



# INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

## THE SOLAR POWER TREE

Hrithik K. Chavhan<sup>1</sup>, Shriya G. Jawalkar<sup>2</sup>, Prasad S. Mandekar<sup>3</sup>, Nayan U. Deshpande<sup>4</sup>

<sup>1</sup>UG Student, Civil Engineering, J.D.I.E.T, Yavatmal, Maharashtra, India, [hrithik123chavhan@gmail.com](mailto:hrithik123chavhan@gmail.com)

<sup>2</sup>UG Student, Civil Engineering, J.D.I.E.T, Yavatmal, Maharashtra, India, [shriyajawalkar21@gmail.com](mailto:shriyajawalkar21@gmail.com)

<sup>3</sup>UG Student, Civil Engineering, J.D.I.E.T, Yavatmal, Maharashtra, India, [sanjaymandekar4@gmail.com](mailto:sanjaymandekar4@gmail.com)

<sup>4</sup>UG Student, Civil Engineering, J.D.I.E.T, Yavatmal, Maharashtra, India, [nayandeshpande76@gmail.com](mailto:nayandeshpande76@gmail.com)

### Abstract

Demand for energy is increasing day by day; to fulfil the required demand we must have to concentrate on utilizing nonconventional sources of energy. Solar energy is the best alternatives among the renewable energy sources. Solar energy is inexhaustible, pollution free, continuous and eco-friendly. It is the only source available in free of cost and in abundance. There are various methods of utilizing the solar energy. One can use solar panel in various ways, places and types. Conversion of solar energy into electric power is one of the well accepted and matured methods. In addressing the problems related to the PV technology, the solar tree is proficient. Solar tree requires very less space for efficient energy production. One can also use "SPIRALLING PHYLLATAXY" for the improvement of efficiency of the solar tree. It is better than traditional solar system, so this will be best option and should be implemented. In this article an attempt is made to overlook the constituents of the solar tree along with its design, working and its requirements and also we are highlighting the benefits of solar tree and raising the awareness about the use of solar tree. This technique is largely adopted in European countries and is now recently adopted in India. The paper gives an idea about new solar technology, which emulates how trees convert sunlight into energy and also gives an idea about the solar panels installation on the welded stem to a pole and aims in building a solar panel array. In this paper we had tried to summarize the past and the current research in the field of the solar tree technology.

*Index Terms: Solar tree, Solar Energy, PV panels, etc.*

\*\*\*

## 1. INTRODUCTION

Nonconventional energy sources are to be adopted since conventional energy sources are on the verge extinction. It has become difficult for the replacement of conventional energy methods by nonconventional energy methods; since energy consumption is at large quantity as per today's scenario of the world it has become difficult to obtain the same quantity of energy from nonconventional energy sources. Efficiency of previous inventions has to be increased to cope with the required quantity for today. The previous nonconventional energy includes solar panels, wind mills. In the other way we can develop on equipment which can generate more power and more efficient for the nonconventional sources. When we are looking for nonconventional sources solar energy comes first as the best choice, since the sun is a constant source of energy to utilize its energy we only have to conserve it and transfer it into another form as per our requirement and thus make use of it. The assembly of PV technology is not much complicated and the system is not so expensive and is having efficient result in collecting the solar panel but the drawback in case of PV technology that they are having linear arrangement while producing electricity. But PV cells can

overcome this problem and can be arranged in series or parallel way. But PV cells consume more area for its implementation so we have introduced the solar tree which had worked on all these drawbacks and is one of the best systems in solar energy utilization.

## 2. WHAT IS SOLAR TREE?

A solar PV carving is formed by intermingle of skill and technology leading to the concept of photovoltaic tree. By adopting this technique we can utilize the energy from sun in an efficient way. The structure of natural tree and solar tree is nearly similar with the only difference that solar PV panels are situated just like leaves, on the branches of solar tree. On the top of the solar tree there are PV panels to collect photon energy. The tree resembles the structure of a tall tower embodied by a steel structure. The photon energy collected by PV panels can be used for charging mobile phones, street lights, laptops and other electronic equipments.



**Fig-1: Solar Tree**

Total surface area of sunlight can be captured by 3D arrangement of PV panels in the tree. PV panels can be arranged in any angle to absorb the energy from the sun throughout the day. By adopting this technique, the use of renewable and sustainable energy sources are reduced to some extent and the land required for implementing this technique is also less. The arrangement of this tree creates curiosity among the people for adopting this technique, as this arrangement also resembles 3D structure imitating a natural tree.

## 2.1 COMPONENTS

### 2.1.1 INVERTER

Inverter plays an important role in the solar tree. As its name is self explanatory that is inverter means which inverts, one type of current into another. The current which we are getting from the solar panels, is in the form of DC (Direct Current), but we required an AC current (Alternating current) on a household level. Inverter converts DC power into an AC power. The range of inverters may vary from 150 Watt to 1 Megawatt. Less current is used by inverter on AC side as compared to DC side.



**Fig-2: Inverter**

### 2.1.2 CHARGE CONTROLLER

For limiting the electric current or drawing the electric current charge controllers are used. For protecting the system from overcharging and overvoltage, charge controllers are used. Over charging and over voltage can reduce the battery life and can endanger the safety. Charge controllers can prevent the battery discharging or control discharges depending upon the technology of the battery. In case of solar applications charge controllers are also named as solar regulators. This can be used for solar or wind power generation. Such as boat and off the grid home battery storage system. Solar regulators are also provided with some additional features, as like in the situations when the batteries will become discharge. A low

voltage disconnect can be provided to separate the circuit which powers down the load.



**Fig-3: Charge Controller**

### 2.1.3 SOLAR CELLS

The device which is in a solid state that converts light energy into electricity by the photovoltaic effect, that electrical device is known as solar cell (Photovoltaic cell or Photoelectric cell). The small pockets of quantum of light present in the cell are called photons in which the light energy is transmitted. Electrical energy is stored in electromagnetic fields, which in turn can create a current of electrons flow. Assemblies of solar cells are used to capture the energy from sunlight. Number of modules assembled together oriented in one plane is known as solar panel. Solar energy is an electrical energy generated from solar modules. Application of photovoltaic cells can be used for the production of electricity. Photovoltaic is often used to refer the production of electricity from the sunlight, and then cells are described as photovoltaic cells. Detection of light or other electromagnetic radiations nearer the visible range can be detected by photovoltaic cells.



**Fig-4: Solar Cells**

### 2.1.4 BATTERY

Battery plays an important role in solar tree. As we know that whenever natural energy is insufficient in that case batteries are very useful. For example when light energy is not available at the time of night, then we will go for the battery. Some inverters have built-in battery charger which recharges the battery bank whenever power is applied from an AC

generator or utility grid, while somewhere chargers are also used.



Fig-5: Battery

## 2.2 WORKING OF SOLAR POWER TREE

The restriction of installation cost and to have maximum solar electricity output, are the challenges before solar industry. Sun rays are directly converted into electricity by means of photovoltaic cells which are installed in solar photovoltaic. From the duration 2000-2016 the fastest growing renewable energy source is PV (Photovoltaic). It is now becoming popular. These are eco-friendly, as fossil fuels emission is less. Photons of light are converted into electrons and thus the electricity is created in the solar cell which is in the form of DC which has to be converted into AC by means of an inverter. By the pattern of Spiralling Phyllataxy, modules are fixed throughout the tall pole so that the load gets distributed and the system is balanced. The system is so created in such a way that due to the top panels the sunlight will not get obstruct on the bottom panel, so that the bottom panels will also receive the maximum sunlight. The angle for the panels are in such a way that the panels will receive maximum energy throughout the day. PV panels are rotated automatically depending upon the facing of sunlight by solar tracker. The best result in the investment of solar power tree is achieved by continuous utilization of PV panels by means of solar tracking system. More electricity is generated by solar trackers than the other stationary counter. Their installations are highly efficient as they increase their exposure to the solar rays.

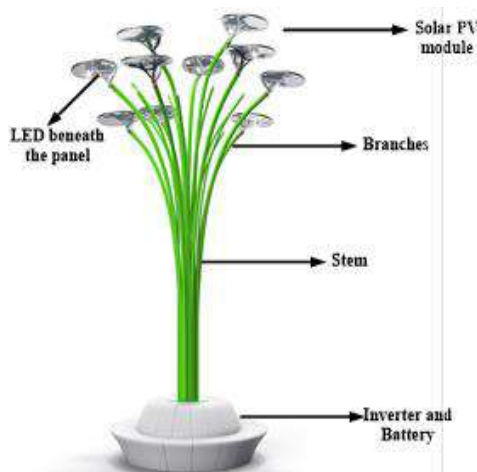


Fig-6: Design of Solar Tree

The block diagram given below (Fig-7) shows the arrangement of all the equipments and their positions. It shows how all the components of solar tree are connected and helps to understand how solar power tree system works and it is very easy to understand. The light energy comes from the sun falls on the panels. The photovoltaic (PV) cell on the panels turns that light energy into the DC electricity. Then the current flows into an inverter and then the inverter converts that DC current into an AC current. Because, on a household level, all the appliances runs on an AC current. So because of that we need here an inverter to convert that DC current into an AC current. Now it's ready to use. That AC current is fed through a meter and then into the home's consumer unit.

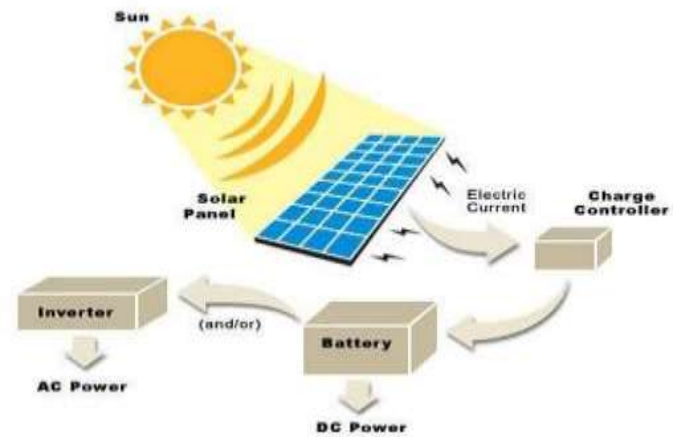


Fig-7: Block Diagram for Working of Solar Tree

## 3. NECESSITY OF SOLAR TREE

### 3.1 OPTIMUM AREA REQUIREMENT

As compare to the traditional PV system the requirement of land is less so it has become a best option of energy generation. Due to high population growth, the land had become the costliest commodity for the human society. For the implementation of this project just 0.10 to 0.12 acres of land is required, which can generate 2 Megawatt power, but in case of PV modules for the same power generation 10 to 12 acres of land space is required for housing its panels. This fulfils the requirement of generation of maximum power in less area.

### 3.2 ABUNDANCE AMOUNT OF ENERGY GENERATION

By using the technique of spiralling phyllataxy maximum energy is generated by this system as compare to other traditional system. By the combination of both the functions i.e. Autonomous and in synchronisation with the public grid solar tree is designed. The energy generated in day time by the solar panels can be used to recharge the batteries by using electric grid. In case of cloudy or overcast weather the solar tree is capable of functioning in these weather conditions. In case when solar tree is coordinated with the public lighting

grid can be activated or deactivated to which eventual surpluses of stored current can be relinquished and the solar tree can be used to recharge the batteries from the energy stored in the solar panels. The storage of electric energy is the major problem of power system. The day and night cycle or weather shifts can eliminate the output fluctuation of solar cell. Batteries are only charged at the day time and solar tree panels automatically switch on the LED. The amount of light produce is regulated by internal control. The amount of light present in the atmosphere can be detected by the device called sensor which automatically switch on or off the solar lamps depending upon the day situations. As LED is a semiconductor light source, so it can be used as indicator lamps in many devices. Energy is released in the form of photons when electrons are combined with electron holes, in the holes this condition occurs when LED is switched on or it is forward biased. The efficiency of plant is improved by adopting the technique of spiralling phyllataxy. Its application can be found in street lighting system and industrial power supply. In point of view of area and energy generation, it is more efficient than the traditional solar PV system.

### 3.3 UTILIZATION OF WIND ENERGY FOR POWER GENERATION

Though the device is named that it generates the energy from sun but it also has capability of generating energy from wind. By rotation of the stem in any direction the energy from the wind is also produced just as that like of natural tree. Flexibility of panels can rotate the stems as per our desire is one of the unique technique. Maximum power can be gained by the manual rotating of stem due to its flexibility.

### 4. COMPARISON BETWEEN TRADITIONAL SOLAR SYSTEM AND SOLAR TREE SYSTEM

We should shift towards such system where the land space requirement is less and more energy is produced efficiently in highly populated countries like India. In such situation solar tree implementation technique are adopted. Such systems are better in point of view of area and efficiency than the traditional solar PV. Large size land is required for the generation of small amount of power in case of traditional system and in solar tree only 1% of land of traditional system is required for the generation of same amount of power. The solar energy is one of the easiest and cleanest means of tapping the renewable energy. By means of solar thermal, solar PV and solar architecture, solar radiation can be directly converted into usable form. The only drawback with the solar tapping is that installation of large solar collectors consumes more area. To overcome this problem the solar tree can be installed, which consumes less space as compare to the traditional one.



**Fig-8: Traditional Solar PV System**



**Fig-9: Solar Tree System**

## 5. APPLICATIONS

- 1) In airports to supply the electricity.
- 2) For street lighting and garden lighting.
- 3) In mountainous regions to overcome the demands of power of off grid households.
- 4) For charging purpose and also for Wi-Fi hubs.
- 5) In rural areas which are disconnected to the grid.
- 6) In desert areas for the power generation.
- 7) For agricultural purpose such as to provide the electricity to the water pumps and agricultural machines.

## 6. ADVANTAGES AND DISADVANTAGES

### 6.1 ADVANTAGES

- 1) The solar tree can be easily fixed on the rough and sloppy hills and mountainous terrains.
- 2) It improves the work environment.
- 3) It provides an easy access of electricity to the rural area.
- 4) It saves the economy.
- 5) It requires less land for its installation as compare to traditional one.
- 6) We wouldn't have to be bothered as much about future energy sources.

### 6.2 DISADVANTAGES

- 1) Its cost is high.
- 2) It may cause hazards to eyesight from the solar reflectors.

## 7. CONCLUSION

The perfect solution for our future energy needs will be satisfied by solar tree. Solar tree is a revolutionary urban lighting concept. A perfect symbiosis between pioneering design and cutting edge eco-compatible technology is represented by this concept. The concept has become very successful one since it has fulfilled the demand of the people and it has saved the land. In India the problem of power cut related to electricity and the extra energy can be provided to the grid by adopting this concept in our country. Highly populated countries like India should make an efficient use of this concept which consumes less space and has high energy generation. It is also better than the solar PV system which favours its implementation. This project will provide the continuous electricity without any power cut problem. Installation of solar power tree is better alternative to produce electricity and it would be cost effective and better for the human mankind.

## REFERENCES

- [1]. [www.google.com](http://www.google.com)
- [2]. [www.wikipedia.com/solartree](http://www.wikipedia.com/solartree)
- [3]. Bernardi, M.; Ferralis, N.; Wan, J.H.; Villalon, R. and Grossman J.C. 2012. Solar energy generation in three dimensions. *Energy and Environmental Science*, (5): 6880-6884.
- [4]. H Garg, "Solar Energy: Fundamentals and Application".