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Maximum Power Point Tracking for Photovoltaic Solar Pump Basedon ANFIS Tuning System

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Abstract – Solar photovoltaic (PV) systems are a clean and naturally replenished energy supply. PV panels have a novel purpose that represents the utmost obtainable power and this is rely on the environmental conditions like temperature and irradiance. A maximum power tracking (MPPT) is thus necessary for maximum potency. During this paper, a study of MPPT for PV water pumping system based on neuro-fuzzy reasoning system (ANFIS) is mentioned. This paper explains a design of maximum power point tracking (MPPT) supported reconciling neuro-fuzzy system for solar panel system. In a solar energy plant, MPPT serves to maximize the solar panel output power. The characteristics of solar panel performance forever follow the sun's line. Underneath nominal circumstances, the most solar panel output power is obtained as the maximum daylight intensity is achieved. This power can be decrease because the intensity of daylight decreases. Therefore, MPPT technology is required to maximize solar battery output power at any time. Many strategies are applied to MPPT technology. During this study the projected technique is reconciling neuro-fuzzy primarily based technique. MPPT supported by this reconciling neuro-fuzzy technique is mounted on an energy converter connected to the solar battery output. Together with this MPPT, it's expected that solar panels output power is often supreme. Solar panels with reconciling neuro fuzzy-based MPPT technique have been enforced in Simulink computer software. Supported the analysis results, they need been obtained that MPPT is ready to maximize solar panels output power well.

Keywords— MPPT, PV, ANFIS, DC Motor

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I. INTRODUCTION

Renewable energy sources are being progressively implemented in several applications due to the growing concern of environmental pollution. Photovoltaic (PV) is a technology during which the energy from the sun is converted to electrical energy. The use of photovoltaic power as the source for water pumping is considered as the most promising area of PV application.

The advantages of using water pumps charged by photovoltaic systems adds low maintenance, easy installation, reliableness and therefore the matching between the powers generated and therefore the water usage wants. Photovoltaic charged water pumping systems need only that there are adequate sunshine and a supply of water. Photovoltaic water pumping systems are appropriate for water supply in remote areas wherever no electricity supply is available. Water will be pumped up throughout the day and stored in tanks, and it will available in the night or once it's cloudy. The pumped up water will be utilized in several applications like domestic use, water for irrigation and village water provides [1-3].

The main objective of this work is to develop a general methodology for the analysis of the long run performance of an instantaneous coupled photovoltaic powered, water pumping system with maximum power point tracker. Within the present work, the variations in system performance ensuing from solar supply variations are taken into thought to ascertain a model for the entire system

There, a program is also developed for all components for photovoltaic pumping system. By using these program, effects of system, on the performance of components and effects of parameters on the performance is studied.

II. SOLAR CELL (PV)

A photovoltaic system is also known as solar power system, is used to transfer solar energy (converted into electrical energy) by means of photovoltaic. It contains an arrangement of various components, which includes solar panels,

Solar photovoltaic is a technology which directly converts solar energy into electrical energy by using, solar panels, conductors etc.

In Solar PV arrangement, PV panels are the main components, which are made up of silicon.

A cell is usually a p-n junction that is created of Silicon. It is made from two totally different layers once a smaller amount of impurity atoms added to it. A PV system convert's daylight in to electricity and the PV cell is basic device of the photovoltaic system. No of Cells square measure combined and sorted to make PV panels or modules. No of PV Panels is sorted to make massive photovoltaic arrays. The star arrays are the mixture of range of cells connected series or in parallel or the mixture of a bunch of panels.

PV array are made by number of photovoltaic cell series and in parallel. an easy photovoltaic cell equivalent circuit model is shown in figure. to boost the performance or rating no of cell are combined. photovoltaic cell are connected series to produce larger output voltage and combined in parallel to extend the present. therefore a selected PV array is that the combination of many PV module connected series and parallel. A module is that the combination of no of solar cells connected.

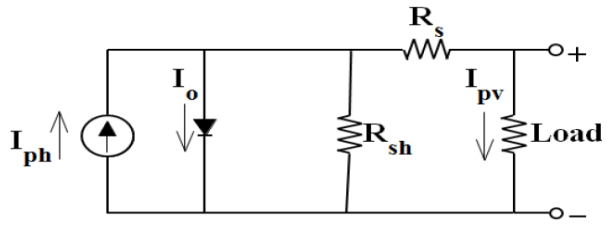

Fig.1 Circuit diagram of a single PV cell

Photo-current of the module:

$$I_{ph} = [I_{scr} + k_i(T - 298)] * \lambda/1000$$

Reverses saturation current of the module:

$$I_{rs} = I_{scr}/[\exp(qV_{oc}/N_s kAT) - 1$$

Saturation current of the module *Io*:

$$I_o = I_{rs}[\frac{T}{T_r}]^3 \exp[\frac{qE_{go}}{BK}\{\frac{1}{T_r} - \frac{1}{T}\}]$$

The current output of PV module:

$$I_{pv} = N_p \times I_{ph} - N_p * I_o[\exp\{\frac{q * V_{pv} + I_{pv}R_s}{N_s AKT}\} - 1]$$

III. FUZZY LOGIC BASE METHOD

A fuzzy system may be a system supported mathematical logic a mathematical system that analyzes analog input values in terms of logical variables that attack continues values between zero and one in distinction to classical or digital logic that operates on distinct values of either one or zero (true or false, respectively).

Fuzzy logic controller is used as to obtain maximum power though the PV modules are capable for producing under changing weather conditions.

FLC three stage process:

Fuzzification, Rule evaluation and De-Fuzzification

Fuzzy logic controller has been used for chase the maximum power of PV systems since it's the benefits like it's robust, comparatively easy to design and doesn't need the data of a particular model.

During this work, a replacement technique primarily based FLC is projected to realize following the maximum power of the PV module beneath climate conditions. The oscillation around MPP is attenuated and also the response is quicker in compared with the standard P&O technique. The projected inputs of the FLC are the modification within the voltage of the PV module and also the modification within the power of the PV module.

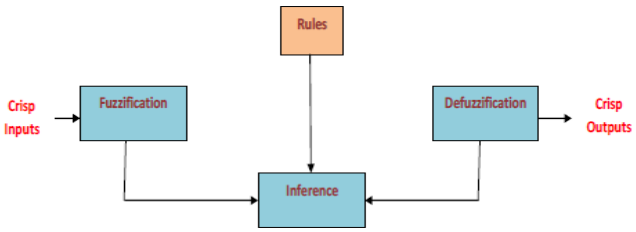

Fig.2 The stages of the FLC

IV. PERMANENT MAGNET DC MOTOR

A high beginning torque, the DC motor by its very nature has a high torque sections speed characteristics, empowering it to manage high resisting torques and ingest unexpected ascents in load easily the motor speed adjusts to the load. In addition DC motors are a perfect method for accomplishing the scaling down that is so alluring to architects since they offer a high proficiency as contrasted and different technologies

In a DC engine, an armature pivots inside an magnetic field. The essential working standard of DC motor depends on the way that at whatever point a current conveying conductor is put inside an

magnetic field, there will be mechanical power experienced by that conductor.

A wide range of DC motors work under this rule. Subsequently for building a DC motors, it is fundamental to set up an magnetic field. The magnetic field is built up by utilizing a magnet. You can utilize various kinds of magnets – it might be an electromagnet or it tends to be a permanent magnet. A Permanent Magnet DC motors (or PMDC motor) is a sort of DC motors that uses a lasting magnet to make the magnetic field required for the activity of a DC engine.

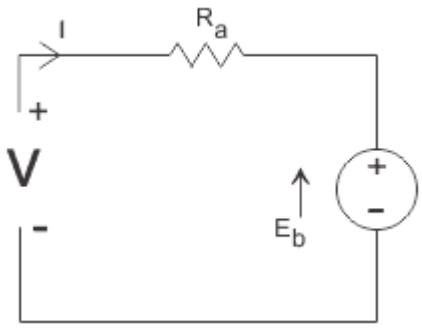

Fig.3 Equivalent Circuit of Permanent Magnet DC Motor

V. RESULT

The MATLAB/ Simulink software package was utilized for the system simulation. Simulation results show that the proposed system faster response.

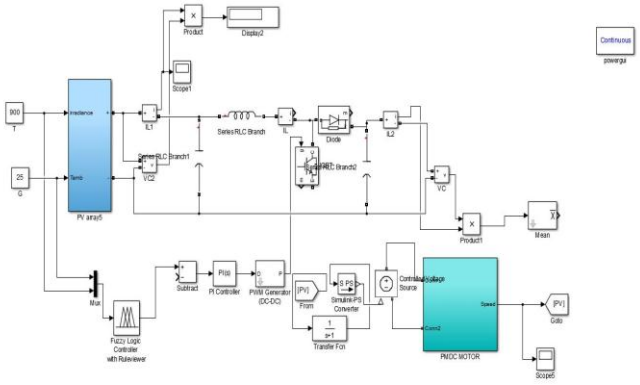

Fig.4 Proposed Model

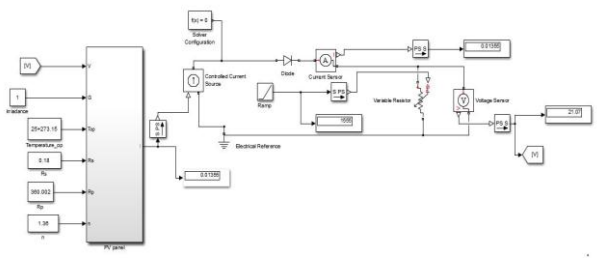

Fig.5 PV module

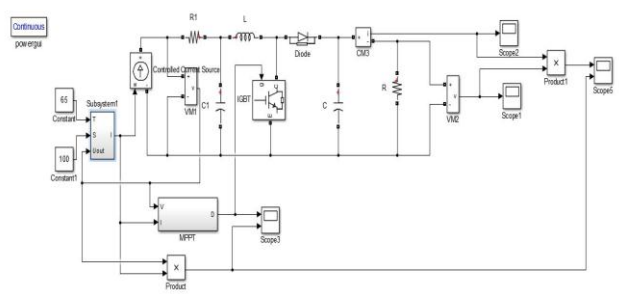

Fig.6 PV module with MPPT

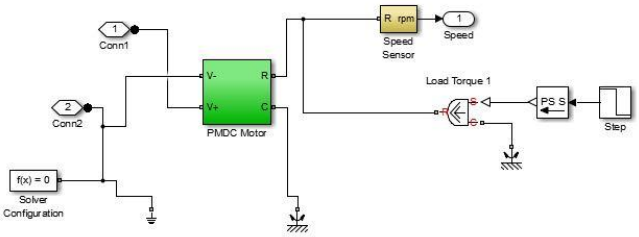

Fig.7 PMDC Motor

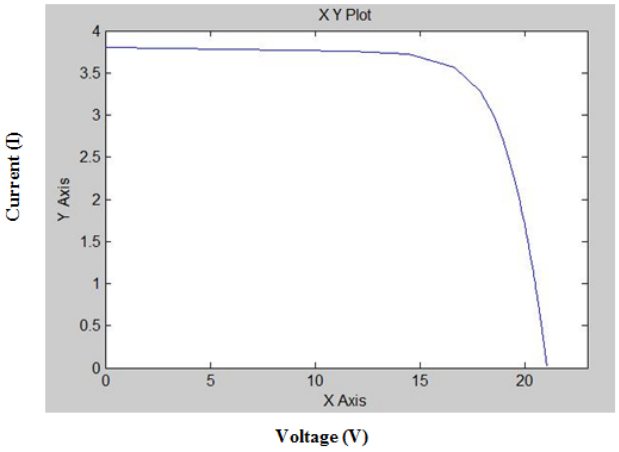

Fig.8 Current and voltage characteristic of PV

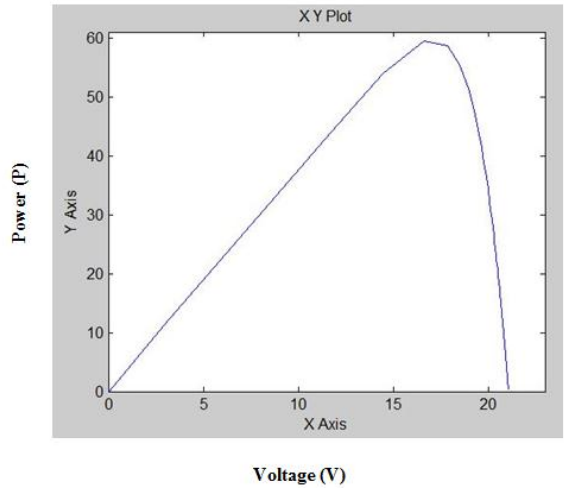

Fig.9 Power and voltage characteristic of PV

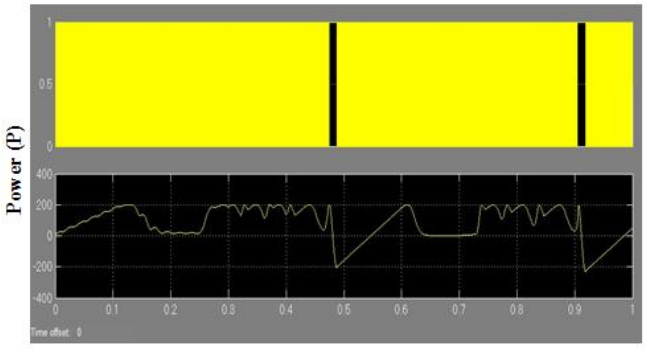

Fig.10 Power of MPPT

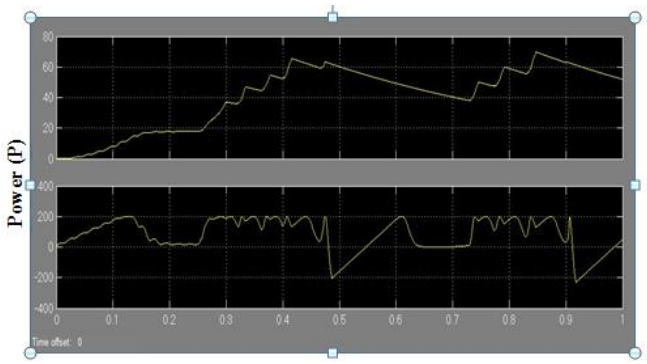

Fig.11 Power of PV with MPPT

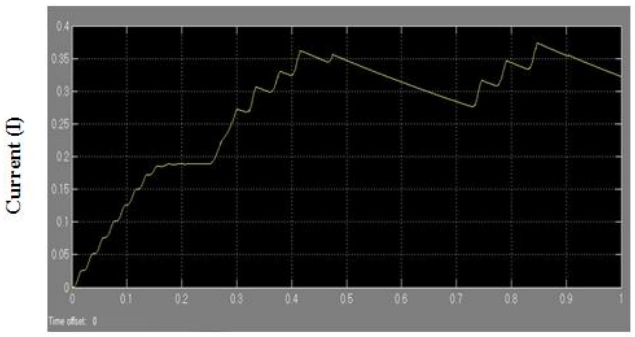

Fig.12 Current of PV with MPPT

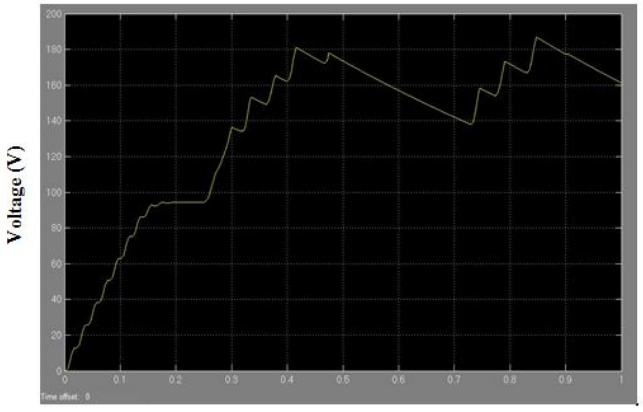

Fig.13 Voltage of PV with MPPT

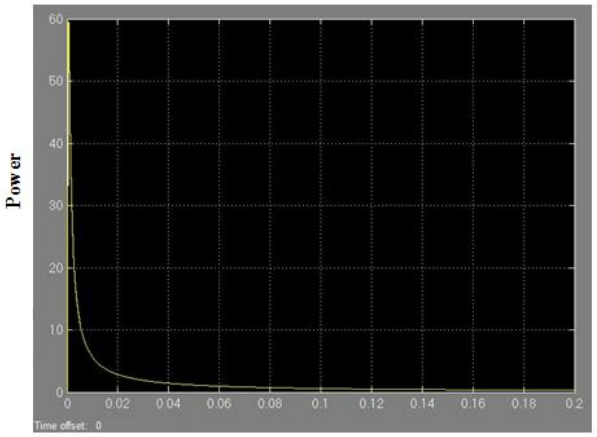

Fig.14 Power of phase current in PV module

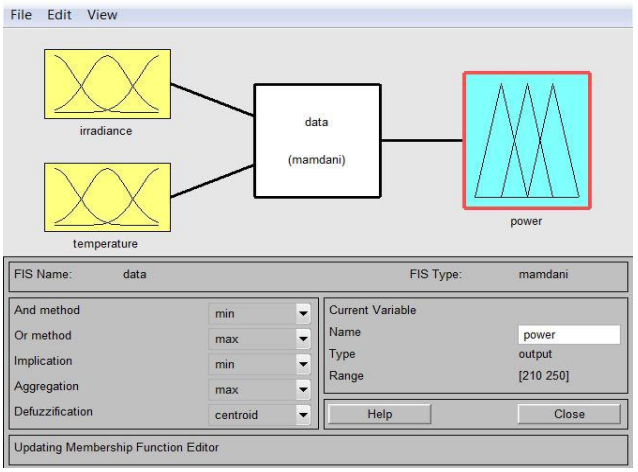

Fig.15 FIS file of fuzzy rule

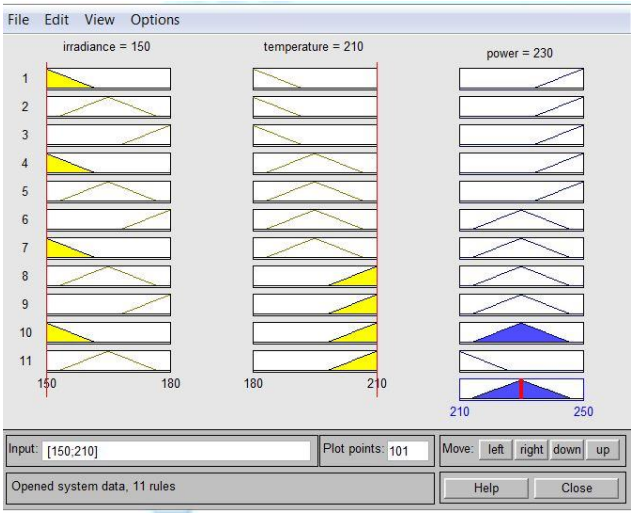

Fig.16 Fuzzy Rule after defuzzification

VI. VALIDATION AND COMPARISON

PI&PID:

To control our process in a smooth manner and respond within reasonable time. A well-tuned loop takes the process value to the set point within the

desired time frame, remove disturbances and can tolerate some variations or uncertainties in the process.

To regulate flow temperature pressure, level and many other industrial process. PID controller is universally accepted. PID is simple provide good stability and rapid response.

The control system tends to keep pressure on a desired level.

In order to provide desired pressure, speed of the pump is changed according to pressure set point. And the adjustment of speed is handled by PID controller.

Speed increments so as to carry the pressure to desired level. Speed diminishes so as to make the pressure lower.

PI controller its simple structure, easy to design and low cost. PI controller will eliminate forced oscillations and steady state error resulting in operation of on-off controller. To decrease reaction time of controller. The parameters of the PI controllers are obtained by using trial and error method. PI controllers are used widely for motion control systems. The controller tries to minimize the error by adjusting the process control inputs.

Comparison of Results

Result analysis

irradiance

Applied Range=[150 180]NumMFs=3

Values

IR1= 150 162

IR2= 153 177

IR3= 168 180

temperature

Range=[180 210 F]

Temp1= 182F

Temp2= 198F

Temp3= 200F

power

$IR1=7.129 \times 10^{-16}\ Watt/M^2 = 0.9828$

$IR2=7.13 \times 10^{-16}\ Watt/M^2 = 0.983$

$IR3=7.131 \times 10^{-16}\ Watt/M^2 = 0.9836$

Table 1 Referring to base paper

ρ	g	h	Q	I	V	η_p
997 Kg/m³	9.8m/s²	20Mtr	100Ltr	0.9828	162	3220W/m²
997 Kg/m³	9.8m/s²	30Mtr	150Ltr	0.983	177	7916W/m²
997 Kg/m³	9.8m/s²	40Mtr	200Ltr	0.9836	180	9320W/m²

VII. CONCLUSION

This study shows an investigation of MPPT for PV systems and its application for a dc pump load under differing irradiation and temperature conditions. The displaying of the PV module dependent on single diode model accomplishes great coordinating with information sheet data. Simulation of the PV system with dc motor pump has been executed with MPPT versus direct coupling framework by MATLAB. The examination demonstrates that the PV system without MPPT has poor productivity due to mismatching between the PV module and the load. The MPPT guarantee impedance coordinating between the PV and the load for most maximum power move by controlling the obligation cycle of the DC–DC help converter. ANFIS MPPT algorithm is simulated to accomplish most extreme power move. ANFIS calculation shows better execution as far as proficiency. ANFIS reaction is quick, less wavering and the increase in the yield power is high at all irradiance levels.

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