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Maximum Power Point Tracking using Fuzzy Logic

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Abstract: ***The increasing need of power and limited resources obligated us to move towards the renewable energy (solar) sources. But renewable resources are suffering from many disadvantages like low efficiency, dripping and weather conditions. Due to this maximum power point tracking algorithms are important in PV system. The main advantage of the MPPT to minimize the size of PV panels and get maximum power from it.In order to increase power output from the solar panel the components of photovoltaic system is should be enhanced here different loads needs are need the different power minimum or maximum. To fulfill the requirement of the load we use MPPT technique. There are various method for increasing the power from solar panel and increases the efficiency. Such as P&O method, incremental conductance method and fuzzy logic. By using fuzzy logic algorithm we can increases the efficiency and power from PV system as compare to P&O method.***

Keywords: Photovoltaic System, Maximum Power Point Tracking (MPPT), Converter, P&O Method and MATLAB

I. INTRODUCTION

A developing country requires more energy. Now days most of the energy supplied by fossil fuel such as diesel, coal, petrol and gas is 80 % of our current energy. Increasing demand of energy results in climate change and energy crisis. As the global energy demand increases the greenhouse gas production increases, hence it is necessary to reduce CO2 emission and offer clean, sustainable and effective solution. Renewable energy is defined as the energy that comes from resources which are naturally refilled on human time scale such as sunlight, wind, rain, waves, tides and geothermal
heat. To recycle the natural energy most popular way is to utilize the solar energy using PV system. A PV cell is an electrical device that converts the sunlight directly into electricity by photovoltaic effect. PV system operate with little maintenance and free from pollution. Required voltage, current and power can be generated by attaching PV modules in series and parallel. In order to reduce the impact of environmental variation a maximum power point tracking (MPPT) controller is needed to optimally utilize the obtainable power. MPPT is a technique used commonly with wind turbines and photovoltaic solar system to maximize the power extraction under all condition. Several techniques of MPPT computation have been propounded and are classified as either conventional such as P&O, incremental conductance or intelligent such as fuzzy logic method. Using adaptive control fuzzy logic can be more flexible as step value of voltage can easily change. The performance of fuzzy logic controller can be optimize with the help of genetic algorithm. Here the comparison of conventional P&O algorithm and fuzzy MPPT logic is implemented.

II. PROPOSED SYSTEM

The block diagram of system as shown in fig. 1 It consist of pv panel, DC-DC converter, MPPT algorithm and load. To track the power from the solar panel various MPPT algorithms Are used. Such as P&O method, Incremental conductance and fuzzy logic etc. there are various converter are used to step up or step down converter to increase or decrease voltage or current form system

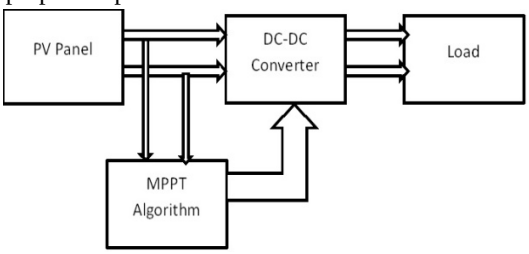

Fig.1 Block Diagram Of System

III. PHOTOVOLTAIC SYSTEM

Photovoltaic system for maximum power point tracking consist of PV panel, DC-DC converter, load and MPPT controller. The PV panel is made up of PV cells by connecting them in series or parallel. For the simulation the 72 polycrystalline cells are connected in series. A photovoltaic cell which act as semiconductor diode which convert visible light to a dc current. Single diode model is considered for simulation.

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IV. PV CELL CIRCUIT DIAGRAM

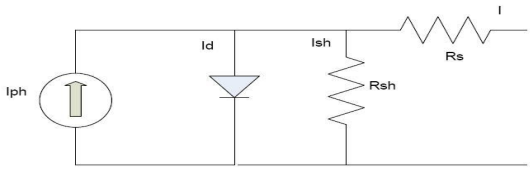

Fig. 2 Circuit Diagram Of PV Cell

The above model represent equivalent circuit diagram of PV System and is called four parameters model which consist of a current source, a diode, series resistance and parallel resistance. When the solar radiation falls on cell, the direct current generated varies linearly with solar radiation.

By applying KCL, the output current is given us

$$I=Iph-Id-Ish$$

Where ,

I= total current

Iph= photocurrent

Id= diode current

Ish= shunt current

The IV characteristics of ideal photovoltaic cell is given by

$$I=IpVcell-Id$$

Where,

$$Id=Iocell[exp(qv/akt)-1]$$

Therefore

$$I= Ipv, cell-Iocell[exp(qv/akt)-1]$$

Equation for total current

$$I=Ipv-Io[exp((V+IRs)/(Vta))-1]-(V+IRs)/Rsh$$

V. BOOST CONVERTER

Example applications of boost converter operation are the regenerative braking circuit of DC motors and in regulated DC power supplies. The step up converter can be applied to MPPT systems where the output voltage needs to be greater than the input voltage. Such as in a grid-connected system where the boost converter maintains a high output voltage even if the PV array voltage falls to low values. The circuit topology of the step-up converter.

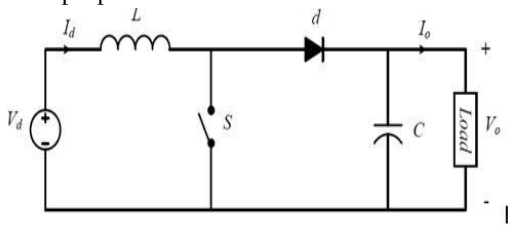

Fig. 3 Circuit Diagram of Boost converter

VI. PERTURB AND OBSERVE METHOD

The strategy of P&O technique is described in equation given below which gives change of power term.

$$P = Pk - Pk-1$$
$$P > 0$$

In the above equation P is the change in power. This change in power is calculated as given above equation by taking difference of actual power and the power calculated by taking delay to actual power. The magnitude of change in power is minimized; if it is already having minimum value then the maximum power points are tracked by this algorithm. shows the flowchart of P&O algorithm used in this work.

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VII. FUZZY LOGIC

In this method, the terms such as membership function, input variable and output variable are used. Apply fuzzy logic rules for maximum power point tracking algorithm using Simulink. The steps to design fuzzy MPPT algorithm are 1) Open fuzzy toolbox of MATLAB. 2) Select the number of inputs and outputs in the system. 3)Give the names to inputs and outputs with their ranges. 4)Run the model. In proposed system, two inputs namely error E(k) and change in error CE(k) and one output as duty cycle. Simulink model of Fuzzy MPPT algorithm used

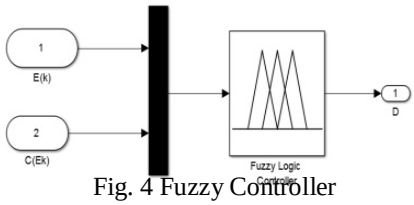

Fig. 4 Fuzzy Controller

Flowchart

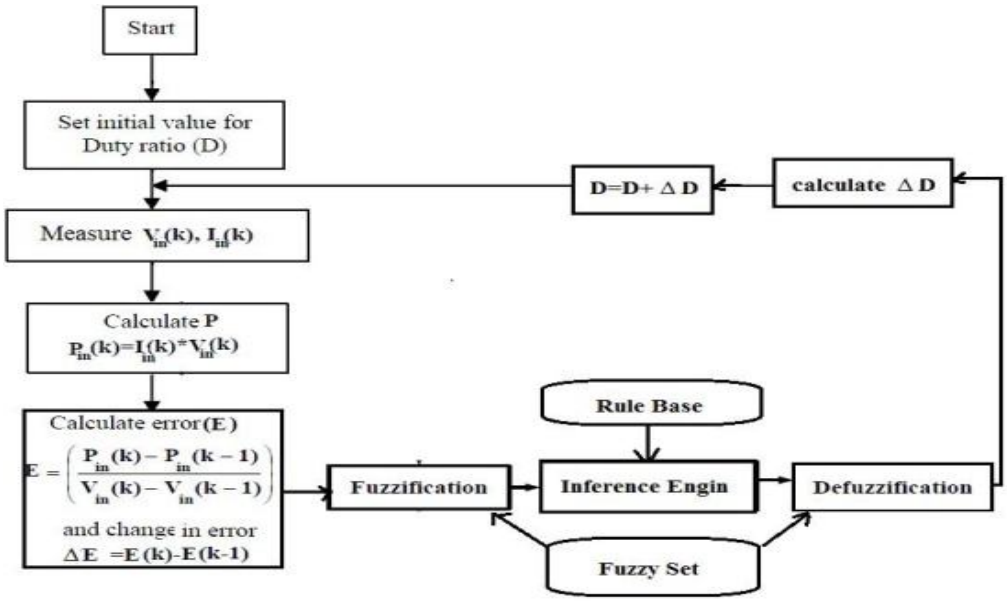

Fig.5 Flow Chart For Fuzzy Logic

Result

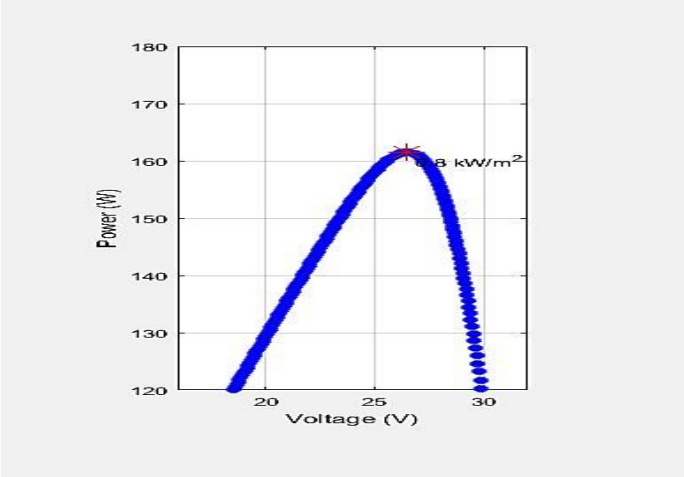

Fig.6 PV Curve

Simulink

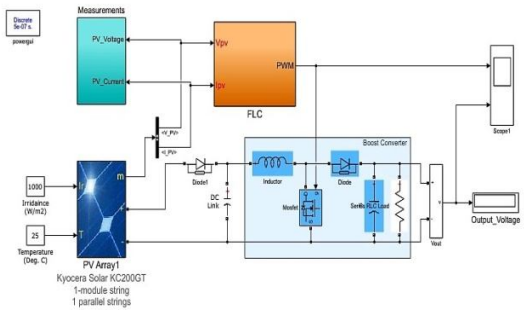

Fig. Simulink Model

VIII. CONCLUSION

Maximum Power Point Tracking (MPPT) controllers are often used to make sure that the PhotoVoltaic (PV) system is to operate in its maximum power point condition. This paper presents modeling of PhotoVoltaic system for various irradiances and temperatures. The efficiency of P&O based Maximum Power Point Tracking(MPPT) method is compared without MPPT method.

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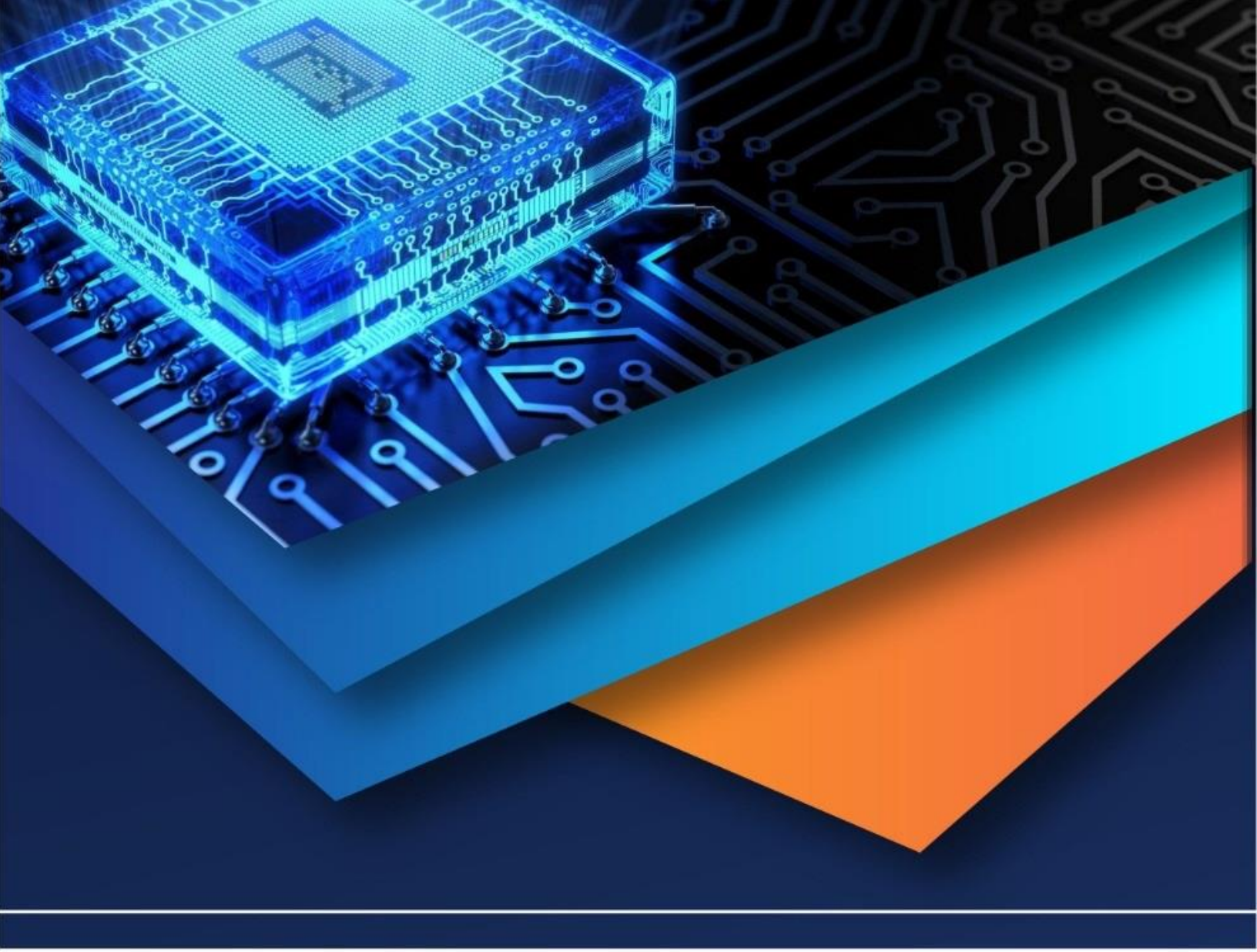

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