SOLAR TREE

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ABSTRACT

In today's world of thriving population, energy is major necessity. In the times of developing technology for the source of energy is rapidly increased mainly concentrating on renewable source of energy because it's a key source of sustainability. And a developing country like India solar energy is the apt option. Solar panels efficiency of condensing more watts of capacity per square foot which reduces its required area. In this event solar tree will be the best and useful option for us. Here technique called "SPIRALLING PHYLLATAXY" is used which draws maximum power from the sun and increases the efficiency. It can be utilised in the lightning systems, commercial unit's power supply systems etc. Considering it has much better option in of terms efficiency and nature conserving it will be adequate option and must be implemented.

INTRODUCTION :

As the population is increasing day by day, the utilization of energy resources are also increasing. So we need renewable energy sources which is pollution free and easily available. The sun contains hot ionized gases, and which generates the energy by the process called thermonuclear fusion. The

temperature of sun is estimated as 8*10^6k to 40*10^6k, and the energy here is released by fusion of hydrogen and helium.

Solar energy is available in plenty, also it is considered to be the cleanest form of renewable energy. To convert solar radiation into usable form the three major forms are: solar thermal, solar photovoltaic, and solar architechture. The main problem with tapping solar energy is to install large solar collectors, which require large space. To avoid this we can install a solar tree instead of number of solar panels which require a small space.

Solar tree is a urban lightning concept and also it satisfies environmental, cultural and aesthetic demands. This can be achieved by using solar cells.

What is a solar tree?

A solar tree is a means of producing solar energy and electricity. It uses multiple solar panels which forms in shape of a tree. These solar panels are arranged in a tree fashion.

TREE stands for

T= TREE GENERATING

R= RENEWABLE

E= ENERGY and

E= ELECTRICITY

As we know trees in the nature produce their own food material by the process called photosynthesis. By this process they are indirectly producing food to society because we are depending on plants directly or indirectly. Solar tree is a tree in which stems connected act like branches where as solar panels as leaves.

Spiralling Phyllataxy:-

It is the technique use to design solar tree. This technique helps the lower panels of a tree from thr shadow of upper panels of the tree, so that it can take the maximum power from the sun. This technology is used to improve the efficiency of a plant.

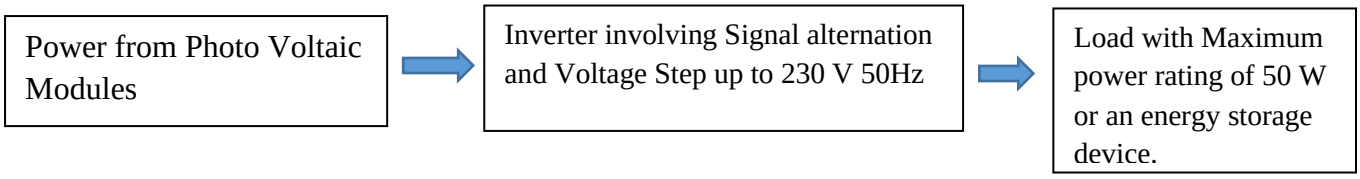
INTRODUCTION ABOUT SOLAR CELL

A solar cell also known as photovoltaic cell or photoelectric cell previously termed as a solar battery is a electrical device that converts the light energy into electricity by photovoltaic effect which is a physical and chemical phenomenon. The energy of light is transmitted by photons which are the small packets or quantum of light. Electrical energy can be stored in the form of electromagnetic fields, which makes the current of electrons flow.

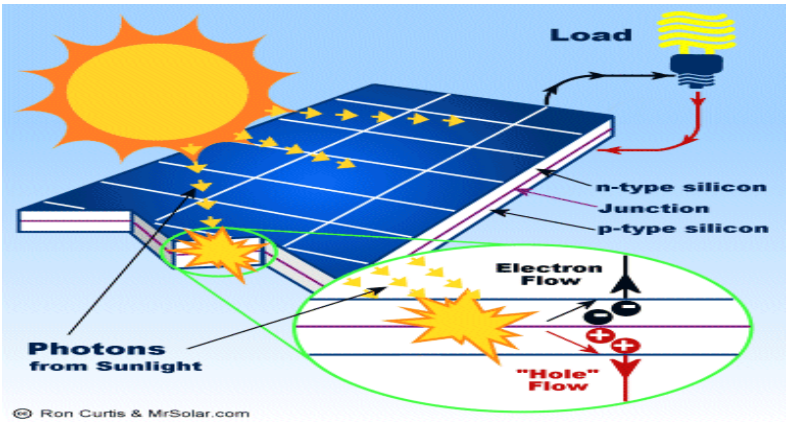
Solar cells constituets solar modules which are able to capture energy from sunlight.When multiple modules are together, the resulting integrated group of modules are oriented in one plane known assolarpanel.Theelectrical energy generated from these is known as solar energy. Photovoltaic is the field of technology related to the application of photovoltaic cells in producing electricity from light, i.e., generation of electricity from sunlight. Cells are referred as photovoltaic cells when light source is not necessarily sunlight. These are used to identify the light or electromagnetic radiation near the visible range. For example., infrared detectors. or measurement of light intensities.

WORKING MECHANISM

Schematic of a Solar Tree's working mechanism :



The Solar panels are attached in parallel for the fact that they deliver power independently even if a panel in the array is damaged unlike series connection.The Solar panel array which is being used in the tree will be giving a cumulative power output of 50W-75W and the energy produced over a day will be approximately 3.4kWh (enough to power 20 street lamps for a day). The number of panels used will be calculated so as to produce required energy. The batteries that are used to store this power will be used accordingly. When the panels are not delivering any power (at the night time), the power in the batteries will automatically be diverted to active power consuming loads with in the limits of 50W-75W. The diversion of power depends entirely on the user requirement.



Different Arrangements and Designs of a Solar Tree:

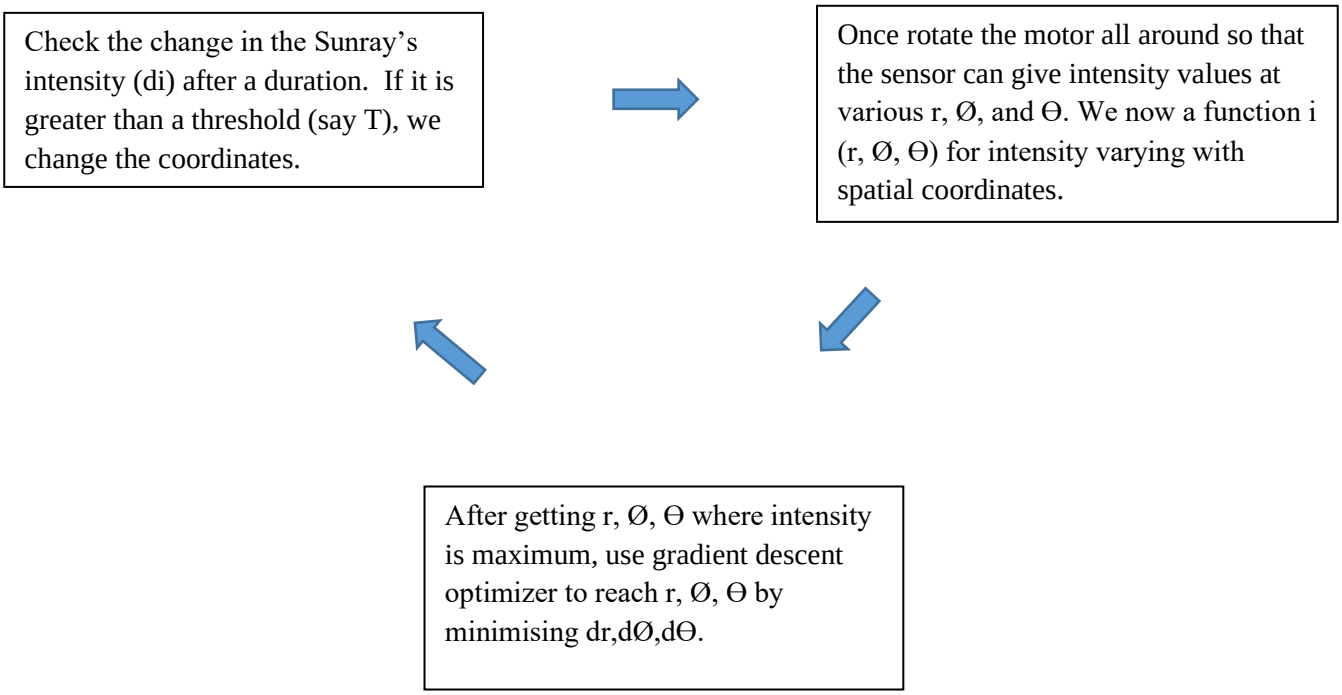
1. **Planar Arrangement of all Solar panels**
   All the Solar panels are arranged on a plane so that angle of incidence of sunlight is same at any given time. They are supported by a common pole which has a pivoting junction that moves such that it can align to the direction of sunrays. It starts at a specific inclination to the horizontal, ends at another inclination and gets back to its initial position when there is no light. The complexity of designing this arrangement is low. There will also be an advantage here since we can add many solar panels to meet daily energy requirements. The disadvantage here is, as we increase the area of utility, there will be a nonuniformity in radiation pressure on solar panels at farther locations which leads to different power products at different panels. Also, the alignment to the sunrays will be administered to the hardware through a standard code. So, if there are seasonal changes in the duration of day and night, there will be a significant misalignment of panels to the rays and this in turn produces less power than anticipated because all the panels will be misaligned due to planar structure. We should also program the initial and final angles of inclinations at the beginning and ending of the day. This requires manual retrieving of sunlight time and incidence angles and geometric analysis of the locality. This arrangement works well at higher positioning of the panels. The hardware we use in this arrangement are moving linear actuators.
2. **Local Solar Panel alignment design**
   Local panel arrangement consists of solar panels with local moving parts. Each solar panel moves on its own aligning to the sun rays. This arrangement works on the principle of Spiralling Phyllotaxy. This is a technique which is inspired by the alignment of leaves in a tree canopy to achieve maximum photosynthesis. The leaves in a tree try to achieve maximum photosynthesis by arranging themselves in such a way that the leaf below another leaf has a minimum shadow of the upper leaf. Similar analogy is being applied to the arrangement of Solar Panels. There are many advantages in using this arrangement. There will be no need for calibrating the initial and final angles as described in Planar Arrangement. This will run entirely on sensors and algorithms that give the relative inclination of sunrays to each solar panel. The algorithm is also designed in such way so as to mimic the functionality of Spiralling Phyllotaxy. Manual supervision is not at all required in this arrangement and this works completely fine even when are seasonal changes in the duration of day and night. But the complexity in designing both hardware and algorithms is very high. The risk in collision of solar panels increases with the increase in number of the solar panels. Also, there will be

relatively high number of moving parts since the local functionality of each solar panel is not common. The algorithm must be designed in such a way that it keeps track of all position coordinates of each panel. The sensors need to calibrate themselves to sunrays with extreme precision.

Solar Panel Position Feedback System for Local Panel alignment design:

The servo motors which control the movement of the solar panels have three position coordinates to adapt themselves in 3D space. If we take spherical system (rotations are easily expressed),then the coordinates will be r, Ø, and Θ. We need to calibrate these coordinates based on the current intensity and radiation pressure from the sunrays.

This feedback can be represented by a flow chart below:



Expressions for Gradient descent:

$$r \rightarrow r - \alpha * dr$$

$$\emptyset \rightarrow \emptyset - \alpha * d\emptyset$$

$$\Theta \rightarrow \Theta - \alpha * d\Theta$$

Here, $dr, d\emptyset, d\Theta$ are the coordinate changes from current location to the coordinates where the value of di is minimum. α is called the Learning rate which controls the magnitudes $dr, d\emptyset, d\Theta$ at each iteration of the descent.

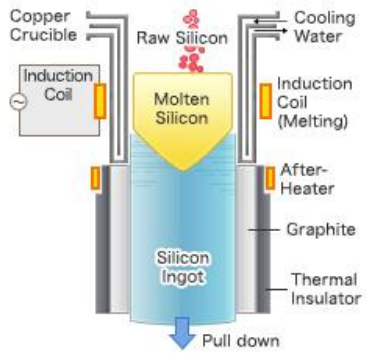
This algorithm should run keeping the phenomenon of Spiralling Phyllotaxy and collision reduction in consideration.Also, the microcontrollers that are being used to carry these optimization tasks must be fast because they should be able approach desired coordinates with lower learning rate and error.The power to perform all these operations will be used from the power generated by the Solar tree itself. Also, we can keep track of r, Ø, and Θ values at distinct time stamps on each day to analyse how the sun is moving relative to the solar panels and use these movement patterns for the future.

Suitable and Exceptional Locations for a Solar Tree:

Solar trees are well suitable to be placed at locations where there is a maximum exposure of sunlight throughout the surrounding 3D space. They should not have any other higher ground obstructions like buildings around their vicinity since there will be a problem where the solar tree will fall in the shadow of those obstructions. They can be placed at parks where there are not too many trees and buildings. They can also be placed above continuously used objects like traffic lights, railway lines and air traffic control stations since there will be less chance for shadows to fall in these places. People on hill stations can make the most out of Solar tress since they have maximum contact to sunlight. They should not be placed in locations where the light source is almost parallel to the horizon (if there are any).

MANUFACTURING TECHNOLOGY OF SOLAR TREE

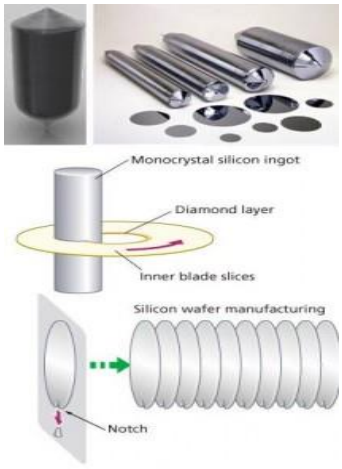
STEP 1:- PURIFICATION OF SILICON



For solar cell we need to have intrinsic silicon. For the production of solar cell, quartzite gravel or crushed quartz made up of silicon are given through an electric in which oxygen is released when carbon arc is applied. . A Thermal and Graphite insulator trap the heat and maintain the furnace at a particular

temperature for gangue to form a slag. The products formed are molten silicon and carbon dioxide. Using seed silicon crystallization and floating zone technique, Silicon ingot is pulled down from the molten silicon. Repeating the same process, impurities are removed. The above process gives silicon with 1% impurity. At this moment the silicon is not useful to be used as solar cell. It has to undergo further purification.

STEP 2:- INGOT AND WAFER PREPARATION



Silicon boules, polycrystalline structures are used to make solar cells, which have the single crystal atomic structure. The process used for creating boule is called Czochralski method. This process describes that a seed crystal of silicon is dipped into melted polycrystalline silicon. A cylindrical ingot or "boule" of silicon is formed as the seed crystal is withdrawn and rotated. Sliced silicon wafers are one at a time from the boule using a circular saw whose inner diameter cuts into the rod, or many at once with a multi wire saw.

STEP 3 :- DOPING

Doping silicon wafers with boron and phosphorous is done by introducing a small amount of boron during the Czochralski process.In the presence of phosphorous gas, the wafers are sealed back to back and placed in the furnace to be heated slightly below the melting point of silicon (2,570 degrees Fahrenheit or 1,410 degrees Celsius). The phosphorous atoms "burrow" into the silicon. It is more porous because it is close to becoming a liquid. To ensure a uniform junction of proper depth, the temperature and time given to the process is carefully controlled. These diffusion processes are performed by the use of a batch tube furnace or an in-line continuous furnace

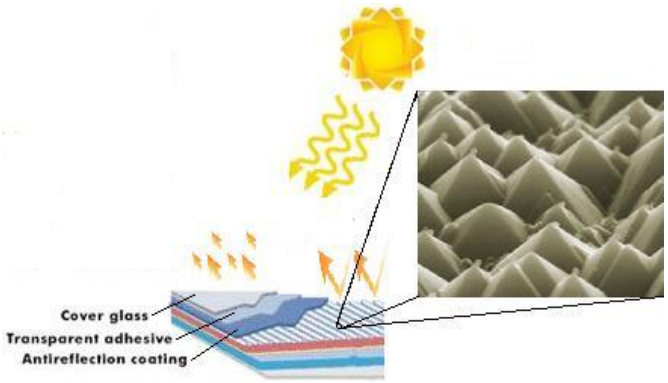
STEP 4 :- SCREEN PRINTING

To create a metal grid, electrical contacts are formed by squeezing a metal paste through mesh screens. This kind of metal paste (usually Ag or Al) needs to be dried so that subsequent layers can be screen-printed using the same method. The wafer is heated in a continuous firing furnace at temperatures from

780 to 900°C. These grid- pattern metal screens act as collector electrodes which carries electrons and complete the electrical continuity in the circuit.

STEP 6 :- ANTIREFLECTIVE COATING

An anti-reflective coating is used to reduce the amount of sunlight lost. The anti-reflective coating is put on the silicon oxide and silicon wafer- mostly titanium dioxide. The material which is used for coating is either heated until its molecules boils off and travel to the silicon and then condense, or the material undergoes sputtering. In this process, a high voltage occurs which knocks molecules off the material and deposits them onto the silicon at the opposite electrode



STEP 7 :- MODULE MANUFACTURING

The finished solar cells are then encapsulated i.e , sealed into ethylene vinyl acetate or silicon rubber. Solar module assembly involves the soldering cells to produce a string of 36 cells (or even more longer) and laminating it between a polymeric backing sheet on the bottom and toughened glass on the top. The encapsulated solar cells are placed into an aluminum frame having a Mylar or tedlarback sheet and a glass or plastic cover. To allow mounting in the field frames are applied, or the laminates may be integrated separately into a mounting system for a specific application such as integration into a building.

ADVANTAGES OF SOLAR PANEL

=>Renewable Energy Source

Among all the advantage of sunlight based boards, the most significant thing is that sun oriented vitality is a genuinely sustainable power source. It very well may be bridled in every aspect of the world and is accessible consistently. We can't run out of sun oriented vitality, in contrast to a portion of different wellsprings of vitality. Sun based vitality will be open as long as we have the sun, thusly daylight will be accessible to us for in any event 5 billion years when as per researchers the sun will bite the dust.

=>Reduces Electricity Bills

Since you will meet a portion of your vitality needs with the power your nearby planetary group has created, your vitality bills will drop. The amount you save money on your bill will be subject to the size of the nearby planetary group and your power or warmth utilization. In addition, not exclusively will you be saving money on the power charge, there is additionally a likelihood to get instalments for

the overflow vitality that you send out back to the lattice. In the event that you produce more power than you use (taking into account that your sun based board framework is associated with the matrix).

=>Diverse Applications

Sunlight based vitality can be utilized for differing purposes. You can create power (photovoltaics) or heat (sunlight based warm). Sun based vitality can be utilized to create power in zones without admittance to the vitality framework, to distil water in districts with restricted clean water supplies and to control satellites in space. Sunlight based vitality can likewise be coordinated into the materials utilized for structures. Not very far in the past Sharp presented straightforward sunlight based vitality windows.

=> Low Maintenance Costs

Sunlight based vitality frameworks for the most part don't need a ton of upkeep. You just need to keep them moderately perfect, so cleaning them two or three times each year will carry out the responsibility. If all else fails, you can generally depend on specific cleaning organizations, which offer this administration from around £25-£35. Most dependable sun powered board makers offer 20-25 years guarantee. Likewise, as there are no moving parts, there is no mileage.

=> **Technology Development:**

Technology in the solar power industry is constantly advancing and improvements will intensify in the future. Innovations in quantum physics and nanotechnology can potentially increase the effectiveness of solar panels and double, or even triple, the electrical input of the solar power systems.

Disadvantages of solar panels:

=>Cost

The underlying expense of buying a close planetary system is genuinely high. This incorporates paying for sun powered boards, inverter, batteries, wiring, and for the establishment. By the by, sun powered innovations are continually growing, so it is sheltered to expect that costs will go down later on.

=>Weather Dependent

Albeit sun powered vitality can even now be gathered during shady and stormy days, the productivity of the close planetary system drops. Sun powered boards are subject to daylight to successfully assemble sunlight based vitality. Subsequently, a couple of shady, blustery days can noticeably affect the vitality framework. You ought to likewise consider that sun based vitality can't be gathered during the night. Then again, on the off chance that you likewise require your water warming answer for work around evening time or during wintertime, thermodynamic boards are a choice to consider.

=>Solar Energy Storage Is Expensive

Sun based vitality must be utilized immediately, or it very well may be put away in enormous batteries. These batteries, utilized in off-the-lattice universes, can be charged during the day with the goal that the vitality is utilized around evening time. This is a decent answer for utilizing sunlight based vitality throughout the day however it is additionally very costly. As a rule, it is more astute to simply utilize sun based vitality during the day and take vitality from the matrix during the night (you

can possibly do this if your framework is associated with the lattice). Fortunately your vitality request is typically higher during the day so you can meet a large portion of it with sun based vitality.

=>Uses a Lot of Space

The greater power you need to deliver, the more sun oriented boards you will require, as you need to gather however much daylight as could reasonably be expected. Sun oriented PV boards require a ton of room and a few rooftops are not large enough to fit the quantity of sun powered boards that you might want to have. An option is to introduce a portion of the boards in your yard yet they have to approach daylight. On the off chance that you don't have the space for all the boards that you needed, you can pick introducing less to in any case fulfill a portion of your vitality needs.

=>Associated with Pollution

In spite of the fact that contamination identified with sunlight based vitality frameworks is far less contrasted with different wellsprings of vitality, sun powered vitality can be related with contamination. Transportation and establishment of universes have been related with the emanation of ozone depleting substances. There are additionally some poisonous materials and unsafe items utilized during the assembling cycle of sun oriented photovoltaic frameworks, which can in a roundabout way influence the earth. In any case, sun oriented vitality dirties far not exactly other elective vitality sources.

Applications:

=>Solar Water Heating

=>Solar heating of buildings

=>Solar distillation

=>Solar pumping

=>Solar drying of agricultural and animal products

=>Solar furnaces

=>Solar cooking

=>Solar electric power generation

=>Solar thermal power production

=>Solar green houses.

CONCLUSION

- To accomplish the need of energy in today's generation of people, saving area in this project is very appropriate and successful one. This can provide uninterrupted power supply and extra energy is stored in the grid.
- Adopting an innovative and sustainable source of energy this is successful one.
- In the area point of view this is the successful model.
- The solar cells used are –organic, hybrid organic and dye-sensitised **cells** (DSCs) are most stable and efficient excitonic solar cells.
- Nanowires which are used in solar cells enhance the efficiency of the tree.
- The main objective is to boost public opinion on R E S.
- The Strawberry Tree, invented by the Serbian company Strawberry Energy is a variation of the Solar Tree in that it is exclusively designed to recharge mobile devices. The company won the Sustainable Energy Week 2011" competition for its innovative contribution.
- While coming to assumptions made that solar energy is expensive,but its durability is long lasting, but this project uses inexpensive solar cells which makes it complete modernized project of all.
- There is a major difference between organically inspired solar trees and structures which have been adopted to create energy efficient parking lots actually these equipment is made usually to protect vehicles from sun damage. They are completely different from solar trees they are organic artistic.

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