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Design and Implementation of 300 W Solar Tree

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ABSTRACT:

Solar tree technology is a new way to get renewable energy. It works by using photovoltaic panels to make electricity, just like real trees do. This design fights climate change by combining useful energy with beauty. It also gives people a nice alternative to regular solar. They are strategically valuable because they make the most of space and make things look good together, which is important in cities where land is limited. People can use solar trees in cities, businesses, and homes. This gives them options when rooftop solar isn't possible. They add features like EV charging, Wi-Fi, and smart lighting to help build smart city infrastructure. They not only provide energy, but they also provide shade, shelter, and educational displays, making public spaces into centers for many uses. This skill makes it easier for people to get involved in their communities and makes life better.

Keywords—Solar Panel, Multi feature inverter ,lithium acid battery,

Introduction:

The goal of a 300W solar tree project is to build and put up a structure that looks like a tree and has solar panels on its "branches" to collect sunlight and turn it into power.The goal of this project is to make a source of renewable energy that can be used to charge devices, power small appliances, or even add to a bigger power grid.Usually, an introduction to this kind of project would explain why the solar tree design was chosen, what the main parts of a solar power system are, and what the benefits of using solar energy might be. Solar trees are a new and interesting way to use solar power. Because of their unique design and operational benefits, they are not like traditional photovoltaic (PV) installations. The goal is to get the most solar energy possible by putting PV panels in a tree-like shape, often following natural phyllotaxis patterns like the 2/5 Fibonacci ratio found in oak trees. The purpose of this biomimicry is not just to look good; it is also to make more energy than fixed panels of the same size in the same amount of sunlight.

Objectives:

The main goals of a 300W solar tree project are to make electricity in a beautiful and eco-friendly way, use less traditional energy sources, and tell people about renewable energy.This includes getting as much solar energy as possible, making the building as space-efficient and structurally sound as possible, and maybe even adding features like shade or educational displays.

- **Maximize Solar Energy Capture:**

The main goal is to make the most of solar energy by turning sunlight into electricity as efficiently as possible.This means figuring out the best place and angle for the solar panels on the "tree" structure so that they can get as much sunlight as possible all day long.

- **300W Output:**

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- **Efficient Energy Conversion:**

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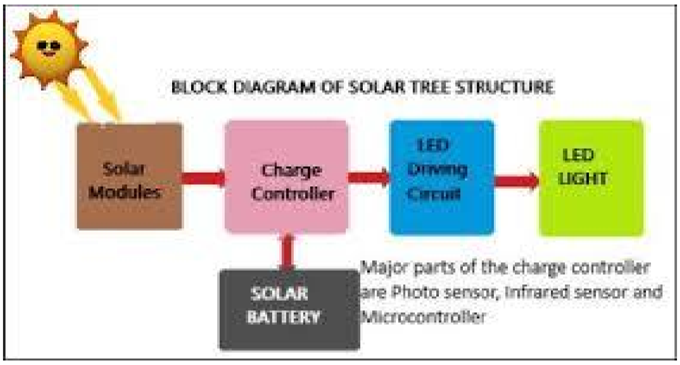
- **Renewable Energy Source:**

The project's goal is to use less fossil fuels and more clean, long-lasting energy.

- **Environmental Awareness:**

Solar trees can teach people about renewable energy and how to live in a way that is good for the environment.

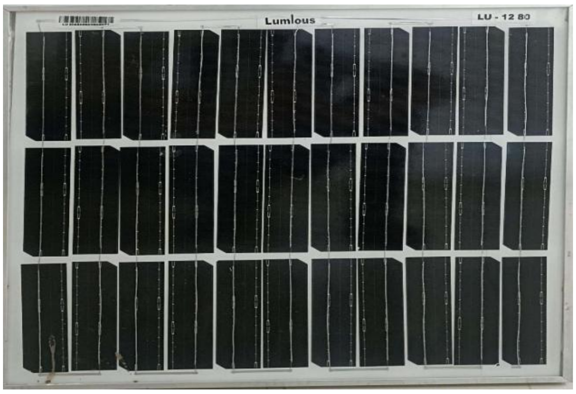
Block Diagram



System Components

Solar Photovoltaic (PV) Panels

The most important part of a solar tree is the PV panels, which turn sunlight into direct current (DC) electricity. Most of the time, they are put on the "branches" of the tree so they can get the most sun. The two most common types of PV panels are monocrystalline and polycrystalline. Black monocrystalline panels are more efficient and look better. Polycrystalline panels are less efficient but cheaper and have a blue tint.



Battery Bank

A battery bank is needed for an off-grid solar tree to store power for use at night or on cloudy days. The batteries store the direct current (DC) electricity that the solar panels make. Lead-acid and lithium-ion batteries are the two types of batteries that are most often used in solar applications. People are using lithium-ion batteries more and more because they last longer, work better, and can be drained more deeply. But at first, they cost more.

Inverter

If you want the solar tree to power regular AC devices like lights, fans, or charging stations, you'll need an inverter. The inverter turns the batteries' DC power into AC power. Solar trees might not need an inverter if they are mostly used to power DC loads like LED lights. There are two kinds of inverters: modified sine wave and pure sine wave. Pure sine wave inverters are more expensive, but they give off cleaner, more stable power that is better for sensitive electronics. .

Working / Methodology

The solar tree system is a stand-alone photovoltaic power generation unit that collects sunlight, stores it, and sends it to different loads. A block diagram can help you see the big picture by showing how energy moves and how the main parts work together.The first part of the system is the Solar Photovoltaic (PV) Panels. They are the main tools that gather energy. These panels collect sunlight and turn it into direct current (DC) electricity. After that, the panels send their DC output to a Charge Controller. This device is very important for making sure that the voltage and current from the solar panels are safe and effective for charging the Battery Bank. The charge controller also keeps the battery from being overcharged or deeply discharged, which makes it last longer. The Battery Bank stores DC energy and acts as a backup power source when solar generation is low or not happening at all. The battery bank sends DC power to the inverter. The inverter's job is to change the stored DC electricity into AC electricity, which is what most appliances and loads need. The AC Loads are the lights, charging stations for electronic devices, and small appliances that the solar tree powers. A built-in Monitoring and Control Unit watches over the whole system and collects data on things like how much energy is being used and produced, the state of the batteries, and the weather. This unit can also do extra things, like keeping track of panels or turning on lights by themselves.The energy only goes in one direction: from the panels to the battery and then to the loads. The inverter and charge controller take care of the changes and management that need to be made.

Conclusions

The 300W solar tree project shows that solar trees can provide energy while taking up less space and being good for the environment. The success of this project's design and implementation opens the door for more research and development into how to improve solar tree designs and use them in more places to help make the future of energy cleaner and more sustainable. The Solar Tree project has been tested and studied in an experiment. It has a 300W solar panel array made up of 5 40W panels and 1 100W panel. The results show that this is a good and useful way to use renewable energy. The calculations show that the peak power output is very high, and the simulated daily energy generation shows that it could meet a lot of daily energy needs.

Ideas for the Future

Better Maximum Power Point Tracking (MPPT): We need to do more research to make MPPT algorithms and hardware that are better and work better, especially for solar trees with different kinds of panels and changing shading conditions. This will make sure that each panel gets the most energy possible, no matter how much sunlight there is.Dependability and Trustworthiness: It's important to make solar tree systems more reliable and stable over time so that they can be used by a lot of people. This means making sure that their structure stays strong in bad weather and that their electronic parts last a long time.

Future Recommendations

- **Maximum Power Point Tracking (MPPT) Improvement:** Continued research is needed to develop more sophisticated and efficient MPPT algorithms and hardware, especially for heterogeneous panel configurations and dynamic shading conditions common in solar trees. This will maximize energy harvesting from each panel despite varying irradiation levels
- .**Dependability and Reliability:** Enhancing the long-term reliability and operational stability of solar tree systems, including their structural integrity under extreme weather conditions and the longevity of electronic components, is crucial for widespread adoption.
- **Cost-Optimization:** Reducing the high capital cost of solar trees remains a key challenge. Future efforts should focus on optimizing material usage, exploring alternative cost- effective materials (e.g., wooden elements with plastic abutments), simplifying designs, and streamlining manufacturing and installation processes to achieve cost competitiveness with conventional PV systems.
- **Inverter Design and Integration:** Developing inverters specifically optimized for the unique electrical characteristics of solar trees, including managing multiple strings with varied outputs and minimizing conversion losses, is an important area for innovation.

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