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DESIGN AND PERFORMANCE ANALYSIS OF SOLAR TREE IN SMART CITY

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Abstract: Solar Energy is accepted as a key resource for the future of the world. The utilization of solar energy could cover a significant part of the energy demand in the countries. One of the most popular example of utilized solar energy that is solar tree. Solar tree is a metal construction that resembles an actual tree. Solar panels are established on pinnacle of every branch. Generated power will be to be had to anybody and it'll be used for charging batteries of cellular phones and portable computers. The location around the solar tree would turn out to be an area in which college students and their buddies can gather to recharge their gadgets and, at the equal time, whilst they wait, exchange ideas, advices and their experiences with each other.

Index Terms: solar panel, battery, inverter, Long tower, LED.

1. INTRODUCTION

A solar cell (photovoltaic cell or photoelectric cell) is a solid state electrical device that converts the energy of light directly into electricity by the photovoltaic effect. The energy of light is transmitted by photons-small packets or quantum of light. Electrical energy is stored in electromagnetic fields, which in turn can make a current of electrons flow.
Assemblies of solar cells are used to make solar modules which are used to capture energy from sunlight. When multiple modules are assembled together (such as prior to installation on a pole-mounted tracker system), the resulting integrated group of modules all oriented in one plane is referred as a solar panel. The electrical energy generated from solar modules, is an example of solar energy. Photovoltaic is the field of technology and research related to the practical application of photovoltaic cells in producing electricity from light, though it is often used specifically to refer to the generation of electricity from sunlight. Cells are described as photovoltaic cells when the light source is not necessarily sunlight. These are used for detecting light or other electromagnetic radiation near the visible range, for example infrared detectors, or measurement of light intensity.

2.THE PROPOSED SOLAR TREE SYSTEM

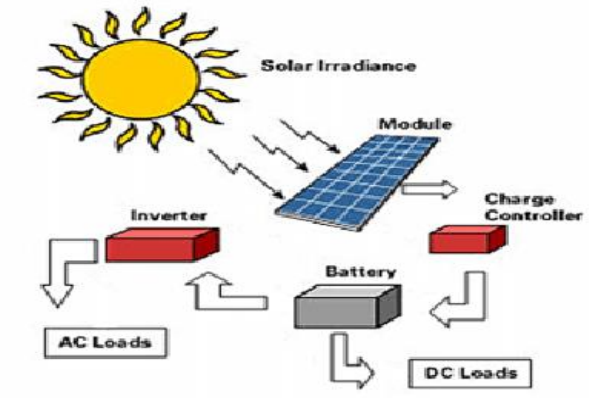

Fig.1 Block Diagram of Proposed Method

2.1 How Solar Cell Works

Solar cells, which largely are made from crystalline silicon work on the principle of Photoelectric Effect that this semiconductor exhibits. Silicon in its purest form- Intrinsic Silicon- is doped with a dopant impurity to yield Extrinsic Silicon of desired characteristic (p-type or n-type Silicon).When p and n type silicon combine they result in formation of potential barrier.
Working of Solar cells can thus be based on two crystalline structure

- Intrinsic Silicon

- Extrinsic Silicon

2.2 Pure Silicon (Intrinsic) Crystalline Structure

Silicon has some special chemical properties, especially in its crystalline form. An atom of silicon has 14 electrons, arranged in three different shells. The first two shells- which hold two and eight electrons respectively- are completely full. The outer shell, however, is only half full with just four electrons (Valence electrons). A silicon atom will always look for ways to fill up its last shell, and to do this, it will share electrons with four nearby atoms. It's like each atom holds hands with its neighbours except that in this case, each atom has four hands joined to four neighbours. That's what forms the crystalline structure. The only problem is that pure crystalline silicon is a poor conductor of electricity because none of its electrons are free to move about, unlike the electrons in more optimum conductors like copper

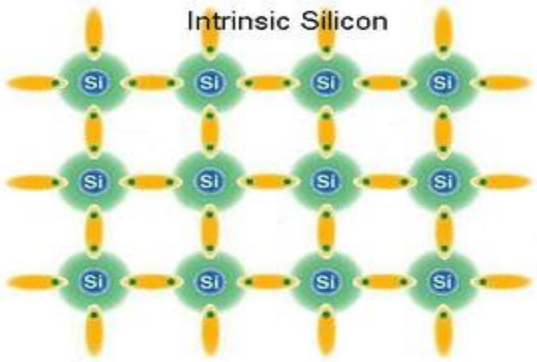

Fig.2 Intrinsic Crystalline Structure

2.3 Impurity Silicon (Extrinsic): P-type and N-type Semiconductors

Extrinsic silicon in a solar cell has added impurity atoms purposefully mixed in with the silicon atoms, maybe one for every million silicon atoms. Phosphorous has five electrons in its outer shell. It bonds with its silicon neighbor atoms having valence of 4, but in a sense, the phosphorous has one electron that doesn't have anyone to bond with. It doesn't form part of a bond, but there is a positive proton in the phosphorous nucleus holding it in place. When energy is added to pure silicon, in the form of heat, it causes a few electrons to break free of their bonds and leave their atoms. A hole is left behind in each case. These electrons, called free carriers, then wander randomly around the crystalline lattice looking for another hole to fall into and carry an electrical current. In Phosphorous-doped Silicon, it takes a lot less energy to knock loose one of "extra" phosphorous electrons because they aren't tied up in a bond with any neighboring atoms. As a result, most of these electrons break free, and release a lot more free carriers than in pure silicon. The process of adding impurities on purpose is called doping, and when doped with phosphorous, the resulting silicon is called N-type ("n" for negative) because of the prevalence of free electrons. N-type doped silicon is a much better conductor than pure silicon. The other part of a typical solar cell is doped with the element boron, which has only three electrons in its outer shell instead of four, to become P-type silicon. Instead of having free electrons, P-type ("p" for positive) has free openings and carries the opposite positive charge.

3. SOLAR TREE:

As we know trees are present in nature and they can produce their own food material by the process called photosynthesis. It is the process by which the green plant collects energy from sun and the water present in soil at the day time and can produces their own food material. By this process they are indirectly providing food to the human society because we are depending on the green plants for our food directly or indirectly.

Here we are considering the example for understanding about the solar tree. This is a tree in which the stems connected acts as the branches of the tree and the solar panels are like the leaves. Green leaves are producing food materials for human beings likewise this leaves are producing energy for the society. So it is very appropriate to called it as a tree.

Natural Tree

Solar Tree

3.1 Why it is needed

- Due to less land requirement
- Efficient energy generation
- It can collect energy from wind

The solar tree consists of some important parts in its design. They are as follows:

- Solar panels
- Long towers
- LDES
- Batteries
- Stems for connecting the panels

Working:

- Battery charging takes place during the day.
- LEDs are utilised to show how much charge or energy is still available and are turned on automatically.
- Energy is also stored in batteries so that we can use it at night and on overcast days when there is no sunlight.

Advantages of Solar Tree

- Ecologically Friendly
- Low Maintenance
- Decreased Electrical Bill
- High Efficiency
- Land requirement is very less

Disadvantages of Solar Tree

- Operating and maintenance cost is high
- May cause hazards to the birds and insects
- Hazards to eyesight from solar reflectors

Applications of Solar Tree

- Street lights
- House supply
- Industrial power supply
- Charging Bolts for Electric Vehicles
- Mobile charging

4. Experimental setup

5.CONCLUSION

Solar trees are the answer to the problem of not having enough space. They can be built anywhere and put up anywhere in the world where there is enough sunlight. The sun tree can make electricity almost everywhere on Earth. And the most important thing about the solar tree is that it only needs a small amount of room to be set up. You don't need a lot of land to set up solar panels that produce the same amount of electricity. The solar tree only needs 1% of the land that is usually needed for other ways. The solar tree does not stop the flow of electricity. On a very small amount of land, it is possible to make enough electricity to power the whole world.

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