

# SOLAR ENERGY OPTIMIZATION USING ARDUINO BASED MAXIMUM POWER POINT TRACKING SYSTEM

B V V Anjaneyulu<sup>1</sup>, B. Prasanna Kumar<sup>2</sup>, D Dushyant<sup>2</sup>, K Likitha<sup>2</sup>, A Kusuma Kumar<sup>2</sup>

<sup>1</sup>Assistant Professor, Dadi Institute of Engineering & Technology, Anakapalle

<sup>2</sup>Student, Dadi Institute of Engineering & Technology, Anakapalle  
[bvveeranjaneyulu@diat.edu.in](mailto:bvveeranjaneyulu@diat.edu.in), [bodiprasanna4919@gmail.com](mailto:bodiprasanna4919@gmail.com)

**Abstract:** Now a day's solar power is very helpful in our everyday life. This power is used in many ways such as homemade electrical appliances, vehicles, satellites and industries etc. The title of this project is "Solar Energy Optimization Using Arduino Based Maximum Power Tracking System". This movement is achieved by installing a couple of servo motors with the solar panel that changes its direction according to the positioning of the sun. There are basically three major parts of this project, sensor, microcontroller and two servo motors. ATmega328 microcontrollers have been used for this purpose. It receives sensor output signal and controls servo motors according to the assigned program. One servo motor is used horizontally to move the panel upward and downward. The other is used vertically from left to right direction. As the solar panel is connected in servo motor so the position of solar panel is same to the servo motor. Since the maximum solar ray is fallen down on the solar panel module so that the maximum power output can be achieved

**Keywords:** Energy consumption, ARDUINO, Microcontroller, seromotor, solarpanel, powersupply.

## 1. Introduction

Solar tree represents a metal construction that resembles a real tree. Solar panels are put on top of its "branches". Utilizing the sunlight energy, solar panels produce electric energy which is then used for charging batteries of mobile phones, tablets, laptops etc. and, additionally, as an element of street lighting. Its attractive and modern design will complement the public areas of our campus and it'll be integrated completely into the architectural design of the Faculty of Electrical Engineering (ETF) at the University of Sarajevo, thus allowing all students and visitors on campus to freely use its resources. Alongside the promotion of renewable sources of energy, Solar tree also promotes the use of energy efficient technologies, ie. LED street lighting.

## 1.2 Objective

The main objective of this project is to track the sun and rotate the solar panel accordingly to receive sunlight to the full extent during the day time. How to optimization of solar energy using MPPT with an Arduino. Look at the viability and technical feasibility of MPPT, looking into the background of solar power globally and giving details on the different methods of MPPT. How to using an Arduino in this system. Design a DC-DC converter solution to connect the solar panel to the load.

## 2. Overview

In this paper we will describe solar energy and MPPT, where we will elaborately describe Solar energy history, Definition, solar panel, working principle of solar panel, solar PV cell, Definition of MPP & MPPT, P&O method and advantage & disadvantage of MPPT etc.



**2.1 Advantages:**

The following are the advantages of energy consumption monitoring and controlling are:

- Very simple and easy to implement and does find true MPP.
- It can be taken as either an Analog or Digital technique of MPPT.
- Most commonly used so information is widely available.
- Provides predictive and accurate solutions to MPPT under PSC.
- No oscillation during tracking and steady state operations

**2.2 Limitations:**

The following are the disadvantages of energy consumption monitoring and controlling are:

- Under rapidly varying irradiance & load conditions the system can track in the wrong direction.
- The size of the change in operation voltage chosen determines the speed & convergence of the MPP and the range of oscillation.

### 3. Methodology

Solar tree has unique properties in terms of height and multi - angle orientation parameters. By employing the height parameter, solar tree requires less space consumption which can reduce the installation cost. Compared to the traditional solar farm which is oriented in a single direction, the multi-angle orientation parameter from the solar tree panels yields the potential capability to absorb higher sunlight intensity leading to higher output energy. At the same time, this parameter eliminates the necessity to install solar tracker which can reduce the operational cost. To increase the collection Generation of 1MW power from PV module system requires the land of 5-6 Acres approximately for housing the panels only. A tall polelike structure would take only 1% of land area in comparison to general PV housing. In India there is scarcity of land in urban and even in rural areas. . It can also be locked at any position to withstand the wind pressure due to heavy storm affecting over the main pole/ trunk. The panels will be naturally facing towards the sun at an angle as required so that they can collect maximum solar energy in a daytime. To get the maximum sun in a day time the top panel should not obstruct the bottom panels.

Solar Tree is having a tree like structure made of metal bars and solar boards. Masterminded in such a manner, that shadow of any solar board is fall on other solar boards subsequently winding style plan of solar boards are generally utilized, as a result of such structures it requires less space and it might be presented close by the streets or in a nursery. The primary concern that must be caring about that shadow of anything not fall on the boards it may lessen the capability of solar Tree.

#### 3. 1 PRINCIPLE COMPONENTS USED IN THE SOLAR TREE

1. Numerous solar boards
2. Secure metal pole
3. Various lights
4. Battery units
5. Metallic trunk and branches for interfacing out numerous solar boards

There are numerous solar boards utilized in the solar tree for harnessing most extreme power yield from the solar energy. The solar boards are mounted in various ways to expand the surface region so as to catch more sunlight.

**Secure Metal Pole:** The secure metallic pole gives auxiliary honesty to the solar tree to fabricate, and consequently make the solar tree to withstand in any climatic condition.

**Various lights:** There are different LED's lights that are associated with the solar tree for using the electrical energy from the solar tree to change over it into light, as such shining each corner around the solar tree with light.

**Battery Units:** Battery units are utilized to store the produced electrical energy from the solar boards and afterward store it as chemical energy for additional utilization later on. The put away chemical energy is then changed over to electrical energy upon employments.

**Metallic trunk and branches:** The metallic trunk and branches are utilized for supporting the mounted solar boards, lights and battery packs. The metallic stem and branches gives various positions and points to the solar boards for catching solar energy

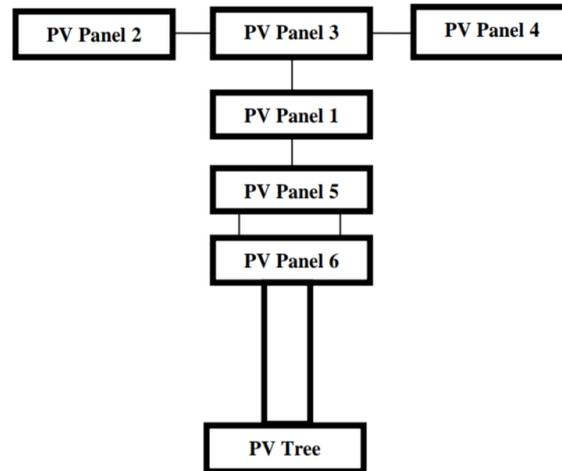


Figure 1: Design of Solar Tree

## 4. Hardware Description

### 4.1 Solar Photo Voltaic Cell

A solar photo voltaic or solar cell is a device that converts light in to electric current using the photoelectric effect. SPVs are used in many applications such as railway signals, street lighting, domestic lighting and powering of remote telecommunication systems. It has a p-type of silicon layer placed in contact with an n-type silicon layer and the diffusion of electrons occurs from the n-type material to the p-type material. In the p type material, there are holes for accepting the electrons. The n-type material is rich in electrons, so by the influence of the solar energy, the electrons move from the n-type material and in the p-n junction, they combine with holes. This creates a charge on either side of the p-n junction to create an electric field. As a result of this, a diode like system develops which promotes charge flow. This is the drift current that balances the diffusion of electrons and holes. The area in which drift current occurs is the depletion zone or space charge region that lacks them mobile charge carriers.

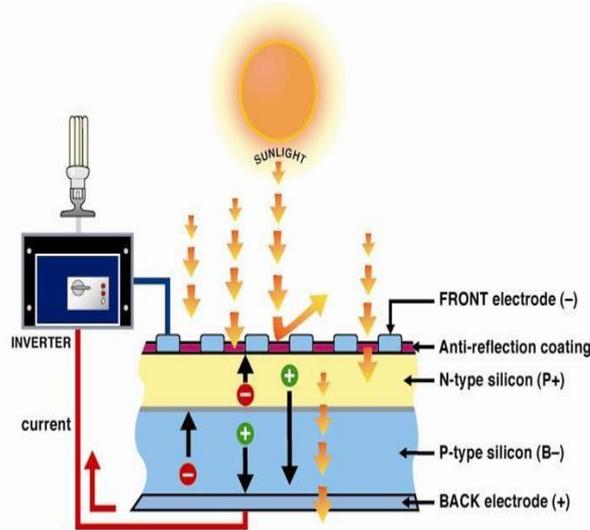


Fig.2 Solar Photovoltaic (SPV)Cell

#### 4.2 Hardware Developed:

A prototype of proposed system is fabricated to test the feasibility of Solar Tree system. Solar PV Panels are mounted on a single tall pole (stem) with the help of suitable supporting base. The arrangement of solar panels maintains a 'Phyllotaxy' pattern. Two stems is fabricated from M.S. pipe of 3" diameter and about 6 feet in height. The stem is made in two parts to facilitate rotation of solar Tree for tracking the sun. The lower part is fixed and the upper part has the provision of rotation on which panels are mounted. At the bottom of lower stem (pipe) a nut is welded and at the lower part of upper stem, screw is welded, which can rotate in that nut. This arrangement is better than pivot bearing assembly because it rotates as per requirement [4]. The bearing assembly rotates more freely which is not desirable and difficult to stop or control the rotations when there is high wind flow. The upper stem part locked by tightening the locking bolts. Structural support for panels cross base is used so that the structure is balanced and bears the load acting on it. To support the PV panels four arms of round bent up pipe are welded to upper part of the stem. Solar panels are mounted on angle brackets on these arms of the tree.

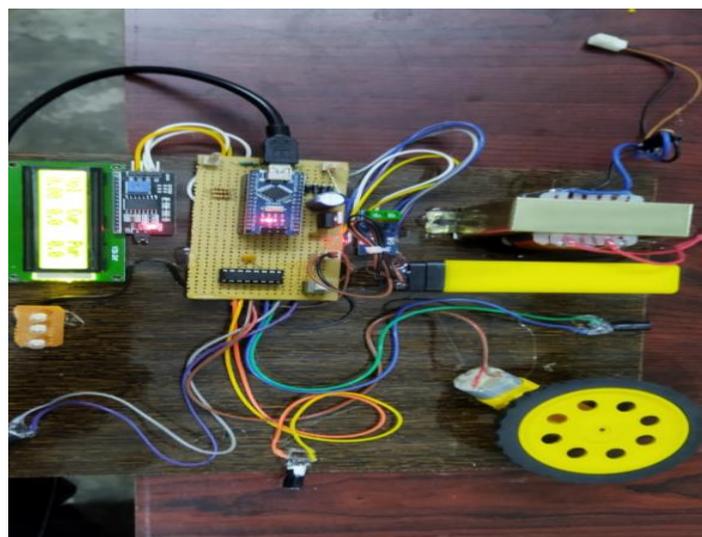


Fig:3 hardware developed

Angle joints is adjustable and are made up of stainless steel and can be adjusted with the help of Allen key. With this system, solar panels can be inclined to latitude or any other required angle (winter and summer correction) manually to get maximum sun radiations.

## 5. CONCLUSION

In simple terms this paper objective is to have a solar panel outputting its maximum possible power all of the time, this occurs when track the sun and rotate the solar panel accordingly, to receive sunlight to the fullest extent always during the day time. In this paper we learned about parameters influencing energy conversion of Photovoltaic (PV) arrays. Also Learned about the general concept of Maximum Power Point (MPP) and how to program burn an Arduino.

## 6. Future scope

Agreeing every above actuality, we can reason that the solar trees are need of things to come on the grounds that these are inexhaustible wellsprings of energy and in coming time these are turned out to be exceptionally famous on the grounds that the prerequisite of land is less and daylight accessible till what's to come. In India the researchers of Central Mechanical Engineering Institute of Research (CSIR-CMERI) made a solar tree which can edify five houses one after another by utilizing just 4square feet of the land. In India there is an excessive amount of populace and the land is less and the necessity of energy is high so the solar trees are as an elective arrangement of these issues. In futurethis can be utilized in house supplies, mechanical supplies and as a beautifying figure.

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