A Survey on PVT Module Optimization

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Abstract – A sun PV array system is created from the following components - solar cells, panel modules, and an array gadget. Thus, standard most efficient design of a sun PV system contains the top-quality design of the additives at three degrees - sun cellular, panel module, and array. The conversion performance, energy output, and incident sun energy concerning the requirements of seasonal demands are to be considered within the method. The most beneficial design parameters chosen here are period of channel, intensity of channel, speed of fluid in the cell, and temperature of the cell. The goal function of the proposed optimization algorithm which is mixture of Gravitational Search Algorithm (GSA) and particle swarm optimization (PSO), implemented for layout optimization of the system is the energy efficiency, which has to be maximized. Simulation results of design optimization of single channel Photovoltaic (SCPVT) device by way of using PSO-GSA, GSA and Genetic Algorithm (GA) are acquired and as compared. Simulation consequences show that hybrid PSO-GSA has better overall performance as compared to GSA and GA when all algorithms are computed for same iterations and populace size.

Index Terms – PV, GSA, PSO, SCPVT, Cellular, Panel Module.

1. INTRODUCTION

1.1 Internet of Things:

The hybrid photovoltaic thermal (PVT) module is a group of collector with the supply of a channel or channels to transform solar strength into thermal and electrical energies concurrently. The PVT collector can be used every time each electrical and thermal strength are required, for domestic uses. It is widely known reality that the performance of the photovoltaic cells decreases as running temperature will increase. Therefore, the usage of those cells as a hybrid photovoltaic thermal collector is better and a greater green for cooling the cells in addition to getting thermal power. Another method for cooling the PV cells is to use a warmth alternate machine, which cools the cells via a heat soaking up medium, consisting of water, flowing in pipes. The warmth removed from the cells effects in warm water. Another benefit of the PVT collector is its better overall efficiency consistent with unit vicinity and lower packaging prices because of its compact layout. Solar PV has mounted huge applications in rural regions for diverse crucial activities except rural domestic lighting fixtures. Crystalline silicon solar cellular generation is more spread, green and extra mature generation in the global due to the subsequent motives:

- Almost 26% of the earth's crust contains silicon mostly in the form of silica and silicates from which silicon is obtained. So we can say that silicon is the second richest element available in the earth's crust, after oxygen. Most of the other elements such as Ga, In, As, Cd and Te, are not available in such fabrication.
- Crystalline silicon has high life time and stability and it is safe to handle and environmentally friendly. Other materials such as As, Te, Cd and S, are either hazardous or toxic.
- Silicon has some other important properties which are helpful for its large scale utilization includes its high degree chemical stability with an extremely low vapor pressure, single phase behavior and a factor which helps during its process treatment at high temperature. In addition, stable and thin oxide layers which are highly insulating and can be quite easily grown on silicon surfaces, in order to meet the technological requirement and to achieve surface protection.
- For almost six decades, silicon device technology has been experimented and improved upon to a very high degree of technological maturity and sophistication. Such a prosperous technological experience is not available with any other semiconductor.

1.2 HYBRID PHOTOVOLTAIC THERMAL SYSTEM

A PVT collector is a system wherein the electrical and thermal strength produced concurrently by the photovoltaic. In this way, heat and electricity are produced simultaneously; it's also called co-technology gadget. Since the demand for sun heat and solar strength are regularly additional, it seems a logical idea to broaden a tool which could satisfy with both needs. The thermal electricity to be had at the PV module can be tapped by way of flowing air/water within the duct or channel. This proposed gadget is known as PVT collector and the class is shown in Figure 1.1. In programs of PVT machine, the primary painting of the PVT module is to supply power, and therefore, it is vital to perform the PV modules at low temperature if you want to maintain the PV cellular electrical efficiency at an enough level. The heat from the lower back surface of PV modules is withdrawn with the help of natural or pressured air move. It is simple and low fee techniques to cast off warmth from PV modules; however they're less powerful when ambient air temperature is over 25°C. To conquer this problem, the warmth may be extracted by way of circulating water via a warmth exchanger that is installed on the again surface of the PV module.

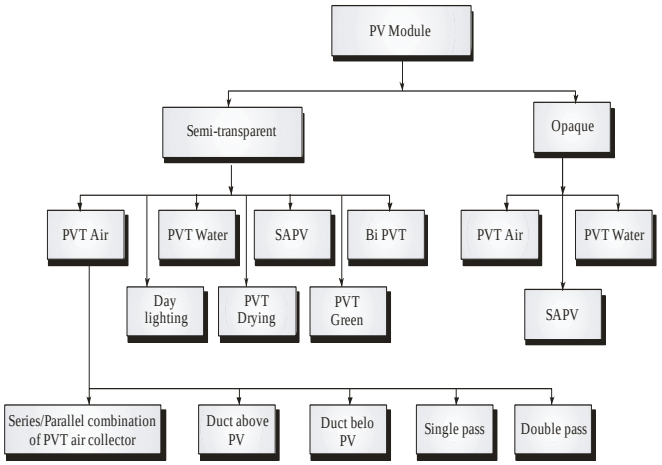

Figure 1.1: Classification of photovoltaic systems on the basis of their use

2. RELATED WORK

Literature review of the solar cell:

1]. Arturo et.al (1985) described a method for the optimization of the attention element in phrases of length and nominal performance (at an intensity of 1sun) through assuming realistic values of the specific resistance among the grid touch styles and the semiconductor. simplest the connection between the conversion efficiency (ηc and concentrated sunlight (C) to the duration of a cellular changed into taken into account. Arturo (1985) did no longer indicate a process to optimize sun cells.

2]. Gessert et.al (1992) reviewed the models and techniques applied to layout and optimize metal contacts and antireflective coatings and recognized the variations between grid metallization of cells used underneath electrical resistivity through the use of a laptop program. A drawback of Gessert's take a look at is that it did no longer take a look at the layout the presence of constraints on design variables.

3]. Reeves and Harrison et.al (1982) received the specific touch resistance from the transmission line model measurements. In pinnacle contact design, it's far essential to locate values of specific contact resistance for planar ohmic contacts between steel elements and the top floor of a sun cellular due to the fact the touch resistance impacts conversion performance of a solar cellular. Two distinctive sheet resistances of GaAs and Si have been in comparison and measured.

4]. Kulushich et.al (2013) provided a method to optimize the front geometric parameters with a attention of power losses, which include the optical, digital, and electrical losses of metal grids. In this work, sun cellular structure and attention ratio were not taken into consideration. The ensuing cost of most conversion performance.

5]. Caballero, Martinez, Sanchez-Friera, and Alonso et.al (2008) tested the front grid layout in commercial silicon solar cells. They investigated the characteristics of collection resistance.

6]. Liou and Wong et.al (1992) centred on improvements in Si and GaAs sun cellular overall performance. They investigated ultimate solar mobile efficiency by way of directing their look at the semiconductor layer thickness and impurity doping concentration. Also, the minority-carrier lifetime, the minority-service diffusion coefficient, and the surface recombination speed were contemplated in sun cell design..

2. Literature review of the panel module:

7]. Tian, H., el. al (2012) provided a cellular-to-module-to-array information for photovoltaic panels. The paper taken into consideration a PV module centered on some of connected cells in collection and parallel. The most important consideration become a way to design circuits with a number of cells and panels.

8]. Jiang, H. et. al (2011) performed an experimental research at the impact of airborne dust deposition at the performance of solar photovoltaic (PV) modules. They investigated the transmittance of sun cells, which impacts degradation of conversion efficiency with PV panels, and analyzed dust accumulation onto different types of sun PV panels.

9].Abiola-Ogedengbe et.al (2015) performed an experimental observe on wind consequences on a stand-on photovoltaic (PV) module the use of four distinctive wind directions.

10]. Shah, et. al (2011) studied diagnostics of thin-film silicon sun cells and sun panels with variable depth measurements (VIM). The VIM approach became used for figuring out the problem referring to a defective cell or module.

11]. Rosa-Clot et.al (2010) investigated the performance submerged of photovoltaic sun panels. This paper confirmed the conduct of a photovoltaic panel submerged in water and its varying strength production characteristics.

2. Literature review of the PV array:

12]. Murtaza et al. (2014) investigated a most strength point tracking approach primarily based on skip diode mechanism for PV arrays beneath partial shading. The consequences of partial shading are because of multiple PV arrays and environmental situations. From this paper, numerous critical observations were talked about by using two complete PV models in which sorts of diodes (bypass and blocking).

13]. Orozco-Gutierrez et. al (2014) offered a method for simulating massive PV arrays that include opposite biased cells. They showed an effective algorithm for simulating a large mismatched PV array using inverse Jacobian matrix and located the array behavior at a cell stage so one can accurately

expect electricity manufacturing and detect or diagnose risky situations for the PV array.

14]. Kouchaki et. al (2013) carried out a new most electricity point monitoring approach for PV arrays below uniform and non-uniform insolation conditions primarily based at the cutting-edge and voltage traits of PV arrays for finding the most energy factor.

15]. Sivakumar et al. (2015) investigated the analysis and enhancement of PV performance with incremental conductance Maximum Power Point Tracker (MPPT) technique below non-linear loading situations. To achieve this, they carried out each simulation and experiment for the evaluation of the PV panel beneath non-linear loading situations.

2. Literature review of uncertainty analysis:

16]. Cabral et. al (2010) studied a stochastic approach for stand-by myself photovoltaic machine sizing. The willpower of the top-quality size of a PV system calls for the characterization of solar radiation. Therefore, they carried out stochastic optimization with random traits of solar radiation and compared the outcomes obtained the use of the average measured and simulated monthly average daily global radiation on an willing panel module.

17]. Zhou et al. (2013) focused on a level programming version for the most useful design of allotted strength structures. The paper used a stochastic programming method. The technique becomes applied during the planning of a distributed energy gadget in a lodge. The mathematical version was used for the design of a allotted strength machine through classifying it into three one-of-a-kind sections: power era segment, energy conversion section, and energy storage segment. The solution strategy for the two-stage stochastic optimization trouble turned into based totally on genetic algorithms.

18]. Gautam et. al (2002) calculated the reliability evaluation of sun photovoltaic arrays the usage of the chance principle. The array performance changed into analyzed by using considering circuit design for solar cells using panel interconnections in series and parallel structures. The fuzzy set idea became added by using Zadeh (1965). Nowadays, this idea is being applied to infinite fields inside and past the scope of conventional engineering.

2. Literature review of multi-objective optimization:

19]. Li, Liao, and Coit et.al (2009) proposed a two-stage approach for solving multi-objective system reliability optimization problems using a Pareto optimal solution set. To find a solution, a multiple object evolutionary algorithm (MOEA) was applied. Basic trade-offs for the Pareto optimal solution set were investigated.

20]. Osman, Abo-Sinna, Amer, and Emam (2004) investigated a three-level non-linear multi-objective decision-making (TLN-MODM) problem with linear or nonlinear constraints. The paper proposed the concepts of tolerance membership function and multi-objective optimization at each level in order to develop a fuzzy decision model.

Serial no.	Technology used	Author's name	Advantage	Disadvantages
1.	Optimization of the element	Arturo, Abiola-Ogedengbe, A., Hangan, H., Siddiqui, K	Accurate result, enhanced all over performance	Not indicate optimization
2.	antireflective coatings	Gessert, Al-Hasan, A	more accuracy	no longer take a look at the layout
3.	touch resistance from the transmission line	Reeves and Harrison	Most Powerful Technique in solar cell	Noisy
4.	optimize the front geometric parameters	Kulushich, Antoniadis	Easy to classify, less power losses	More electrical losses
5.	front grid layout	Caballero, Martinez, Sanchez-Friera, and Alonso	Filter the accurately	false positive rates are high
6.	ultimate solar mobile efficiency	Liou and Wong Bony, L., Doig, S., Hart, C., Maurer, E.,	Long minority-carrier lifetime	time consuming
7.	cellular-to-module-to-array information	Tian, H., Brecl, K., and Topic, M	design circuits is easy	Availability of real world data

8.	airborne dust deposition	Jiang, H. Cabral, C.V., Filho, D.O., Diniz, A.S.A.C., Martins,J. H	High accuracy	Less capability, degradation of conversion efficiency
9.	wind consequences	Abiola-Ogedengbe ,Camps, X., Velasco, G., Hoz, J.D.L., Martin, H	High accuracy and high processing speed	Highly expensive
10.	variable depth measurements (VIM).	Shah, Chang, T. P	figuring out the problem referring to a defective cell, Good Performance,	Low accuracy
11.	submerged of photovoltaic sun panels	].Rosa-Clot, Chaudhuri, S. and Deb, K	Easy installation	Need to maintain, varying strength production characteristics
12.	strength point tracking approach	Murtaza, Goodrich, A., James, T., and woodhouse , M.	Easy numerous critical observations	over fitting

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