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Implementation of Different Arrangement of Solar Panels

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ABSTRACT

Nowadays the peoples are aware of harmful effects of burning of fossil fuels for electricity generation and this is the reason they are looking forward to the use of renewable energy sources especially solar energy. In this paper our focus is on differentiating the ways of generation of electricity by different arrangements of solar panels. It shows the comparison between the linear or traditional arrangement of solar panels and the solar tree i.e. solar panels arranged in Fibonacci series manner in place of leaves. It also includes the structural design of linear as well as solar tree arrangement. This paper introduces a new solar technology that emulates how trees convert sunlight into energy. Building the solar tree can be very beneficial for raising awareness about solar energy, its advantages and ways of usage. Hence we can say that it is a revolutionary urban lighting concept and these technologies lead to the development of high efficiency solar energy.

Keywords : Charge Controller, Fibonacci Series, Solar Panels, Solar Tree.

I. INTRODUCTION

Because of increasing energy and growing population one option to fulfill the increasing demand of energy is renewable energy source. Renewable energy is energy produced from natural sources like sunlight, wind, rain, waves and geothermal energy which are renewable. Among all this solar energy seems to be the greatest promise for the mankind as it is free, inexhaustible & non-polluting and it has a particularly low impact on the environment. The sun is constantly sending energy to the earth and all we need to do is to catch it and then use it. Solar energy is most advantageous for countries having very less space to produce energy efficiently and having very large population like India. Solar energy is the conversion of sunlight into electrical energy moreover directly by using photo voltaic or concentrated solar power [1]. PV technology is simple, less costly and efficient technology to collect solar power. Generally the PV technology is used in linear arrangement where these PV cells are connected in series or in parallel to produce electricity. But this requires a very large amount of land. Hence the concept of solar tree has been introduced.

In the nature the trees produce their own food by the process called photosynthesis. According to this process green plants produce their own food with the help of sunlight. To understand about the solar tree we can say that it is a tree in which the stems are connected works as the branches of the tree and the solar panels are working as the leaves. Leaves of the solar tree (solar panels) are producing energy (food) for the society, so it is very suitable to call it as a tree [2], [3].

II. METHODS AND MATERIAL

A. Linear Solar Arrangement

The linear solar arrangement is basically an arrangement of solar panels which are placed horizontally at some angle of 45 degrees and facing towards the sun, so that it can collect the maximum energy from the sun and then convert it into an electrical energy. The solar panels are connected in series or parallel connection. The linear solar arrangement is shown below

Figure 1: Linear Solar Arrangement

B. Solar Tree

A solar tree is an artificial tree in which solar panels are arranged in a Fibonacci series pattern instead of leaves. They can be framed from small scale like a bonsai tree to very large scale like the size of the wind turbine. This technique can also be used for system of street lighting, industrial power supply etc. In area point of view, solar tree is more efficient and much better than the traditional solar system. To install solar panels we require a very large land area. To avoid this problem we can install a solar tree instead of a number of solar panels which require a very small space.

It is a combination of artistic and technological work which is represented as a solar artwork. This relatively new concept was conceived in an attempt to merge new technology relating to the absorption and use of solar power. Since the angle of sun's rays is not fixed, particularly during the changes in seasons, the linear arrangement of panels is inefficient. Some residential solar systems are designed with tracking system but these systems substantially increase the cost of solar energy because they are expensive and require maintenance [4].

Solar tree opens up new prospects for urban lighting in that it satisfies today's most pressing environmental, social, Cultural and aesthetic demands. The solar tree arrangement is shown below,

Figure 2 : Solar Tree

C. Fibonacci Sequence

Leonardo of Pisano developed the Fibonacci sequence that is given by adding the last two numbers in series together and the sum became the next number in the sequence. The number sequence started to look like this 1, 1, 2, 3, 5, 8, 13, 21, 34,…. (1+1=2, 2+1=3, 3+2=5, 5+3=8 etc.) .In this sequence ratio of each number to its previous number settles to a value called Golden Ratio and is equal to 1.618034[5].

A naturalist Charles Bonnet observed that plants sprout their branches and leaves in a Fibonacci pattern such that leaves above do not hide below leaves and each gets a good share of sunlight. This type of sequence is found in Oak tree, Elm tree, Almond tree etc. the Oak tree has a Fibonacci pattern of 2/5, which means that the spiral takes five branches to spiral two times around the trunk to complete one pattern. Similarly, Elm tree has a Fibonacci pattern of 1/2 and Almond tree has the Fibonacci pattern of 5/13[5]. The working model for the Fibonacci pattern of Oak tree is shown in figure (3) in which the four branches are introduced which are at 137 degrees from the previous branch and situated at the same distance.

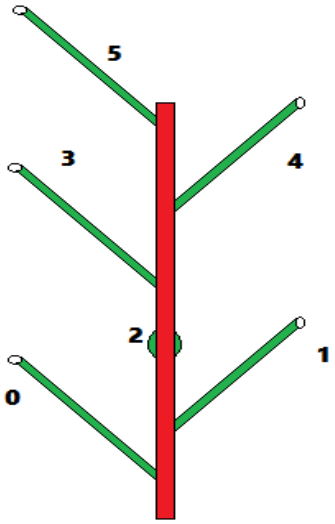

Figure 3 : Fibonacci Pattern

D. Control Circuit

The control circuit is consisting of the charge controller, battery and the DC load. The power generated by both the solar arrangement is operated with the help of two way switch. Then it is given to the charge controller which controls the power and delivers it to the battery for charging and also provides the power to the dc load. This control circuit is so designed that it will give comparison between both the arrangements. i.e. Lineal solar arrangement as well as solar tree arrangement. In this way we can differentiate the power given by both the arrangements and also the efficiency can be compared.

The block diagram of the control circuit is shown in figure 4,

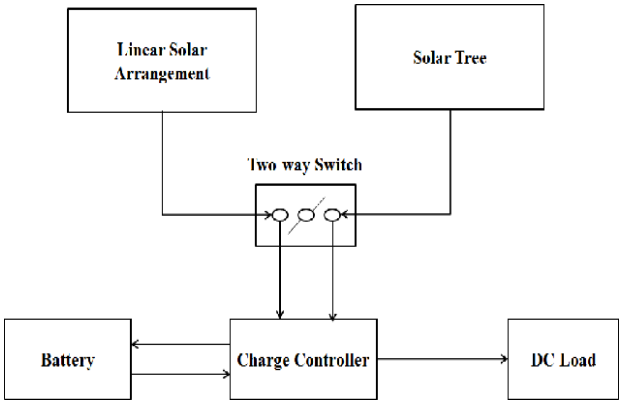

Figure 4: Block Diagram of the control circuit

This control circuit is consisting of a two way switch which is used to provide the power from the linear solar arrangement as well as solar tree to the load. The measuring instrument is also provided in the circuit to measure the voltage and current of the solar panels. Hence power generated by the panels can be calculated. The control circuit is shown below,

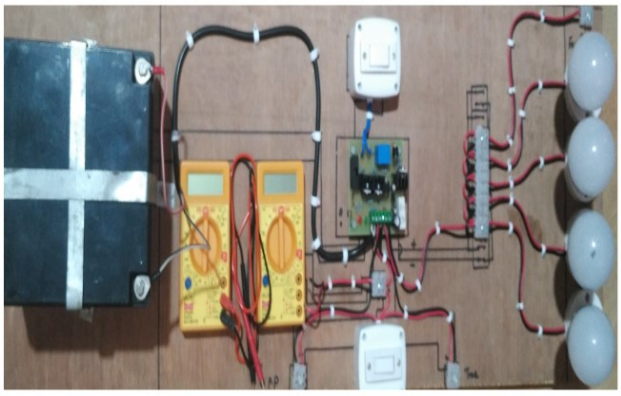

Figure 5: Control Circuit

A. Charge Controller

Charge controller is used to control the overcharging of the battery and to maintain the constant supply to the load. Maximum power varies with solar radiation, ambient temperature and solar panels temperature. Charge controller is a power electronic device interconnecting a solar power source and a load which maximizes the power output from solar panels with varying operating conditions, and therefore maximizes the system efficiency.

B. Battery

A battery is a device that converts chemical energy to electrical energy. Battery is rechargeable which means it can be used multiple times by recharging it externally. The battery is charged at its specified voltage and current ratings. The power generated can either be stored in battery or can be used directly by the load.

C. DC Load

DC load is used in the system which consisting of the dc lamps and a dc fan. The energy generated by the solar panels is provided to the load via battery or can be provided directly from the panels.

III. RESULTS AND DISCUSSION

A. Comparison Between Solar Tree And Linear Arrangement

- Solar tree requires a very less space as compared to the linear solar system. Since the space requirement is very less in solar tree it can be installed in very small amount of land which is not possible in linear arrangement.
- In linear arrangement, sunlight collected by the solar panels is less as it is inclined at the same angle whereas the solar tree collects large amount of sunlight due to the presence of Fibonacci pattern.
- As the sunlight collected by linear arrangement is less, the energy generated will be less and it is more for the solar tree as it collects more sunlight.
- Solar tree produces about 20% more energy as compared to the linear solar arrangement[6]

Figure 6: Different Arrangements of solar panels with the control circuit and DC load

B. Applications

- It can be used for street supply.
- House supply.
- Industrial power supply.
- Can be used as a charging station for electric cars.
- Applicable in golf courses and resorts.
- Applicable in recreational parks, city parks.

C. Observations And Results

The power generated by both the solar arrangements is observed for three days for the off load, on load by using battery and on load without using battery and the following observations has been obtained,

Days	Day 1		Day 2		Day 3	
Arrangement	Tree	Linear	Tree	Linear	Tree	Linear
Off Load	1.78w	0.25 w	4.71 w	0.36 w	3.13 w	1.17 w
On Load With Battery	11.5w	4.39 w	13.0 w	7.51 w	16.0 w	13.8 w
On Load Without Battery	19.9 w	17.35w	18 w	16.4 w	18.4 w	17.4 w

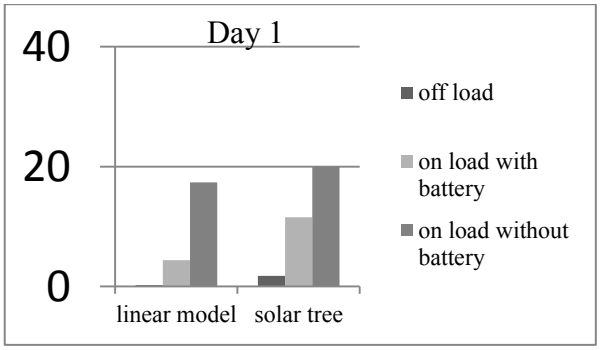

Figure 7: Graphical representation of power within day 1

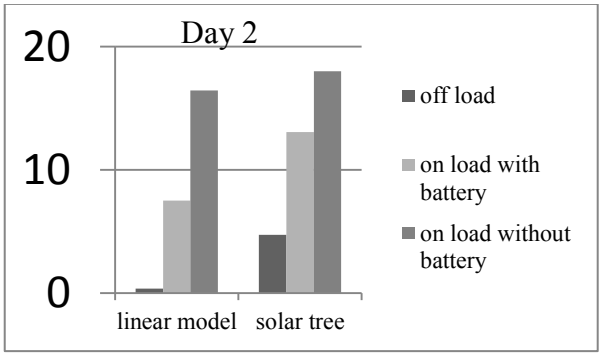

Figure 8: Graphical representation of power within day 2

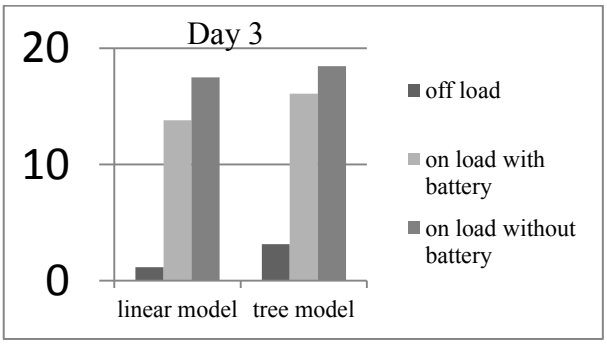

Figure 9: Graphical representation of power within day 3

IV. CONCLUSION

Solar tree is the new technique of energy generation with nature science of Fibonacci series can be very useful in increasing efficiency of solar power generation. In this work, it is observed that the solar tree structure is more efficient and compatible as compared to the linear solar arrangement. It generates comparatively more amount of power than the linear solar arrangement when implemented together and it generates electricity in more efficient way and it also overcomes the drawbacks

of conventional method. Solar tree is the best option for generating maximum electricity using minimal land.

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