Generation of Single Phase Energy from Inverter from Solar Tree

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Abstract: *The solar tree is an innovative way to harness solar energy by installing solar panels on a tree-like structure. The energy generated from the solar panels is converted into usable electricity through an inverter. This paper focuses on the generation of single-phase energy from the solar tree with the assistance of charge controller and inverter. The solar tree consists of multiple branches, each with several solar panels installed on them. The solar panels are connected to a central inverter that converts the DC energy generated by the panels into usable AC energy. The inverter is also designed in this paper is used to regulate the output voltage and frequency to ensure that the electricity produced is stable and usable.*

Keywords: Solar Tree, Portable Computers, inverter.

I. INTRODUCTION

The generation of single-phase energy from an inverter through a solar tree is a renewable energy system that uses solar panels to convert sunlight into electrical energy. A solar tree is a structure that consists of a tall pole with branches, each of which has solar panels attached to it. The solar panels capture the energy from the sun and convert it into direct current (DC) electricity.

The DC electricity generated by the solar panels is then fed into an inverter, which converts it into alternating current (AC) electricity that can be used to power homes and businesses. The inverter also regulates the voltage and frequency of the electricity to ensure that it is safe and reliable for use.

The single-phase energy generated by the inverter can be used to power a variety of electrical devices, such as lights, appliances, and electronic equipment. The solar tree can be installed in a variety of locations, such as parks, schools, and residential neighbourhoods, to provide clean and renewable energy to the surrounding community.

Overall, the generation of single-phase energy from an inverter through a solar tree is a sustainable and environmentally friendly way to generate electricity, reducing our dependence on fossil fuels and helping to mitigate the effects of climate change.

II. METHODOLOGY

In a tall pole, the panels are organized like a tree. TREE represent T= Tree Generating, R=Renewable, E=Energy and E=Electricity. Solar Power is like a tree in structure and the panels are like leaves of the tree which produces energy. To generate single-phase energy from an inverter through a solar tree, the following methodology can be followed:

Design the Solar Tree: A solar tree is designed to convert solar energy into electrical energy. The tree comprises a pole, branches, and leaves, which are the solar panels. The design should take into account the number of panels needed to generate the desired power output. To generate single-phase energy from an inverter through a solar tree, the following methodology can be followed:

- **Design the Solar Tree:** A solar tree is designed to convert solar energy into electrical energy. The tree comprises a pole, branches, and leaves, which are the solar panels. The design should take into account the number of panels needed to generate the desired power output.

- **Selection of Inverter:** The next step is to select an inverter that is compatible with the solar tree's design and has the capacity to convert the DC power output from the solar panels into AC power that can be used by households and commercial establishments.
- **Solar Panel Installation:** The solar panels are installed on the branches of the solar tree, and their connections are made in series or parallel configuration to generate the desired voltage and current.
- **Inverter Installation:** The inverter is installed near the solar tree, and the DC input from the solar panels is connected to the inverter. The inverter should be rated to handle the total power output from the solar panels.
- **Electrical Wiring:** The electrical wiring is done to connect the inverter output to the load, which can be a household or a commercial establishment. The wiring should be done according to the local electrical code.
- **Commissioning:** Once the solar tree and the inverter are installed, the system is commissioned. The inverter is switched on, and the power output sis monitored to ensure that it meets the desired specifications. Any issues that arise during the commissioning process are addressed.
- **Maintenance:** The solar tree and the inverter need regular maintenance to ensure that they function optimally. The solar panels need to be cleaned periodically, and any faults in the inverter need to be repaired promptly.

By following these steps, single-phase energy can be generated from an inverter through a solar tree. This method of generating electricity is sustainable and eco-friendly and can help reduce dependence on fossil fuels.

III. BLOCK DIAGRAM

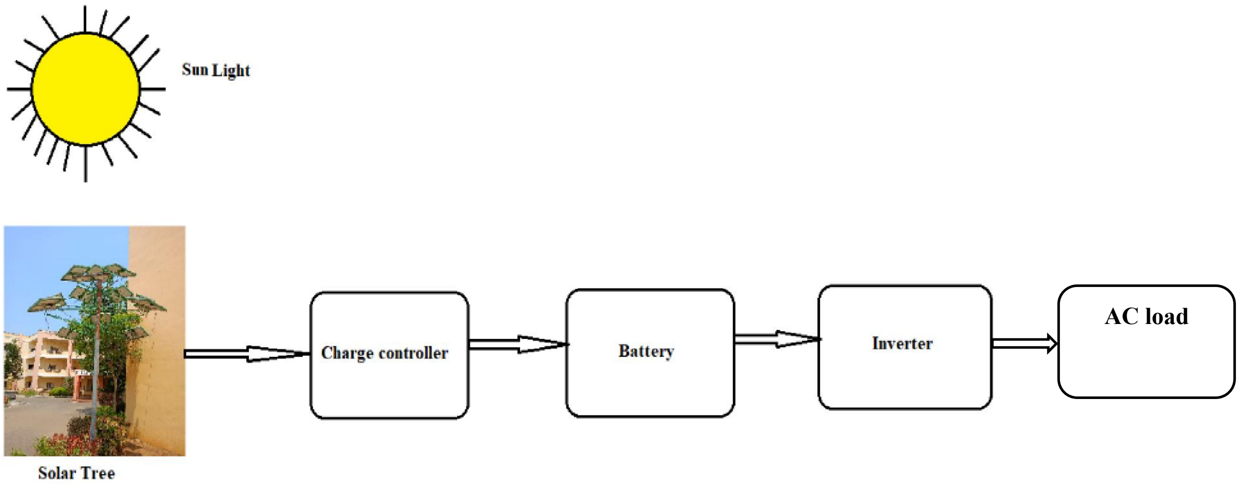

Figure 1: Block diagram of solar tree connected with single phase inverter

While designing a SOLAR TREE the factors must be taken into consideration. They are,

1. **Solar Tree with PV panels:** photovoltaic panel is a power generating unit and it was contain number of photovoltaic modules and panels. These photovoltaic cells[1] are collects the solar energy from the sunlight and covert into the direct current.
2. **Charging Control:** In addition to discharging, the Solar tree should also keep an eye on the charging process. When batteries are charged unsuitably, they frequently suffer damage or have a rapider lifespan. A two-stage charger is used for lithium batteries. Constant Current (CC) refers to the first phase of charging the battery, when the charger transports a steady current. Another phase, known as the Steady Voltage (SV) phase, isworking when the battery is almost full. During this stage, a steady voltage is given to the power unit at very low current[6].
3. **Battery:** Battery is a device that stores a chemical energy and that convert into electric energy. In a solar tree the working of battery was that can be store a electricity that you can use when your solar panels aren't generating sufficient energy.
4. **Inverter:** Inverter was the most important equipment in a solar tree system it can be convert the direct current (DC) generate by solar array to alternate current(AC).

This conversion is achieved through the use of electronic components such as transistors, capacitors, and diodes.

IV. SPECIFICATION OF THE APPRATUS

The specifications of the predominant apparatus of the proposed work are illustrated in the below table 1

Table 1: Specifications of panels of solar tree, Charge controller, Battery, and Inverter:

PANELS RATINGS	
Maximum power (P_{max}) Maximum power voltage (V_{mp}) Maximum power current (I_{mp}) Short circuit current (I_{sc}) Open circuit voltage(V_{oc})	40*13=520W 19.25V 2.08A 2.22A 22.5V
CHARGE CONTROLLER RATINGS	
Type Battery Type Charge current Discharge current Weight	PWM solar charge controller, 30A, 12V/24V DC 12V/24V Lead-Acid 20A 20A 165g
BATTERY RATINGS	
Capacity Battery type Voltage Nominal filled weight Layout	150Ah Tubular Battery 12V 59Kg Left layout
INVERTER RATINGS	
Input	Output
Voltage (V): 110-250	V/VA/W/I: 110V-180V/500VA400W/4.8A 200-250V/675VA/480W/3.4A
Current (A): 4.8	
Frequency (Hz): 50 +/-5	Frequency (Hz): 50 +/-5
Supply: single phase	Supply: single phase

V. FUNCTIONING OF PROPOSED METHODOLOGY

Solar PV modules will be static through the tall pole having a pattern of spiraling phyllotaxy with the modification of load distribution over the pillar for its balancing. At the same time the pattern is adjusted that the top panels would not delay the bottom panel from getting the maximum sun light in a day time[3]. The panels will be facing towards the sun at an angle as mandatory so that they can get maximum solar energy for entire day. The block diagram representation of a 13 panel solar tree is given in Fig. 2.

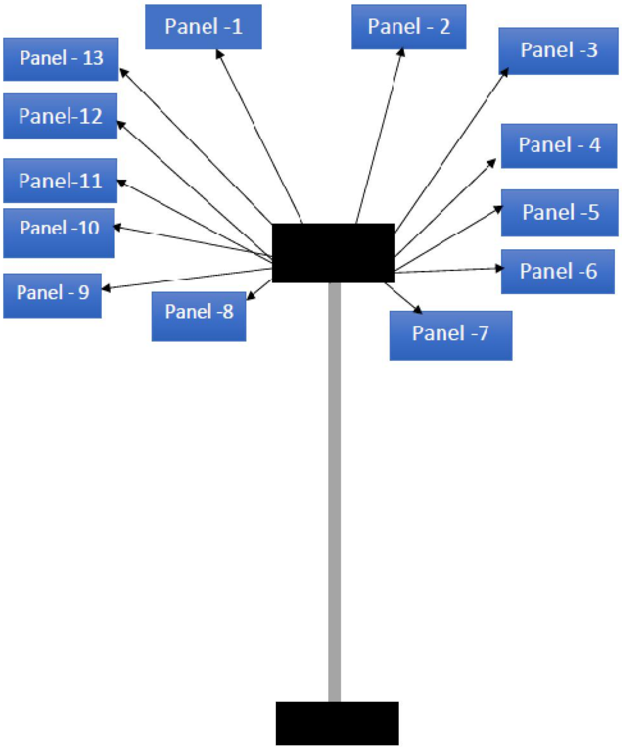

Fig. 2: Block diagram representation of a 13 panel solar tree.

There are 13 solar panels are available in solar tree. Each panel of 40W rating. The efficiency of solar tree is assessed based on the following equation (1) as given below.

$$efficiency = \frac{Panelpower\ (inKW)}{Panellenght \times Panelwidth} \times 100\ (1)$$

Each panel has length of 0.620m and width of 0.416m. Thus, the efficiency of our designed solar is 15.50%.

Solar energy produces far less releases than do fossil fuel energy sources. Solar cells generate electricity by converting photons of light into electrons. Solar cell creating direct current, this DC current is converted to alternating current, by using inverter.

The battery used in our work is of Lead-Acid type. It is selected based on the following calculations.

It is chosen based on backup time. The back time formula is given in the equation (2) as follows:

$$Backuptime\ (t) = \frac{BatterysizeinAH \times Volts}{LoadinW} \times 100\ (2)$$

In our work, we have selected the battery rating for 6 hours of backup time. Thus,

$$BatterysizeinAH = \frac{LoadinW \times Backuptime\ (t)}{Volts} \times 100\ (3)$$

Wherein equation (3), the load chosen is 300W. Thus, the battery rating obtained is 150AH. The pictorial representation of our battery is illustrated in Fig. 3.

Fig. 3: Pictorial representation of 150AH Lead-Acid Battery.

The output of battery is connected to inverter. It converts into AC power from DC power. The circuit consists of 4 MOSFET switches those are controlled by a microcontroller. The switching frequencies are from a few kilohertz to several megahertz. The main parts of an inverter are DC power source, input filter, inverter, circuit, output filter, and step up transformer. The developed inverter circuit is given in Fig. 4.

Fig. 4. Inverter Circuit design

VI. APPLICATIONS OF SOLAR TREE

- **Public places:** solar tree can be installed at public places like parks, gardens, tourist spots and etc. to power lightings as well as to increase visual appearance.
- **Highways:** Solar trees can be positioned alongside roadways to power lighting and security equipment.
- **Street light:** solar tree can be used for the street lighting purpose for saving the electric power.

There are many motives to think solar energy will play a key part in tackling the climate catastrophe and other future issues. Solar energy is also becoming more cost-effective and requires less maintenance. The building also has a rechargeable battery that saves energy for overcast days and powers LED lights at night.

VII. SOLARTREE OUTPUTTESTRESULTS

The output voltages of solar tree are examined for three months for assessing its superiority. It was done for 3 months **name, January, February, and March.**

Table 2: Output voltage of solar tree for January month:

JANUARY	10AM	12 PM	2 PM	4 PM
DAY -1	17.1V	17.9V	18.1V	17.2V
DAY -2	17.3V	18.0V	18.3V	17.1V
DAY -3	17.2V	17.8V	18.1V	17.1V
DAY-4	17.3V	18.1V	18.1V	17.2V
DAY -5	17.0V	17.7V	17.9V	17.3V
DAY -6	16.6V	18.2V	18.4V	17.1V
DAY -7	17.0V	18.0V	18.3V	17.2V
DAY -8	17.3V	17.6V	17.9V	17.2V
DAY -9	16.5V	18.0V	18.0V	17.OV
DAY-10	17.3V	18.2V	18.3V	17.1V
AVERAGE	17.03V	17.9 V	18.1 V	17.1 V

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Table 3: Output voltage of solar tree for February month:

FEBRUARY	10AM	12 PM	2 PM	4 PM
DAY -1	17.3V	17.9V	18.2V	17.3V
DAY -2	17.4V	18.1V	18.3V	17.3V
DAY -3	17.3V	18.0V	18.2V	17.2V
DAY-4	17.2V	18.2V	18.3V	17.3V
DAY -5	17.1V	17.9V	18.1V	17.5V
DAY -6	17.2V	18.3V	18.5V	17.2V
DAY -7	17.1V	18.1V	18.4V	17.3V
DAY -8	17.4V	17.9V	18.1V	17.4V
DAY -9	16.9V	18.1V	18.3V	17.2V
DAY-10	17.4V	18.3V	18.5V	17.2V
AVERAGE	17.23V	18.08 V	18.29 V	17.25 V

Table 4: Output voltage of solar tree for March month:

MARCH	10AM	12 PM	2 PM	4 PM
DAY -1	17.4V	18.0V	18.2V	17.4V
DAY -2	17.6V	18.2V	18.4V	17.5V
DAY -3	17.4V	18.2V	18.3V	17.4V
DAY-4	17.3V	18.3V	18.4V	17.5V
DAY -5	17.4V	18.1V	18.3V	17.4V
DAY -6	17.1V	18.4V	18.4V	17.5V
DAY -7	17.4V	18.4V	18.3V	17.4V
DAY -8	17.3V	18.2V	18.2V	17.5V
DAY -9	17.2V	18.3V	18.4V	17.2V
DAY-10	17.3V	18.4V	18.5V	17.2V
AVERAGE	17.34V	18.24 V	18.34 V	17.41 V

Table 5: The average output voltage of January, February and March months:

MONTH	10AM	12 PM	2 PM	4 PM
January	17.03V	17.9 V	18.1 V	17.1 V
February	17.23V	18.08 V	18.29 V	17.25 V
March	17.34V	18.24 V	18.34 V	17.41 V
AVERAGE	17.20V	18.07V	18.24V	17.25V

The graphical representation of output voltages obtained from solar tree for three months illustrated in Fig. 5.

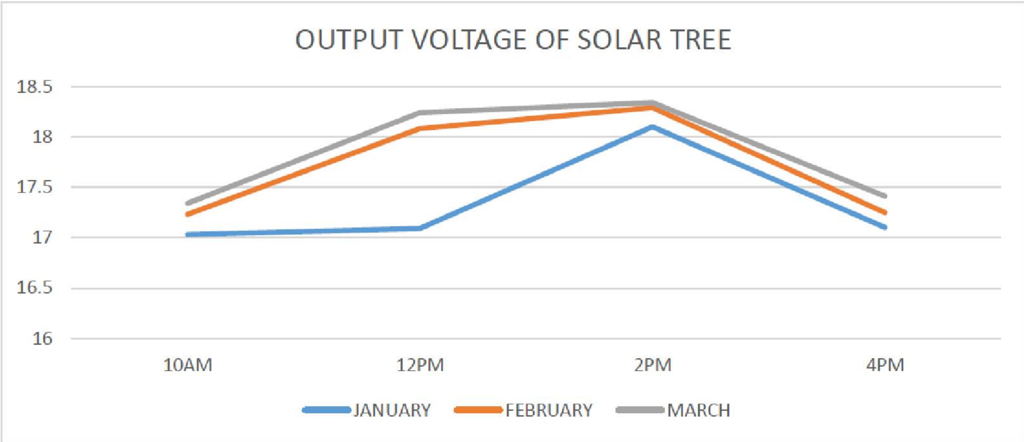

Fig. 5. Graphical representation of output voltages obtained from the designed solar tree.

VII. CONCLUSION

The world's oil supply is depleting, and it is predicted that 80% of it will be used up within our lifetimes. Although the supply of coal seems to be quite great, it is actually running low. a potentially harmful component of nuclear power. Unconventional energy sources including geothermal, ocean tides, wind, and solar energy are thus the greatest alternative to satisfy future energy needs. The single phase AC supply is efficiently obtained from the solar tree with the assistance of charge controller, lead-acid battery, and MOSFET inverter. Thus, this type of methodology can be adopted for the various applications such as Agriculture, commercial, military, residential etc.,

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