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Solar Charge Controller with Battery Management at Remote Areas

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ABSTRACT:The aim of this project is to design and construct a solar charge controller, using mostly discrete components. The charge controller varies its output to a step of 12V; for a battery of 20 to 30 Amp rating. The design consists of four stages which include current booster, battery level indicator, battery charge controller and power supply unit. The designed system is very functional, durable, economical, and realisable using locally sourced and affordable components. This work is a prototype of a commercial solar charge controller with protection systems that will prevent damages to the battery associated with unregulated charging and discharging mechanisms. Remote areas, hilly regions, strategic location, border areas (army deployment), Islands etc. generation of power is scanty if not nil. In these situations solar system Battery Charging Unit would be of great help to provide power supply to battery chargers or battery operated gadgets like mobile phone, communication devices, radio, lamp, fan, TV etc.

KEYWORDS:Solar, battery, economical

I. INTRODUCTION

A solar charge controller is a voltage and current regulator that prevents a battery bank from overcharging due to solar arrays. The voltage and current coming from the solar panel is being regulated before going to the batteries by ensuring that a deep cycle battery does not overcharge during the day. Furthermore, no power gets back to the panels that will drain the battery during the night when there is no sun energy to charge up the solar panel. There are several charge regulators that have additional capabilities such as load control and lighting. Solar Energy plays vital role for development in all sectors. With depletion of fossil fuels used for power generation and increase in demand for power, the gap between supply and demand is becoming more. Renewable energy sources can only provide solution to face this energy crisis. Out of renewable energy options, solar energy is the most potential source for all tropical countries. Sun radiates 180 billion MW of energy over Earth Just one hour of this energy could meet power needs of entire planet for a year. India receives 5000 Trillion KW hrs. of energy from SUN per annum. This energy is clean, pollution free and inexhaustible and is available free and in abundance. MNRE, Government of India is promoting utilization of the solar energy for different applications since 1980's. Basically the components involved in solar system are Solar panel, DC-DC Converter, Battery, Load or Inverter. Voltage regulator stabilizer and charging controller are also involved. The Same components are present in our system with some additional accessories to improve the overall performance of the system. A solar charge controller is fundamentally a voltage or current controller to charge the battery and keep electric cells from overcharging. It directs the voltage and current hailing from the solar panels setting off to the electric cell. Generally, 12V boards/panels put out in the ballpark of 16 to 20V, so if there is no regulation the electric cells will damage from overcharging. Generally, electric storage devices require around 14 to 14.5V to get completely charged. The solar charge controllers are available in all features, costs, and sizes. The range of charge controllers is from 4.5A and up to 60 to 80A.

II. LITERATURE REVIEW

The voltage and current coming from the solar panel is being regulated before going to the batteries by ensuring that a deep cycle battery does not overcharge during the day. Furthermore, no power gets back to the panels that will drain the battery during the night when there is no sun energy to charge up the solar panel. There are several charge regulators that have additional capabilities such as load control and lighting. Energy is the key influencing factor for development in all sectors i.e., Industrial, Commercial, Agriculture, Domestic etc. as per capita energy consumption is one of the indicators of national development status. per capita energy consumption is about 600 units in our country,



where as it is 1400 units in China, 6898 units in Germany, 13,000 units in U.S.A. World average is about 2430 units. The fast diminishing world reserves of fossil fuels, increasing demands for energy, particularly in developing countries, and the damage to the environment caused by the consumption of large quantities of fossil fuels in the preceding century have encouraged intensified search for renewable and environment friendly sources of energy. The use of renewable energy resources involves the tapping of natural flows of energy in the environment. If the resource is used in a sustainable fashion, the energy is removed at a rate comparable to that at which energy is being replenished. Renewable energy is thus inexhaustible as opposed to conventional sources of energy, which has a limited lifespan. The use of conventional sources of energy such as fossil fuels has many adverse side effects. Their combustion products produce pollution, acid rain and global warming which are currently major global concerns. Conversion to clean energy sources can improve the quality of life throughout the planet earth, not only for humans, but for its flora and fauna as well. Consequently, the use of renewable energy can contribute to environmental protection not only for the present generation but for future generations as well. Because of the foregoing, there is a need to develop ingenious methods of renewable energy conversion systems and then to substitute it where applications of fossil fuels are most vulnerable. With renewable energy technologies, a secure and diverse supply of energy can be secured and resources can be restored. Additionally, renewable energy is widely distributed and is available and indigenous to almost every region of the world. Currently, the worldwide renewable percentage contribution is about 18%. By the year 2020, the World energy Council predicts that the contribution from renewable will rise to 30% and that biomass will continue to be the dominate source of renewable energy.

III. PROBLEM ANALYSIS, OBJECTIVE AND METHODOLOGY

Problem Analysis: India is blessed with a huge potential for solar energy. On an average, India receives 200 MW/km square of solar radiation per day. With almost 60 per cent of the population residing in the rural region, the solar industry has a massive market to explore. Much of rural India still lacks a regular electricity supply. As a result, dependency on conventional energy sources such as kerosene and coal is high in the remote region. Thus, the adoption of solar power in remote areas can not only reduce the use of fossil fuels but also result in the generation of clean and cheap energy. Further, there are many social and economic benefits linked to solar installations in rural areas. Solar panels in remote areas can be a source of revenue as well. Solar projects can be a valuable means of income generation especially because the land is a vital component for such projects. Some solar developer lease barren lands that otherwise hadn't been of any use. In this way, the rural communities are getting a stream of cash flow without any cost if investment. Further, such projects can also create jobs during as well as post-development phases in operation and maintenance areas. Opportunities for local workers and electricians are often hired during the development phases of solar projects. Moreover, solar projects may also create opportunities after the development phase such as for maintenance of the projects. Some of the common job roles in the post-development phase include cleaners, security personnel, gardeners, technicians and operators. As well. Solar projects can be a valuable means of income generation especially because the land is a vital component for such projects. Some solar developer lease barren lands that otherwise hadn't been of any use. In this way, the rural communities are getting a stream of cash flow without any cost if investment. Further, such projects can also create jobs during as well as post-development phases in operation and maintenance areas. Opportunities for local workers and electricians are often hired during the development phases of solar projects. Moreover, solar projects may also create opportunities after the development phase such as for maintenance of the projects. Some of the common job roles in the post-development phase include cleaners, security personnel, gardeners, technicians and operators. Skill Development Opportunities Large solar projects often require men and women for everyday operations and maintenance work. Usually, firms hire unskilled or semi-skilled labourers from the nearby villages. Usually, labours in rural regions depend on manual work and often lack modern skill sets. Solar projects can help drive new skill development and enable the labours to aim for higher income. Further, these projects also create various temporary employment opportunities. Solar power in rural India can also power other sectors in the community such as agriculture, pottery, weaving and carpentry. People can also seek employment and improve their skill sets in these sectors. Due to such projects, the economic health of the villages is growing. Due to the above advantages, the use of solar energy in village's areas is experiencing a gradual surge. However, the road is long and challenging. The major hindrance is the lack of communication and awareness among the rural population. Technology will play a major role in this. Once the benefits of solar energy get communicated to rural India, the rest will be a matter of time.

Objective: Any project at its starting stage starts with setting of objectives followed by the ideas compared to get the best method to achieve the objective. Similarly for this project a lot of good ideas resulted in the model of solar system charging controller. A solar charge controller is a voltage and current regulator that prevents a battery bank from



overcharging due to solar arrays. The voltage and current coming from the solar panel is being regulated before going to the batteries by ensuring that a deep cycle battery does not overcharge during the day.

- To develop solar system charging controller of electricity in the remote, hilly areas.
- The measure objective is to generate electricity from solar panel through installation of solar panel on the roof houses in remote areas.

Methodology:The energy created by the solar charge controller can be stored in various types of lead-acid batteries. Energy stored in battery form can act as a supplemental energy source for battery banks that may already be used for wind, hydro and photovoltaic systems. Also, energy that is stored within the lead-acid battery can be utilized as DC current for use in DC appliances such as those found in automotive mobile homes. If Alternating Current (AC) appliances are in place then an inverter must be used to transfer the 12 volts of DC current into the standard 110 volts of AC current for usage by these appliances → Solar power integration → Solar energy, radiant light and heat from the sun, has been harnessed by humans since ancient times using a range of ever-evolving technologies. Solar radiation, along with secondary solar-powered resources such as wind and wave power, hydroelectricity and biomass, account for most of the available renewable energy on earth. Only a minuscule fraction of the available solar energy is used. Solar powered electrical generation relies on heat engines and photovoltaic. Solar energy's uses are limited only by human ingenuity. A partial list of solar applications includes space heating and cooling through solar architecture, potable water via distillation and disinfection, day lighting, solar hot water, solar cooking, and high temperature process heat for industrial purposes. To harvest the solar energy, the most common way is to use solar panels.

IV. CONSTRUCTION AND MANUFACTURING

The basic configuration of a solar charging controller consists of solar panel where solar panel releases energy to charging controller. In charging controllers there is voltage stabilizer are used to stable the voltage upto 12V and Dc to Dc convertor are also used. The battery is also there to store the energy/electricity. After that we can connect the DC load or also Inverter.

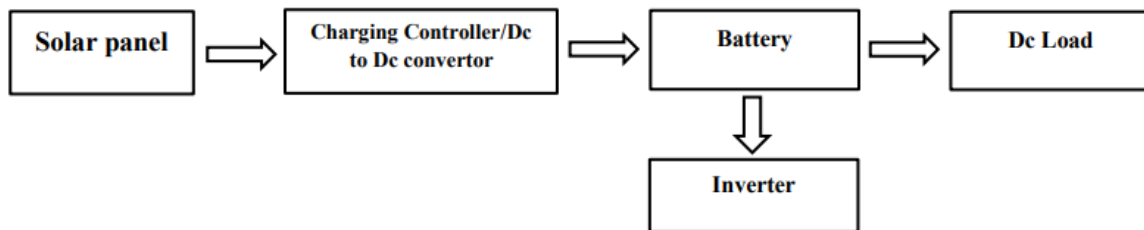


Figure 1: Basic diagram

- Solar panel: When the sun shines onto a solar panel, energy from the sunlight is absorbed by the PV cells in the panel. This energy creates electrical charges that move in response to an internal electrical field in the cell, causing electricity to flow. Solar panels, sometimes also called photovoltaic collect energy from the Sun in the form of sunlight and convert it into electricity that can be used to power homes or businesses. These panels can be used to supplement a building's electricity or provide power at remote locations.
- Dc to Dc converter: A DC-to-DC converter is an electronic circuit or electromechanical device that converts a source of direct current (DC) from one voltage level to another. It is a type of electric power converter. Power levels range from very low (small batteries) to very high
- Voltage Regulator Stabilizer: A voltage stabilizer is an electrical device that delivers a constant voltage to a load at its output terminals, regardless of the changes in the input or incoming supply voltage. It protects equipment or machinery against over voltage, under voltage, and other voltage surges.
- Controller: A solar charge controller is used to keep the battery from overcharging by regulating the voltage and current coming from the solar panel to the battery. A solar charge controller is fundamentally a voltage or current controller to charge the battery and keep electric cells from overcharging. It directs the voltage and current hailing from the solar panels setting off to the electric cell.



- Battery: A battery is a device that stores chemical energy and converts it to electrical energy. The chemical reactions in a battery involve the flow of electrons from one material (electrode) to another, through an external circuit

V. ADVANTAGES, LIMITATIONS AND APPLICATIONS

Advantages

- Free energy Source
- We Can Generate Electricity at hilly areas
- Limited maintenance required
- Economical
- Less Installation Cost
- Eco-friendly
- Solar panel free utilization of energy can be done

Disadvantages

They do not provide you with much flexibility for system growth. Moreover, the voltage of the battery bank must be matched to the nominal voltage of the solar array.

Applications:

- Solar charge controller can be used to charge the battery which may be a great opportunity of people of remote area to use electric light with less cost.
- It can be a great source of light during night time and save a great amount of electricity
- Quick response for remote and disaster area.
- Easily to operated.
- Battery charging.
- We can use as inverter in home.

VI. CONCLUSION

Solar system charge controller is really helpful at remote and hilly areas. Some of the merit solar system charge controller is Low maintenance cost, Long life, User friendly Economical etc.

Some of the disadvantages: In rainy season they do not produce energy as much as they produce in all other season. It cannot optimize for voltage differences and there is no load optimization

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