iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 Issue: IV Month of publication: April 2024

DOI: https://doi.org/10.22214/ijraset.2024.60321

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

Design and Construct of a Portable Solar Mobile Charger

Aakash Pingale[1], Purvesh Salunkhe[2], Shreyash Phule[3], Sahil Malushte[4], Rohan Bhand[5]
UG Students of Dept of E&TC, Trinity Academy Of Engineering, Pune

Abstract: The state of incessant power failure accompanied with the increase in pump price of petroleum in India, solar energy becomes the most sought after energy source. Solar chargers are simple, portable and ready to use devices which can be used by anyone especially in remote areas. Going solar can solve the problems of dependence on fuels and the prevalent energy crisis. This project aims to make a portable solar charger which can be used on the go. A portable solar mobile phone charger is simply a power electronic device that converts solar radiation into electrical current for the purpose of charging the batteries of mobile phones. This charger is made by converting, controlling and conditioning the flow of electrical energy from source to load according to the requirements. of the load; this technology is called power electronics. An external adjustable voltage regulator is used to obtain the desired constant voltage. A zener diode switches on to ensure charging is cut off at the saturation point. Two 3.7V lithium ion batteries are used as backup; an operational amplifier works here as a comparator to signify when backup is fully charged. Ultimately, 11V and 160mA is supplied by the panel under full sunlight. This charger has an output voltage of 5V and an average of 800mA current to charge a mobile phone, this system charges a phone fully between 4-5hours and it has a capacity of 4800mAh. This device charges all mobile phones by all manufacturers using a universal serial bus connector. It is the only viable solution to charging mobile phones as it is portable, light-weight and does not cause pollution

I. INTRODUCTION

Portable Solar Mobile Phone Charger is a power electronic device that converts the sun's radiation into electrical energy for the purpose of charging the batteries of mobile phones. It does this by converting, controlling and conditioning the flow of electrical energy from source (solar panel) to load (mobile phone) according to the requirements of the load. In a densely populated , country with a population of over 1.44 Billion people in the case of India, it is unarguable that the epileptic state of power supply is an issue of great concern to Indians. Citizens find it very difficult to charge

their phones when they eventually have a flat battery. We are now left with the option of putting on a generating set (Generator) which causes air pollution and depletion of the atmospheric ozone layer (green house effect), generators are also very expensive to operate due to the hike in price of petrol in the country. The option of charging through public charging centre is inconvenient as most times these centre are crowded and employ the use of a generator as well. Theft of mobile phones is prevalent with charging centre and fire outbreaks in many cases due to overload of supplying cables and very unprofessional connections done in order to realize money as quickly as possible.

The aim of this project is to design and construct a portable solar mobile phone charger. In order to achieve this aim, the following objectives were set;

1) To design a portable solar charger.
2) To construct the designed solar mobile phone charger.
3) To evaluate the performance of the designed charger.

Section I of this paper contains the introduction, Section II contains review of related works, section III explains the methodology with flow chart, Section IV describes results and discussion of result and Section V concludes research work with future directions).

II. LITERATURE REVIEW

[At the time of the solar electrical generation we require the constat source voltage to controlling that we need to use voltage controller to control the current. [1]

Wireless power transmission for charging mobile phones.[2]

Wireless power transfer by incorporation of solar energy.[2]

Solar wireless power transfer using inductive coupling for a mobile phone charger.[2]

Design of solar power wireless charger for smartphone.[2]

Transmitting power through a wireless system was invented by Faraday. His research was about current conduction in the wire. If current flows through one wire of a conductor, then another wire near to it will gain some current as well. For this, the second wire has to be placed very near to the current carrying wire. This principle was developed by Tesla who built towers to transmit power through the entire world. But the project was unsuccessful because his sponsor discontinued providing financial support for the transmission. The reason for this was, the experiment results were not satisfactory.[3]

Research had been done in the same field and the proposed device’s efficiency was very high.[4]

Another automatic portable grass cutter machine is proposed in which a solar panel, a charger and a battery are used for power supply.[5]

A wireless remote control system is applied for protection of the linear generator where the electrical power is supplied from a solar panel connected with a battery and a charger.[6]

In most of the cases, a dc motor connected to the photovoltaic array with or without storage is used in solar power-based grass cutters. Although, there are a number of available renewable energy sources, but in Bangladesh, solar energy is very popular because of its geographic location. Use of renewable energy in daily use appliances can lessen the demand in the conventional energy sector and energy conservation system.

III. METHODOLOGY

The method used in realizing this device is in terms of modular design and implementation and carried out in the laboratory in the year 2016. This system consists of units and blocks which make up the entire solar charging device. Figure 1 shows a well simplified block diagram of the systems.

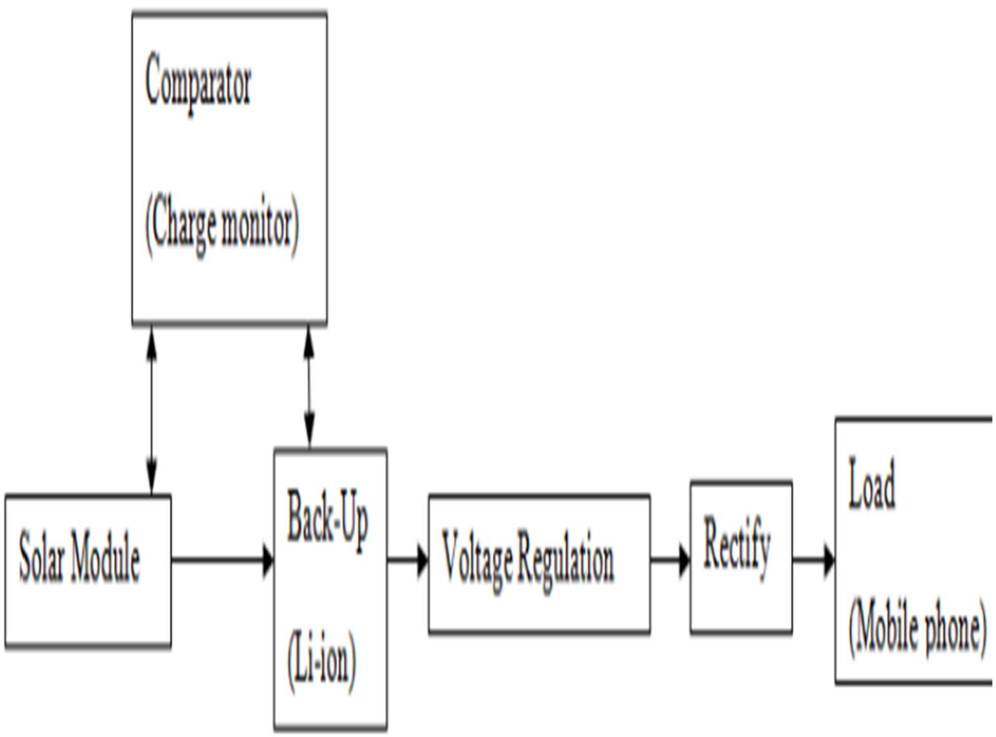


Fig 1. BLOCK DIAGRAM OF SOLAR MOBILE PHONE CHARGER

The power source of this system is solar radiation that is converted into electricity by a solar panel. The supply received from the solar panel’s output is a DC. DC-DC conversion using a power electronic converter called a chopper is used to provide the regulated power to the backup for storage. It is the backup that in turn charges the mobile phone. The backup system consists basically of two lithium ion batteries. Figure 2 shows the Flowchart.

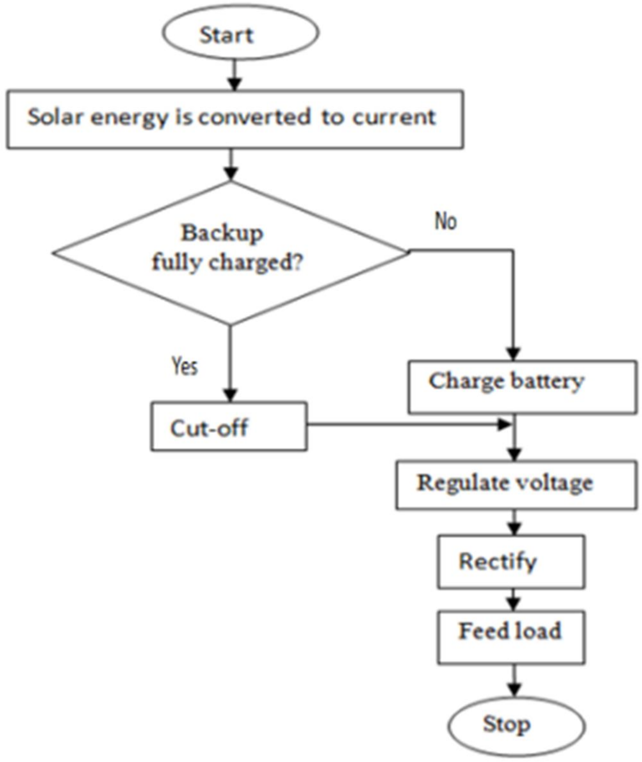
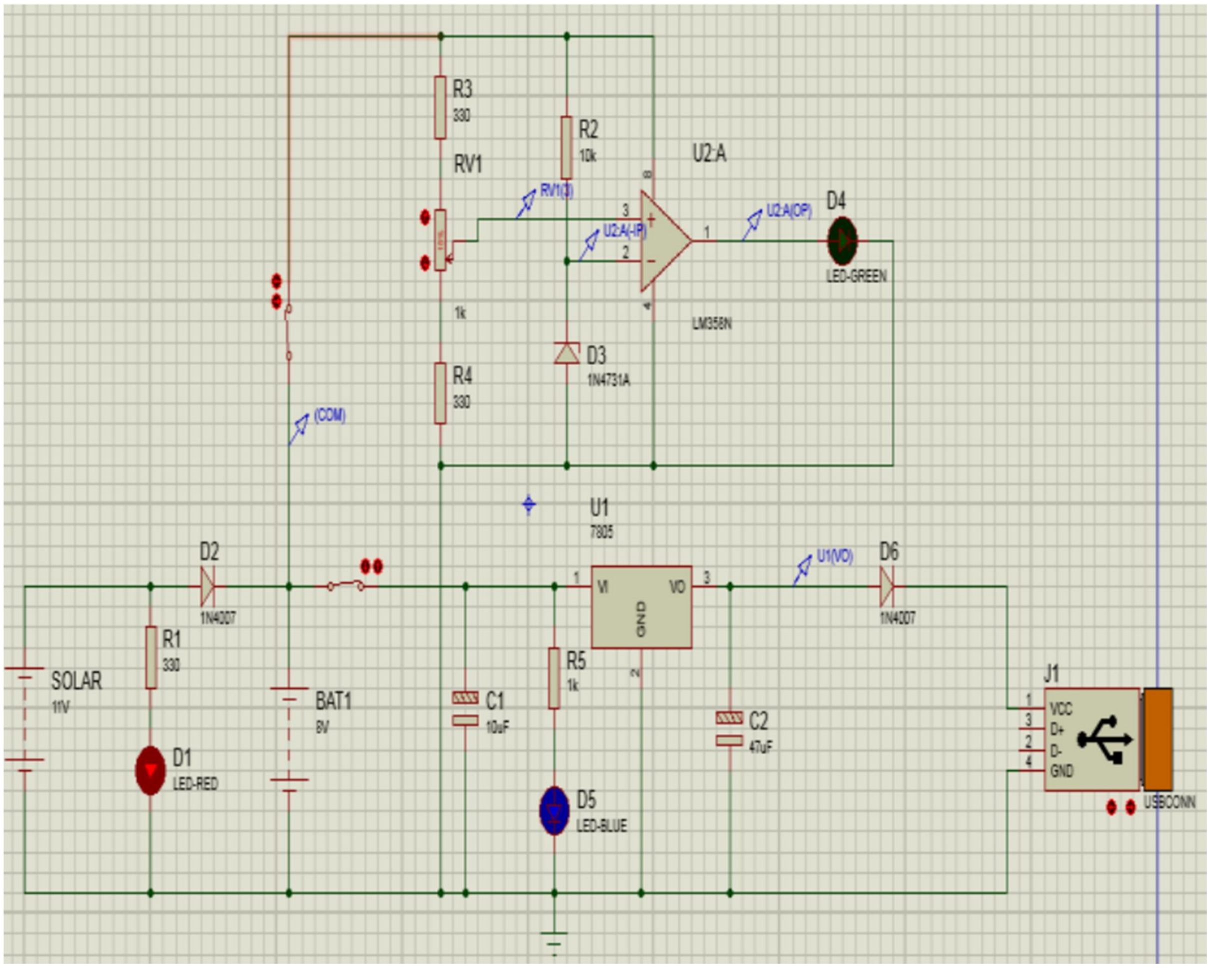


Fig 2: FLOW CHART OF THE SOLAR MIBILE PHONE CHARGER

Connected in series to give 11V operating voltage. A current value of 160mA is obtained and used to charge the back-up Li-ion batteries. For current to flow from source to sink, the source voltage must be higher than the sink voltage. Therefore, 11V at source pushes 160mA current to charge battery rated 8V. D1 is a Red LED that indicates that solar panel is receiving and converting solar energy into electrical energy and charging the back-up. R1 is a small-valued 330Ω fixed resistor that limits current flow to the LED D1. D2 is a blocking diode (1N4007) that ensures current does not flow in the reverse direction to the solar panel in order to avoid damage to the panel. So, D2 ensures flow of current only to the back-up and otherwise is not permitted

1) *Back-Up Module* - The back-up module consists of two 3.7V Lithium-ion batteries connected in series to give a total voltage of 7.4V and 8V when fully charged. As one 3.7V Li-ion battery gets to 4.2V when fully charged. The blocking diode, D2 ensures current delivery to the back-up. The switch on the right hand side is used to deliver power or not to deliver power to the regulator circuit.
2) *Voltage Regulation Unit*- The voltage regulation unit consists basically of U1 (LM7805 voltage regulator) that regulates the voltage from the back-up and gives an output of 5V as shown in fig 3.18. C1 is a 10uF capacitor that filters the output from the back-up before feeding the regulator, R5 is a 1kΩ resistor which limits the current into D5 (a blue LED) used to indicate when load is charging. When mobile phone is charging, D5 is ON. C2 is a 47uF polarised capacitor that further filters the output from the regulator before feeding the load.
3) *Rectification Unit*-This unit consists of a blocking diode 1N4007, D6. D6 is used to ensure current flows in only the direction of back-up to load and not otherwise. This is to ensure the mobile phone's battery does not discharge when back-up battery is LOW. The USB female connector, USBCONN delivers power to the phone for charging.
4) *Comparator Unit*-With respect to the op-amp (LM358) circuit , If VIN > VREF then VOUT = +VCC while when VIN < VREF then VOUT = -VCC. VREF is the voltage of the negative, pin 2 (INVERTING PIN), VIN is the input voltage at the positive, pin 3 (NON-INVERTING PIN) and pin1 is the OUTPUT of the op-amp. The reference voltage is 8V i.e the battery voltage. As the non-inverting (positive) input of the comparator is less than the inverting (negative), output becomes LOW and this implies that the Green LED D4 will be OFF due to negative saturation of the output. As input voltage increases such that VIN goes bove reference voltage VREF (at the inverting pin), the output voltage abruptly changes to HIGH in the direction of the positive supply voltage which is +VCC and this causes the Green LED D4 to be ON due to positive saturation of the operational amplifier's output [22].

These ensure that the Green LED glows when the battery voltage is at 7.99V or 8V (i.e when fully charged) and LED does not glow at less than 7.99V battery voltage. The zener diode D3 (1N4731A) ensures cut-off when saturation is reached as battery voltage tries to go above 8V. This is in order to avoid damage to the electrodes of the battery cell. The system circuit diagram is shown in figure 3.



IV. HARDAWARE COMPONENTS

Overcharge Protection:

1) SOLAR PANEL:-

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

Solar panels, also known as photovoltaic (PV) modules, are devices that convert sunlight into electricity using semiconductor materials. They consist of multiple solar cells interconnected to generate usable electrical energy. When sunlight strikes the solar cells, photons dislodge electrons from their atoms, creating an electric current. This direct current (DC) is then converted into alternating current (AC) using an inverter for use in homes, businesses, and various applications. Solar panels are a sustainable and renewable energy solution, contributing to reduced carbon emissions and energy independence. Their efficiency and reliability continue to improve, driving widespread adoption in both residential and commercial settings.

2) BATTERY:-

Lithium-ion batteries are rechargeable energy storage devices widely used in various applications, from smartphones to electric vehicles. They operate based on lithium ions moving between the positive and negative electrodes during charging and discharging cycles. Their high energy density, lightweight, and long lifespan make them ideal for portable electronics and electric transportation. However, they require protection circuits to prevent overcharging and overheating, which can lead to safety hazards. Despite this, ongoing research aims to enhance their performance, safety, and cost-effectiveness, driving their continued dominance in the energy storage market and facilitating the transition to renewable energy and electrified transportation.

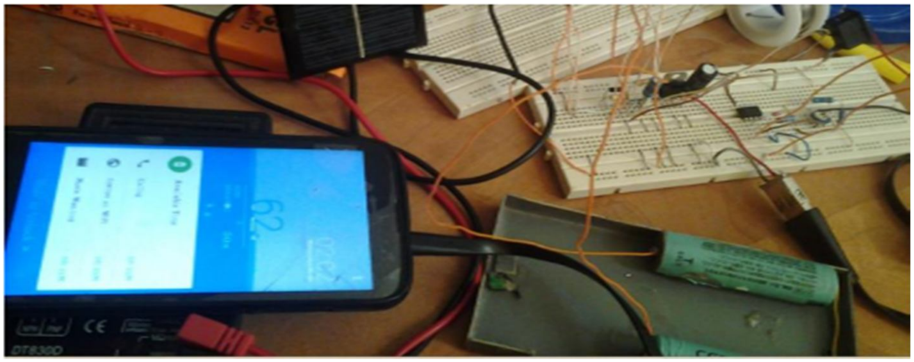
3) CHARGE CONTROLLER:-

A charge controller, also known as a charge regulator, is a crucial component in solar power systems. Its primary function is to regulate the voltage and current from solar panels to ensure proper charging of batteries without overcharging or damaging them. Charge controllers come in two main types: PWM (Pulse Width Modulation) and MPPT (Maximum Power Point Tracking).PWM controllers regulate the charging current by intermittently disconnecting the solar panel from the battery to maintain a preset voltage level. MPPT controllers, on the other hand, continuously track the maximum power point of the solar array and adjust the voltage and current to maximize power output, increasing overall system efficiency.

V. PROJECT WORKING AND RESULT:-

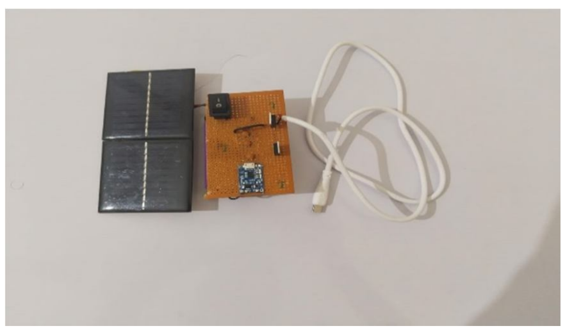
A. Breadboard Test

Components were connected to form the overall circuit on a breadboard as shown in Figure 5 for a more reliable test; this is as a result of the inconsistencies in simulations by Proteus. The output from the solar panels in series: 160mA, 11V. Parameters associated with each small panel used are: operating current; 160mA, floating current; 200mA. Operating voltage; 5.5V. Dimension; 63 by 63mm. Output current through USB female connector to the mobile phone at a load voltage of 3.7V is between 800 – 884mA.



B. Construction Test

After a level of assurance was attained from the preliminary examinations on Proteus and Breadboard, the respective components were soldered to form the device as shown in Figure 6. The Green LED D4 comes ON as soon as the output voltage at pin1 of the Op-Amp was greater than or equal to 2.17242V. Blue LED D5 glows to show delivery to load while the Red LED D1 glows throughout as it indicates the presence of a D.C source as the Solar Panel.



Furthermore, solar chargers offer a sustainable energy solution, reducing reliance on non-renewable energy sources like fossil fuels. By harnessing solar power, users can significantly decrease their carbon footprint and contribute to mitigating climate change. This eco-friendly aspect aligns with the growing global emphasis on adopting clean energy technologies to combat environmental degradation.

However, despite chargers also face some limitations. Their effectiveness depends heavily on sunlight availability and weather conditions, which can affect charging efficiency, particularly in cloudy or rainy climates. Additionally, solar chargers typically require longer charging times compared to traditional plug-in chargers, which may not always be practical for users with urgent power needs.

In conclusion, solar mobile phone chargers represent a promising innovation in the realm of portable power solutions, offering convenience, sustainability, and energy independence to users worldwide. While they may not completely replace conventional charging methods, their ability to harness renewable energy sources and reduce environmental impact makes them a valuable tool in the transition towards a more sustainable future.

REFERENCES

[1] K. Ahmed, J. Paul, M. M. Rahman, A. Shufian, M. S. Tanvir, and M. M. I. Sagor, "Automatically Controlled Energy Conservation System for Corporate Office Based on Microcontroller," 1st Int. Conf. Adv. Sci. Eng. Robot. Technol. 2019, ICASERT 2019, vol. 2019, no. Icasert, pp. 1–6, 2019, doi: 10.1109/ICASERT.2019.8934695.

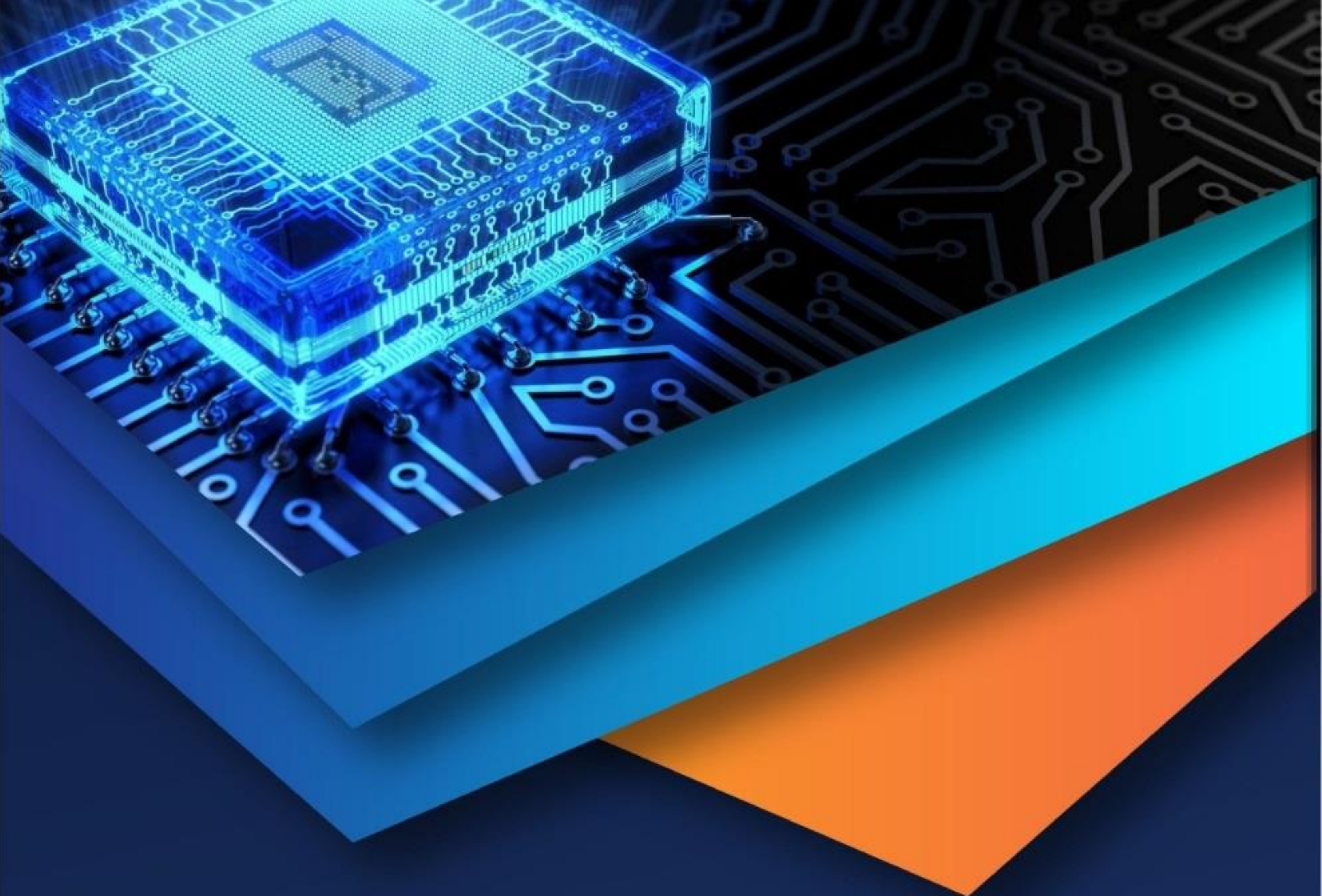
[2] A. V. Sutar, V. Dighe, P. Karavkar, P. Mhatre, and V. Tandel, "Solar Energy based Mobile Charger Using Inductive Coupling Transmission," Proc. Int. Conf. Intell. Comput. Control Syst. ICICCS 2020, no. Iciccs, pp. 995–1000, 2020, doi: 10.1109/ICICCS48265.2020.9120916.

[3] B. Akin, “Solar power charger with universal USB output,” India Int. Conf. Power Electron. IICPE, pp. 0–3, 2012, doi: 10.1109/IICPE.2012.6450447.

[4] D. Freier, R. Ramirez-Iniguez, C. Gamio, T. Jafry, and F. Muhammad-Sukki, “Novel nonimaging solar concentrator for portable solar systems for developing countries,” Proc. - 2017 IEEE PES-IAS PowerAfrica Conf. Harnessing Energy, Inf. Commun. Technol. Afford. Electrif. Africa, PowerAfrica 2017, no. iv, pp. 307–310, 2017, doi: 10.1109/PowerAfrica.2017.7991242.

[5] M. R. Habib et al., “PID Controller Based Automatic Solar PowerDriven Grass Cutting Machine,” 5th Int. Conf. Comput. Commun. Chem. Mater. Electron. Eng. IC4ME2 2019, pp. 1–4, 2019, doi: 10.1109/IC4ME247184.2019.9036513.

[6] O. Farrok, M. R. Habib, M. R. Afefin, and A. Habib, “A new protection system of linear generators used for converting oceanic wave energy into electricity,” 5th IEEE Reg. 10 Humanit. Technol. Conf. 2017, R10-HTC 2017, vol. 2018-January, pp. 755–758, 2018, doi: 10.1109/R10-HTC.2017.8289067.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY