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A Novel Odd Even Configuration to Reduce Solar Power Mismatch under Partial Shading Condition

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Abstract: *In this project the effect of Partial Shading Condition (PSC) on various solar photovoltaic (PV) array topologies has been studied extensively. PSC reduces the maximum power of a PV array and produces multiple Maximum Power Points (MPPs) in the PV characteristics. A novel PV array configuration, as the Odd Even Configuration (OEC) named has been proposed to mitigate the effects of PSC under a diagonally progressing shadowing scenario and performance parameters like mismatch power loss, Fill Factor (FF) and Performance Ratio (PR), have been measured. The performance of the proposed OEC has been compared with pre-existing standard configurations such as TCT, SP-TCT, BL-TCT and BL-HC. Another recently proposed configuration has also been used for comparison. The effect of variation in temperature on the shade dispersion effect has also been studied. All the considered PV array configurations have been modelled configuration is found to be superior to other configurations for all the PSCs considered, with minimum power loss and improved FF.*

Keywords: Photovoltaic, Partial shading condition, Reconfiguration strategy, Global Maximum Point, Mismatch Power loss

I. INTRODUCTION

In the present scenario, the world is spiralling down into an energy crisis. Conventional energy resources like fossil fuels are being depleted at an alarming rate and may be completely exhausted in the next few decades. In a situation like this, it is only logical to look for an alternate source to meet our energy demands. A feasible alternative can be found in renewable energy resources, which offer easy availability and get replenished over time, so they would not be depleted. Though the renewable energy sources might be easily available, harnessing them to their full extent still remains a challenge. Some strides have been made in renewable energy technology, especially in the field of solar photovoltaic (PV) based power generation Out of all the renewable energy generation technologies, solar PV energy is the most dominant technology, owing to availability of sunlight over wide geographical area and direct conversion of sunlight to electricity. In the year 2018, the total renewable energy generation capacity was at 2195 GW, which represents 18.2% of global human energy consumption. Of this, the solar PV energy generation capacity is at 402 GW which accounts for 1.73% of global energy generation.

II. METHODOLOGY

2.1 Mathematical Model of PV System

To study the effects of partial shading conditions (PSC$_s$) and their mitigation on solar PV system a mathematical model of the solar PV array has been developed in MATLAB /Simulink environment. First a model for a single PV module is developed and then multiple such module are interconnected in different configuration to construct a solar PV array.

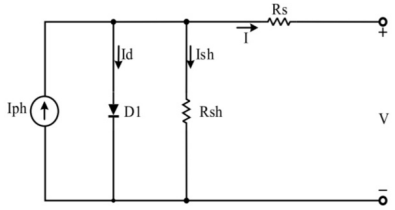

Fig 1. Equivalent circuit model of a solar PV module

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2.2. Odd Even Configuration

In this project a Novel configuration named the Odd Even Configuration (OEC),is presented as depicted in figure 2 .The electrical connections between the PV modules like the ASY configuration ,are made in a manner which is exactly the same as TCT configuration. But within a series column string all the PV modules belonging to the odd numbered row according to their electrical connection are clumped together physically within a PV array. After placing all the odd numbered module in this manner within a column they are followed by modules belonging to even numbered rows according the electrical connections which are again clumped together. Furthermore the physical position of module connected in the first row of a given column is shifted by a certain number of rows after every column in arithmetic position.

For an m*n PV array the row index of a module which is electrically connected in the ith and jth is determined by the following method

For a module which is connected in the first row of any given column its row index can be expressed as: R1j=1+ (j-1)2

For all other modules electrically connected in an odd numbered of rows, Rij = R1j+ (i-1) /2

For all the order modules electrically connected in an even numbered of rows,

Rij = R1j +m/2+i/2 – 1

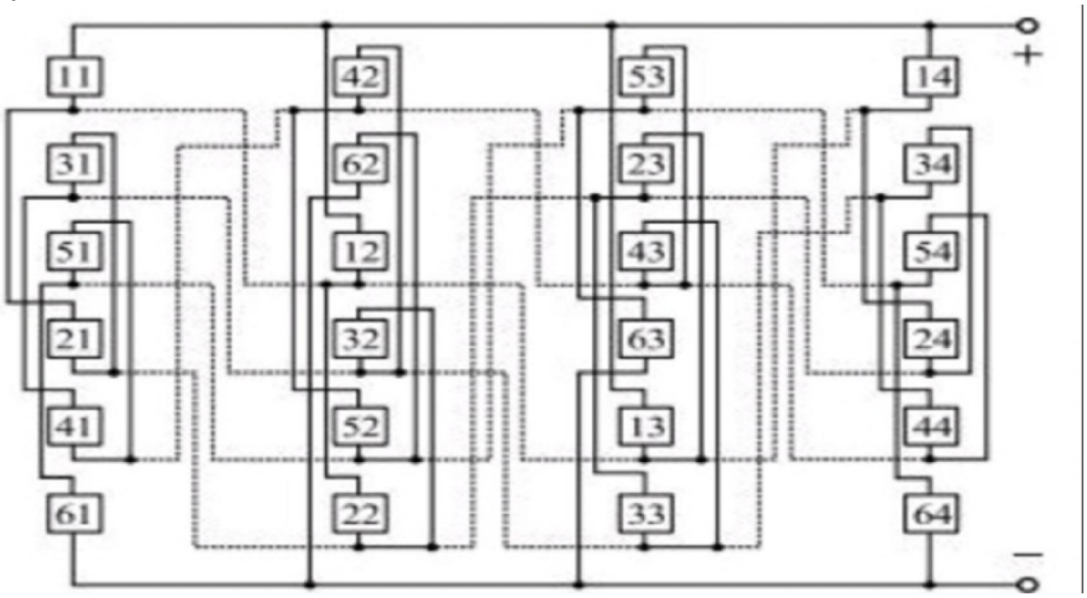

Fig 2.The interconnection of PV module within a 6 * 4 PV array with OEC

III. SOFTWARE REQUIREMENT

MATLAB (an abbreviation of Matrix LABoratory) is a proprietary multi paradigm programming language and numeric computing environment developed by MathWorks. MATLAB allows matrix manipulation, plotting of functions and data, implementation of algorithm creation of user interfaces and interfacing with program written in other language.

3.1 Software Used

MATLAB simulink

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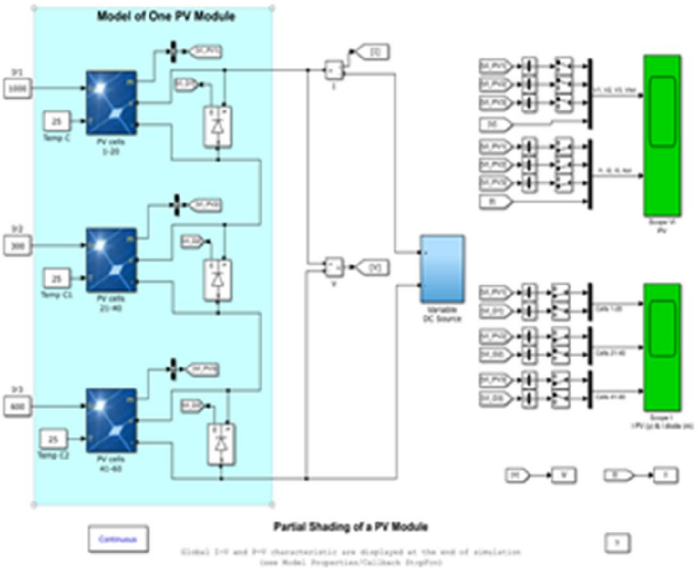
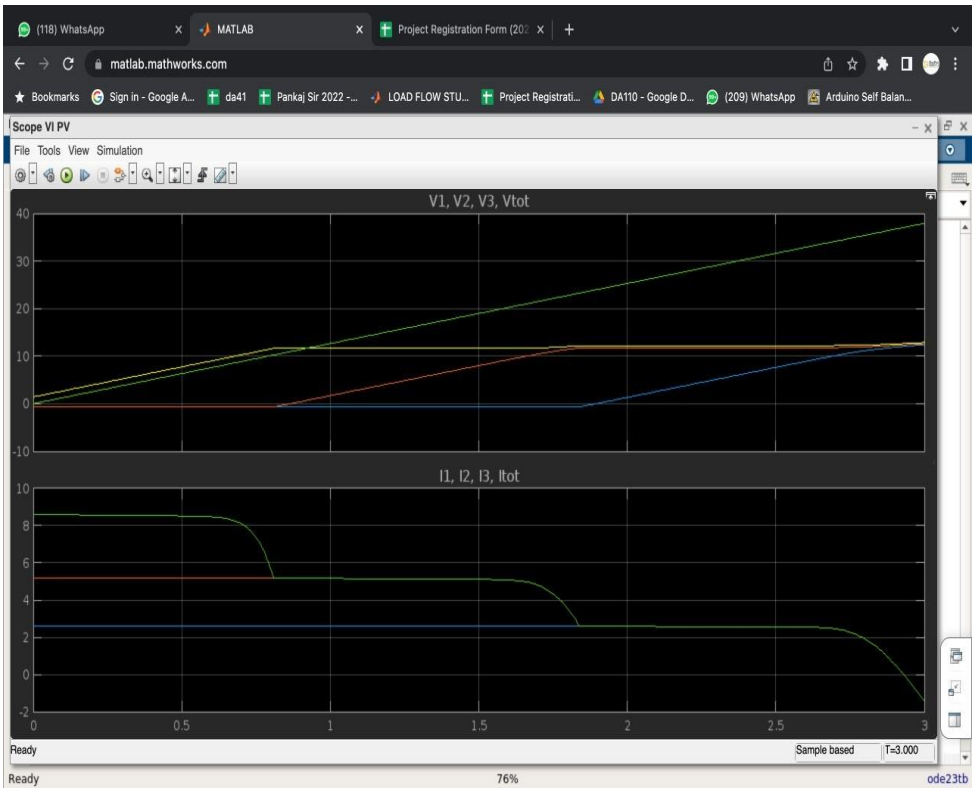
IV. RESULT





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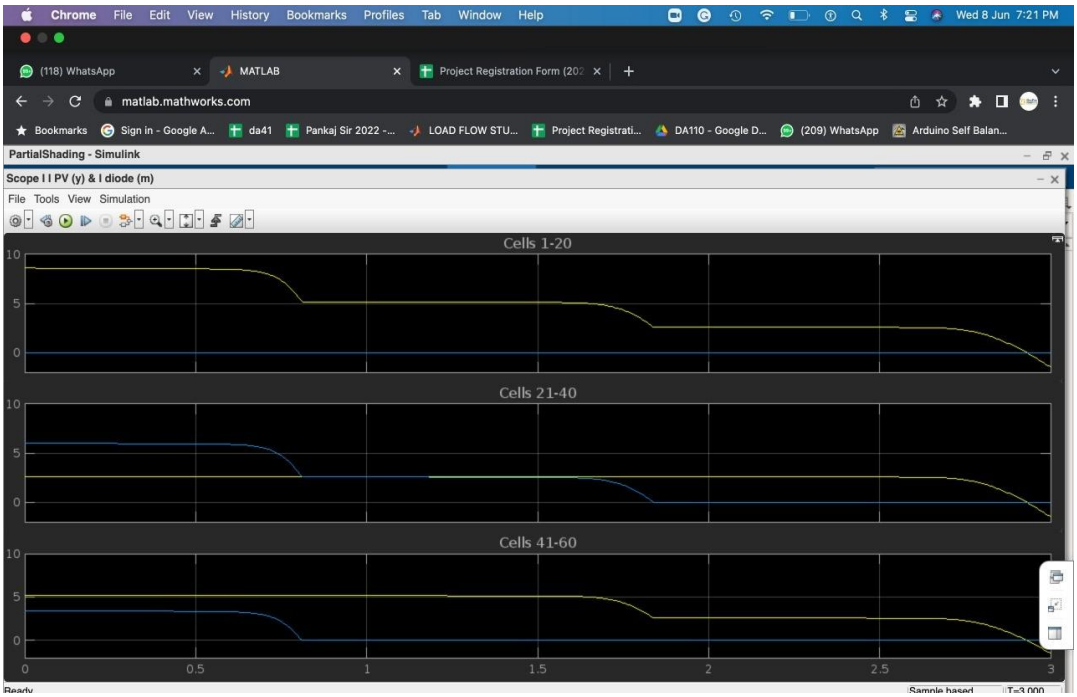

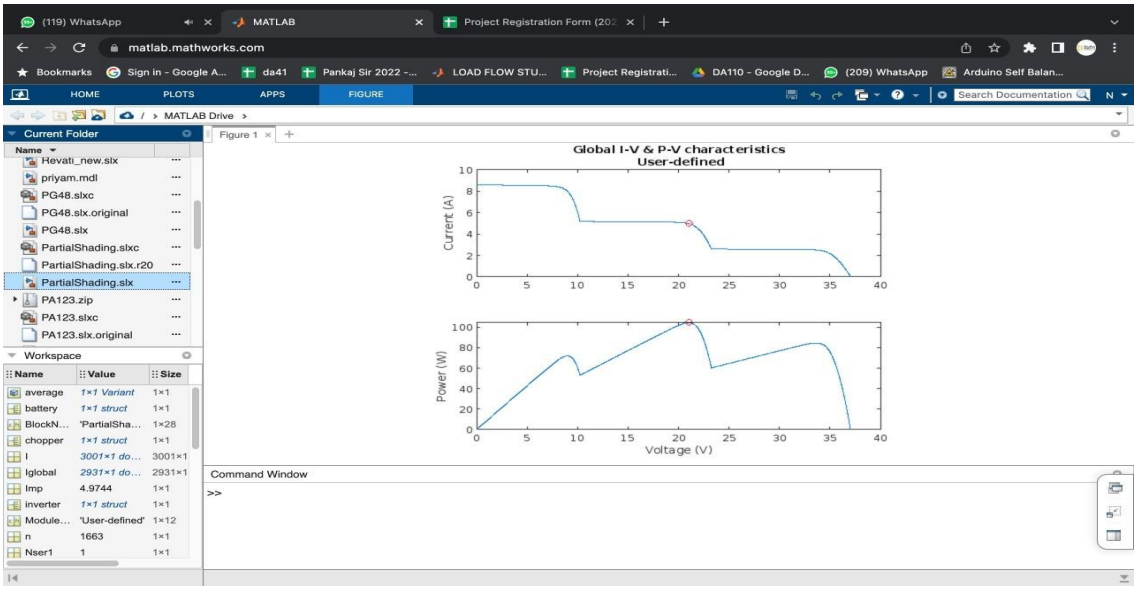

V. APPLICATIONS

1. Solar water heating.
2. Solar heating of building
3. Solar distillation
4. Solar pumping
5. Solar drying of agriculture and animal products
6. Solar furnaces
7. Solar cooking
8. Solar electric power generation

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9. Solar thermal power production
10. Solar green house

VI. ADVANTAGES

1. Solar power is pollution free and causes no greenhouse gases to be emitted after installation.
2. Reduce dependence on foreign oil and fossil fuels.
3. Renewable clean power that is available every day of the year, even cloudy days produced some power.
4. Return on investment unlike paying for utility bills.
5. Virtually no maintenance as a solar panel last over 30 years.
6. Creates jobs by employing solar panel manufactures, solar installers, etc. and in turn helps the economy.
7. Access power can be sold back to the power company if the grid inner tied.
8. Ability to live grid free if all power generated provides enough for the home/building.
9. Can be installed virtually anywhere; in a field to on a building.
10. Use batteries to store extra power for use at night.
11. Solar can be used to heat water, power homes and building ,even power cars
12. Safer than traditional electric current.

VII. CONCLUSION

Different PV array configuration, namely TCT, SP-TCT, BL-TCT, BL-HC, ASY and proposed novel configuration, OEC has been extensively studied and analysed. Various PSCs pertaining to a diagonally progressing shadow movements have been applied to the above configuration and the obtained parameters like maximum power, voltage, current ,mismatch power loss fill factor and % performance ratio have been used to assess and compare their performance. The effect of varying temperature on partially shaded PV modules has also been investigated. The extensive simulation results so obtained have been analysed.

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