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SOLAR BASED 18-POINT MOBILE CHARGING STATION

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Abstract: Necessity is the mother of invention concept has switched over to pandemics is the reason of various innovation, in last two years we all have realized that physically we may be quarantine but our thought process innovates better and finally leads us to be more independent individually and socially as well. The country has become independent in many aspects including almost complete digitization. Consequently, cell-phones has become more as an integral entity of our daily life. Booking travel tickets, paying utility bills, carrying important documents, health tracking and what not. As an initiative of Digital India, more and more domains of human life are getting digitized. Even Union Finance Budget for the year 2022 (First time in history of India) is also online. Recently, due to pandemic online learning and work from home has further enhanced its requirement. Therefore, use of cell phones for huge data transceiver will make its battery to discharge quickly and need to be recharged quickly and regularly. This research work presents the concept quick mobile charging station based on solar energy which is available free addressing problem of rural and remote areas where regular electric supply is a question and even in urban areas where there is frequent cut in the electric supply.

Index Terms **- Buck converter, solar panels, battery, charge controller**

I. INTRODUCTION

From photosynthesis to photovoltaic, sun is the ultimate source of energy. Directly or indirectly survival of living creatures depends on it. In the pandemic crisis when everything is going online right from education to work there were some remote places for which it was challenging. Due to limited resources of electric supply students were not able to attend their classes and also many other necessary activities got hampered.

Solar energy has been used since time immemorial. In its primitive stage, it was used to dry agriculture products and heat water. Archimedes used the concentrating mirrors to set fire. Years later the photovoltaic effect was discovered and it revolutionized the way we harness solar energy. Concerns regarding climate change and extinction of fossil fuels in nearby future has made us to think on renewable and clean source of energy. India is taking strong initiative in solar project in compliance with International Solar Alliance.

In view of all these strengths and weakness, we designed a portable 18-point mobile charging station based on solar energy.

II. Schematic Design

The idea of the project is to simplify the process by enabling direct utilization of DC voltage. DC voltage generated by solar panels is stored in a battery which can be utilized to charge 18 mobile phones simultaneously via buck converter.

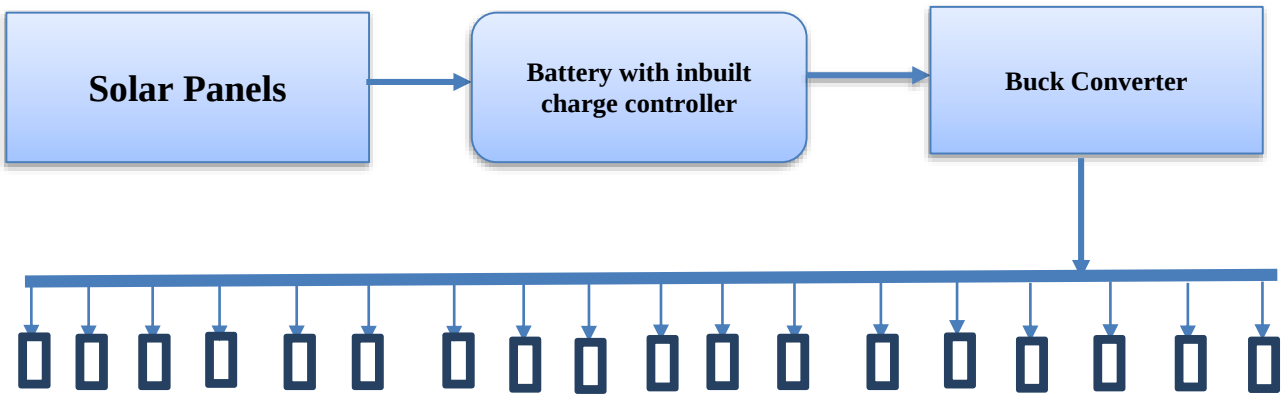


Fig 1: Design of Set up

III. SYSTEM COMPONENTS

1. Solar Panels:

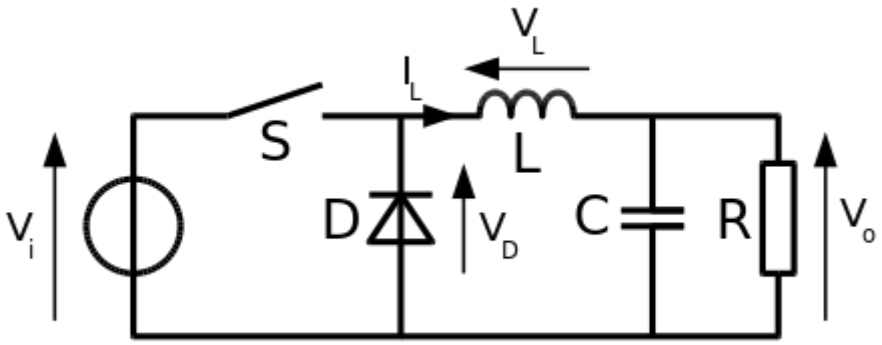
Two solar panels of 12 V 40 W connected in parallel to enhance the current, are mounted on a portable stand and inclined as per orientation based on latitude of the location, so that sunlight falls perpendicular on the panel surface. Monolithic solar panel were used considering its longer life and higher efficiency. Panels are mounted on the stand with wheel to move it easily on the ground along with sufficient space to keep battery. DC voltage generated by the solar panels is used to charge the battery.

2. Battery:

A valve regulated lead-acid (VRLA) battery of 12 V and 26 AH is used. Battery is sealed and is maintenance free which ensures no leakage of electrolyte from terminal and casing along with no repetitive checking for topping throughout its life. With many other features like eco-friendly, low self-discharge, excellent charge retention and recovery it makes it an ideal choice. Solar Panels will provide optimum current (5A) required for charging a battery which requires only 2.6 A of current. Battery will provide regulated 12 V to a buck converter which then is connected to USB.

3. Buck Converter

A buck converter is a DC-to-DC power converter which steps down voltage from its input supply to its output load. It is called a buck converter because the voltage across the inductor "bucks" or opposes the supply voltage. The efficiency of buck converters can be very high, often over 90%, making them useful for tasks such as converting a computer's main supply voltage, which is usually 12 V, down to lower voltages needed by USB.



Beginning with the switch open (off-state), the current in the circuit is zero. When the switch is first closed (on-state), the current will begin to increase and the inductor will produce an opposing voltage across its terminals in response to the changing current. This voltage drop counteracts the voltage of the source and therefore reduces the net voltage across the load. Over time, the rate of change of current decreases and the voltage across the inductor also then decreases, increasing the voltage at the load. During this time, the inductor stores energy in the form of a magnetic field

If the switch is opened while the current is still changing, then there will always be a voltage drop across the inductor, so the net voltage at the load will always be less than the input voltage source. When the switch is opened again (off-state), the voltage source will be removed from the circuit and the current will decrease. The decreasing current will produce a voltage drop across the inductor (opposite to the drop at on-state) and now the inductor becomes a current source. The stored energy in the inductor's magnetic field supports the current flow through the load. This current, flowing while the input voltage source is disconnected, when appended to the current flowing during on-state, totals to current greater than the average input current (being zero during off-state).

The "increase" in average current makes up for the reduction in voltage, and ideally preserves the power provided to the load. During the off-state, the inductor is discharging its stored energy into the rest of the circuit. If the switch is closed again before the inductor fully discharges (on-state), the voltage at the load will always be greater than zero

Expression for the output voltage in terms of duty cycle D in terms of buck converter is

$$V_o = DV_i$$

4. The USB:

USB short for universal serial bus is interface that allows a connection between buck converter and mobile charging. USB connectors come in different shapes and sizes. Most of the USB connectors, including the standard USB, Mini-USB, and Micro-USB, have two or more variations of connectors.

IV. OBSERVATION

With this setup, we generate DC which can directly be used to charge the devices that require DC voltage. Due to the photovoltaic effect, DC voltage is generated. Each cell of the solar panel generates around 0.5 Volts of DC while the entire Solar panel generates 12 Volts. Generated DC voltage is now stored in a 26 Ah battery which after appropriate processing is ready to be utilize for charging up to 18 mobile phones simultaneously. Different USB connectors ensure phone of any type and brand can be charged. As a prototype we have shown four mobile phone charging simultaneously.

Image showing 4 mobile phone charging

V. Scaling Up of the IDEA:

The idea of this project can be utilized for various commercial applications

1. Sophisticated public charging stations can be manufactured with the facility to pay-per-use. Since no electricity is needed as input for the station to function, the operation cost is minimal providing good profits.
2. Standalone units can be manufactured to be used in commercial spaces that provide free charging points to the employees.
3. Electric Vehicles (EV) are set to be launched in India. The solar panels, batteries in this project can be upgraded appropriately and mobile phones can be replaced by Electric Vehicles. This would make an efficient, multiple point EV charging station.
4. Electric vehicles can be replaced by a grid of shops. All the electricity requirements of such shops can be fulfilled using such a setup.

There is an immense scope for applications on a large scale by calculating power requirement and using appropriate setup of solar panels and batteries.

VI. Social Benefits:

Using renewable energy through such projects have social benefits along with commercial applications thus resulting in overall development of a society enhancing the quality of life

1. Addressing the digital divide: At a time when online education has become part of life, a large number of students face technical constraints like electricity failure, irregular power cuts. While some areas due to remote locations have no access to electricity at all. Here solar charger can be used to provide digital access to students.
2. Empowering the rural population: The mobile grid can be modified to a computer grid to provide greater access to the rural population to markets and other information.
3. Sustainable development: The project is an ideal model that demonstrates sustainable development. It promotes the latest technology while producing zero carbon emissions.

VII. Conclusion:

Renewable and clean source of energy is an emerging disruptive technological area that has the potential to stimulate economic growth, inspire innovation, increase research and development opportunities, create jobs and simultaneously advance environmental sustainability. Besides utilizing a clean source of energy, the project emphasizes Direct Current or DC technology. DC is inherently compatible with renewable sources of energy making it an ideal choice while manufacturing clean energy sources. Therefore, irrefutably DC is the future of electricity. To conclude, ideas such as the 'Solar based 18-point mobile charger' will be instrumental in our bid to attain highest levels of environment friendly technologies.

VIII. Acknowledgements:

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