupling. They show that, we can easily transmit electricity using electromagnetic theory by simply using two inductive coils.

Jin, K., & Zhou, W. (2018). *Wireless Laser Power Transmission: A Review of Recent Progress. IEEE Transactions on Power Electronics:* A comprehensive overview of LPT (Laser power transmission) technology is presented from the point of efficiency optimization view in this paper.

Leopold Summerer, Oisin Purcell, ESA - Advanced Concepts Team, Keplerlaan 1, NL-2201AZ Noordwijk: In this paper different concepts and applications of wireless power transmission via laser are discussed, including terrestrial and space-based applications.

III. BLOCK DIAGRAM

This is the block diagram of the proposed model of the project. It consists of Solar Panel as a source of electric current, Battery, Voltage regulator, LASER, photodiode and Digital multimeter.

The Solar Panel takes the energy from the sunlight and provides voltage to the battery. This voltage stored in battery. The battery provides a fixed 9 V voltage through the circuit. Here used a 3-terminal positive voltage regulator LM317 which is capable of supplying different DC voltage outputs to vary the intensity of the LASER.

Then LASER emits a very narrow beam of light radiation towards the photodiode which converts light intensity into an

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electric current. The DMM (Digital Multimeter) is connected to the photodiode to measure the electric values suitable for our receiver.

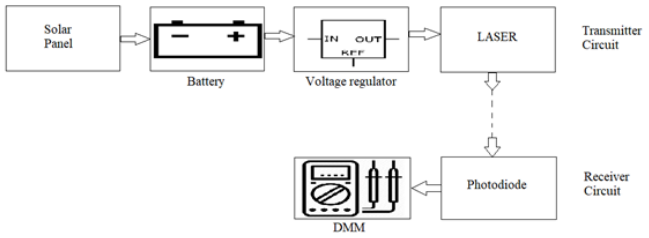

Figure 1: Block Diagram of proposed system

IV. METHODOLOGY

The basic structure of the model consists of a Solar Panel, Battery, and Laser which is at transmitter side, photodiode at receiver side and a receiving device.

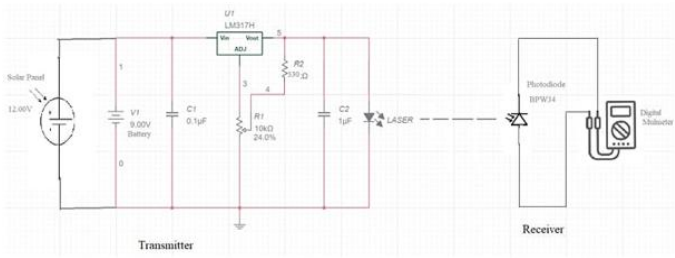

Figure 2: Circuit Diagram of Proposed System

The solar panel is used to avoid the use of non- renewable source i.e.,to save electricity. Solar panels are made up of photovoltaic cells that convert the sun's energy into electrical energy. When a photon or light particle falls on a photovoltaic cell, which consists of electron free from atoms generates a flow of electricity. For storing this electricity, we use solar battery. To make use of renewable energy during non- peak hours solar battery is used. These solar batteries store power from the sun while other conventional batteries stores power from power source electricity. The difference between the solar batteries and conventional batteries is that solar batteries have fast charge and less discharge rate than that of other conventional batteries.

The electricity which is stored in solar batteries is passed to the Laser. Where the main part of project has been done, I.e. it converts the electric signal to optical signal. Laser's basic principle is that it is a device that stimulates atoms or molecules to emit light at a particular wavelength and amplifies that light, typically producing a very narrow beam of radiation. This emission generally covers an extremely limited range of visible, infrared or wavelengths. This laser transmits its light which is then received by photodiode. The photodiode is used to generate the current, when the photons are absorbed by the photodiode current is generated. The current constitutes in the diode are directly proportional to the intensity of light absorb by it. The time response of photodiode is much faster. The device voltages increase slightly with increase in current. As the distance between that transmitter and receiver circuits varies the output voltage also varies. And this output voltage is sufficient for the receiving device.

Circuit Diagram

1) This is the circuit that we have made i.e., transmitter circuit and receiver circuit.
2) At Transmitter side we have following components:
    a) Solar Panel – To avoid use of non-renewable source of energy

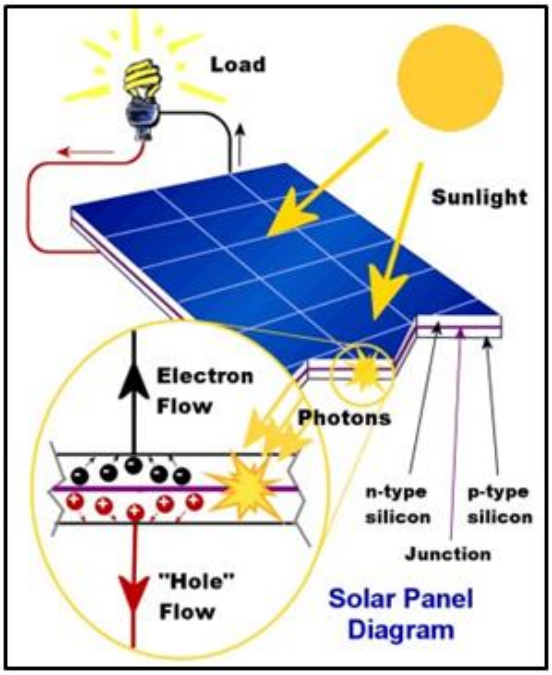

Figure 3: Working of Solar Panel

Figure 4: Typical Solar Panel

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b) Battery – used to store the solar energy

Figure 5: Lead Acid Battery

C) Laser diode-A laser diode is the main device in this project which emits light by process of optical amplification depend on stimulated emission of electromagnetic radiation. It takes input voltage of approximately 2.5v and has wavelength of 650nm and output power of 5mW.

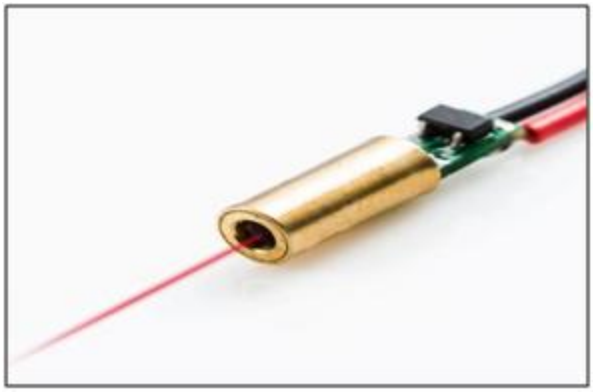

Figure 6: Laser Diode

d) Laser Diode Driver Circuit

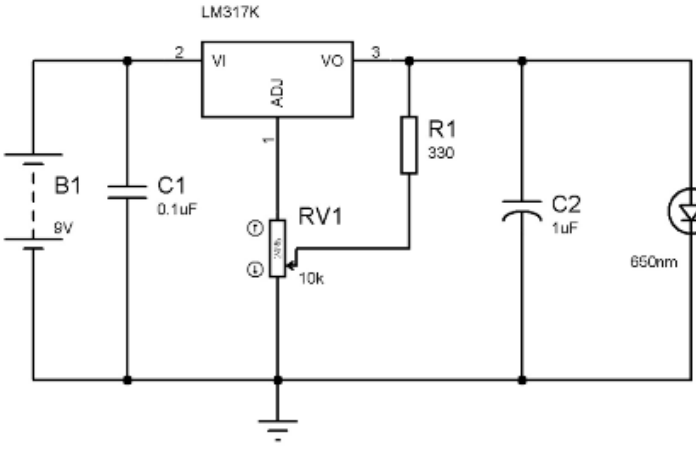

Figure 7: Laser Diode Driver Circuit

a. 330 Ω resistor
It is connected to adjustable pin1 of LM317 IC

b. 10 k potentiometer
A 10k potentiometer is used to adjust the output voltage and change the intensity of the laser.

c. 1µ electrolytic capacitor
Used to filter the output voltage

3) Now at Receiver side we have Photodiode and to calculate Output we have Digital multimeter
   a) Photodiode – (BPW34) this photodiode has large surface area because of which it is highly photosensitive and we get high output voltage of upto 1.5 V on multimeter.

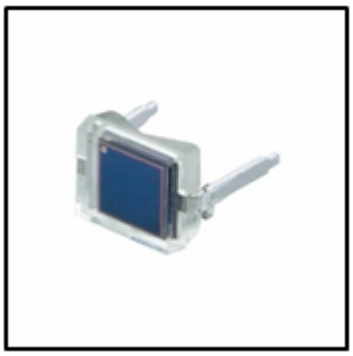

Figure 8: Photo Diode BPW34

4) Laser diode driver circuit is used to limit the current and supplies to laser so it can work properly.
5) It we directly connect laser to supply it will get damaged and in low current it won't operate.
6) Normally for a LED a resistor is enough to limit the current but as we are using laser diode, we need proper circuitry to regulate current.
7) Laser diode driver is made up of following components:
   a) 0.1µF ceramic capacitor
   It is used to filter high frequency noise from the source and it gives input to the IM317 voltage regulator IC
   b) LM317 voltage regulator IC

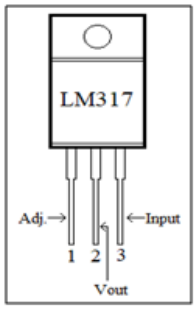

Figure 9: LM317 voltage regulator IC

c) In this project we have made use of LM317 voltage regulator IC as it can give output voltage ranging

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from 1.25v to 37 v. The voltage regulator here helps in current limiting, thermal overload protection and safe operating area protection. Because if its features LM317 is used before lasers to regulate the power in laser diode driver circuit.

PIN NO.	PIN Name	PIN Description
1	Adjust	We can adjust the Vout through this pin, by connecting to resistor divider circuit.
2	Output	Output voltage pin (Vout)
3	Input	Input voltage pin (Vin)

V. RESULT ANALYSIS

The Result of our Project is as follows:

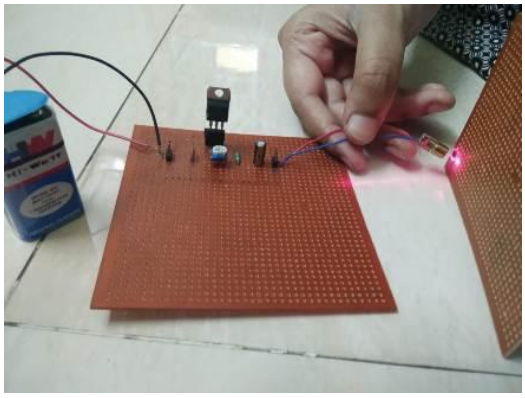

Figure 10: Hardware Prototype of Laser Driver Circuit

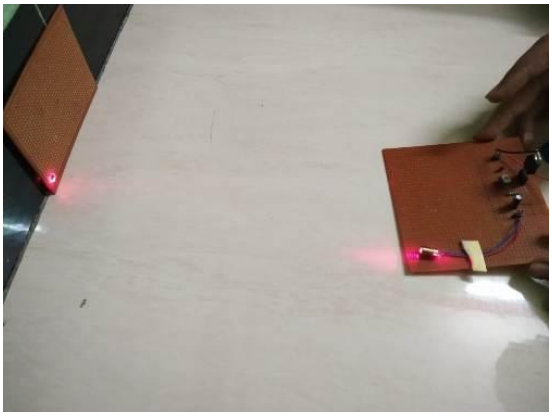

Figure 11: Distance vs Output Voltage Measurement

Distance in Feet	Distance in cm	Output Voltage (V)
1	30	1.52
1’3’’	38	1.356
1’5’’	43	1.286
1’7’’	48	1.11
1’9’’	53	1.09

Our project mainly depends on two factors. First, Distance between laser and photodiode i.e., distance between transmitter and receiver. Basically, Output voltage is Inversely proportional to the distance between them. Moreover, as we increase the distance the voltage decreases. Second factor is Intensity of light .We are using laser instead of any other device because to get unidirectional and high beam intensity light. By using laser diode driver circuit, we can adjust the regulating flow of voltage at input, that means even if we provide 9V battery, laser require only 3-4 V to emit light. So to get required input to the laser and reduce the loss of battery storage efficiency we are using laser diode driver circuit.

Applications

a. We can use this technology to charge mobile using wireless technology.
b. Also we can charge renewable batteries or to run other home appliances which work on electricity.
c. In future we can also use this technology to charge batteries of Electric cars in power stations or in home.
d. Remote locations instead of using long wires to provide electricity we can use this technology from generator to power station.

VI. CONCLUSION

The whole world is adapting new technology in wireless charging. There are lots of experiment has done to get maximum output in wireless medium. Our project is also a part of that experiment. We use renewable source like solar panel, a Laser to transmit high intensity beam and a photodiode which collect maximum light and provide required output. We also try to reduce number of components to reduce the cost.

VII. FUTURE SCOPE

We basically wants to help people who does not get sufficient electricity in there remote areas due to wires breakdown in middle of the places. The idea we are presenting is completely supports wireless technology and hence to provide electricity in remote areas we can use this technology using industrial components and by establishing receiver stations.

ACKNOWLEDGMENT

We are grateful to our respectable guide, Prof. A. V. Sutar sir, whose insightful knowledge benefited us to complete this project successfully. The completion of this project could not have been possible without you sir. Thank you so much for your continuous support and presence whenever needed.

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