

ARTIFICIAL NEURAL NETWORK BASED MAXIMUM POWER POINT TRACKERING TECHNIQUES IN SPV SYSTEMS

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Abstract— As the demand of energy is increasing, non-conventional energy resources is becoming very popular. Solar, wind, biogas etc are being looked as for alternative resource. The solar PV being the most popular in many places because of its various advantages such as low maintenance, long life etc. Due to the non linear current-voltage characteristic, output of PV panel is quite low. Maximum power point tracker (MPPT) are used to increase the efficiency of the system by making it to operate at maximum power. There are many MPPT techniques are available in literature. These are classified on these techniques are based on their design, sensor requirement, speed, effectiveness, cost and their implementation. These existing techniques have their own advantages and disadvantages. This paper presents a ANN based constant voltage technique which increases the efficiency of the system.

Keywords:- Photo voltaic (PV) Array, MPPT, ANN, DC-DC converter.

I. INTRODUCTION

The energy crisis refers to the very fact that we might tend to run out of energy. There's the danger that humans might expertise severe energy shortages within the coming decades. This could lead to shortages of power, difficulties with agriculture and so on.

From ancient times people have used cow-dung and fuel as the main sources of energy. Later they begun to use coal and fossil fuel and lately nuclear and alternative energy.

The rise in consumption of fossil fuel and its merchandise throughout the last two decades has redoubled significantly and therefore the stock of fossil fuel and alternative sources of energy area unit quick depleting.

In fact, the globe has become frightened over the energy crisis. Oil crisis lead to sudden rise in the price of oil. Moreover it leads to decrease in supply of oil. An oil crisis can lead to and political and economical disturbance throughout the world.

Since oil provides the main source of energy for advanced industrial economies, To overcome the above problems several researches have taken place in the field on renewable energy especially solar Photovoltaic's. The drawback of the photovoltaic being low efficiency is overcome by adding maximum power point tracker (MPPT).[1-2]

MPPT are classified in many ways like one variable and two variables methods. Another way to classify MPPT techniques is as direct (online) MPPT, offline (indirect) MPPT and other techniques.

The MPPT techniques based on soft computing techniques are becoming more popular lately due to accessibility of enormous

and economical computing process. The techniques included in this is Artificial Neural Network(ANN), Fuzzy Logic Controller(FLC), Genetic Algorithm(GA), Partial Swarm Optimization(PSO), Evolutionary Algorithm(EA).

II. EVOLUTIONARY ALGORITHM (EA)

Evolutionary algorithm (EA) is a stochastic process that appears to be very proficient in optimizing real-valued non-linear and multi-modal objective functions . Since the technique is based on investigate optimization, in opinion, it should be capable to locate the MPP in spite of environmental variations. Various EA methods for MPPT are found in the literature; the most popular ones are Particle Swarm Optimization (PSO) , Genetic Algorithm (GA) and Differential Evolution (DE).

The GA algorithm needs V_{oc} and I_{sc} as inputs and it gives the optimal current I_{mp} (current at maximum power) using the cell model, without knowing the irradiance and the cell temperature.

According to the researcher, PSO is a simple and effective heuristic approach to solve the optimization problem. In this many particles are used to exchange the information between them and take two best performed particles and move towards the best condition itself. By this way, each particle ultimately evolves to an optimal or close to optimal solution [3-5]

III. FUZZY LOGIC TECHNIQUES

It convert numeric input variable to linguistic variable. In this, two input error signal and one output signal. The human description of a system reaction or command strategy is used to produce the best performance and insure high flexibility during the conception of controller. Fuzzy logic is only possible if there is human know to how to be interpreted as fuzzy rules, for which exact functioning of the system must be known. In a fuzzy logic, system composed three steps

- 1.Fuzzification
- 2.Interface
- 3.Defuzzification

1) Fuzzification-According to membership function, numerical input variable convert linguistic variable. The simplest form in many types of function is triangular, in which for a given time, two function are active for each input. This method limits the calculation times of given parameters, and simplifies the command.

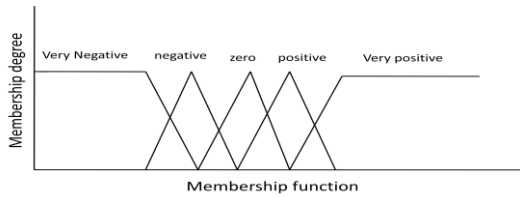


Fig .1. Membership function

2) Interface-After the fuzzification the second process is interface. In this, fuzzy interface formulate the mapping from a given input signal.

3) Defuzzification- After fuzzification and interface process the value again moves from fuzzy to real domain. In the fuzzy logic needs temperature and irradiance as an input and calculate maximum power at different solar temperature and solar irradiance. [6-9]

The main advantage of fuzzy logic is that it does not need an accurate mathematical model of system and it is capable of handling system non linearity[10]. It can work efficiently in different weather conditions. Disadvantage of this system is effective dependence on user’s knowledge and complexity in choosing the correct error.

The author proposes fuzzy logic controller to be implemented in Perturb and Observe method to reduce the oscillation near MPP which is the drawback of MPP. These oscillation around MPP leads to power loss.

ANN is used to overcome the disadvantage of open circuit voltage. In the open circuit voltage, panel is disconnected from load to measure the open circuit voltage (Voc). It increased the losses of overall system. To reduce this drawback ANN is used to find the MPP without disconnecting the panel from load. ANN based trackers are fast and respond quickly under sudden change in solar irradiation.

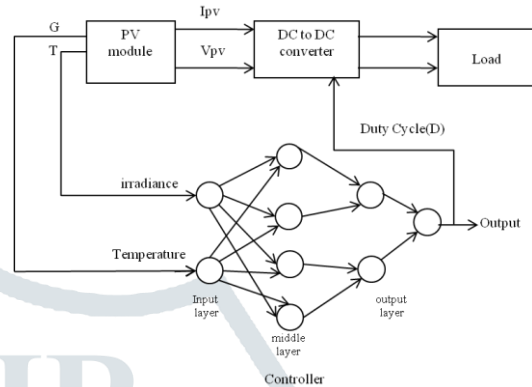


Fig .2. Block diagram of Artificial Neural Network

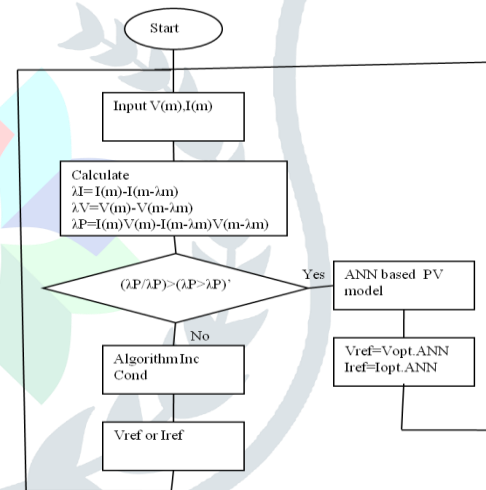


Fig .3. Flow Chart of ANN

IV. Artificial Neural Network

ANN is one of the machine learning technique which has been developed over the decades as generalization of mathematical models of biological nervous system like a human body nervous system. There are different MPPT based on artificial neural network [9,10].

First method is using neural network as a controller, it is used to control duty cycle of pulse width generator block and the output resistance match with the load resistance to provide axiom power.

Second method is using neural network as a reference to the maximum voltage (Vmax) and current (Im). This method uses another Fuzzy logic controller to track MPP.

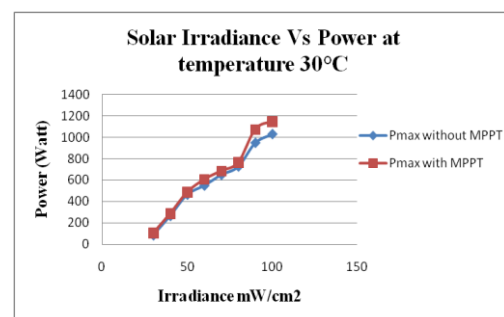


Fig .4. Variation of power with different solar isolation at constant temperature(T=30°C)

SIMULATION RESULTS

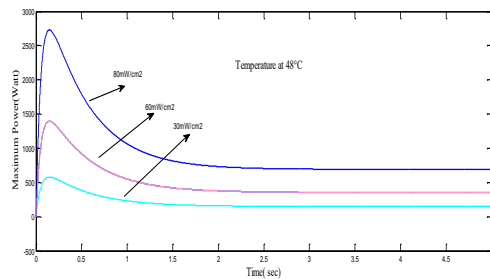


Fig. 5. Graph between maximum power (Pmax) and time at constant temperature and varying solar isolation.

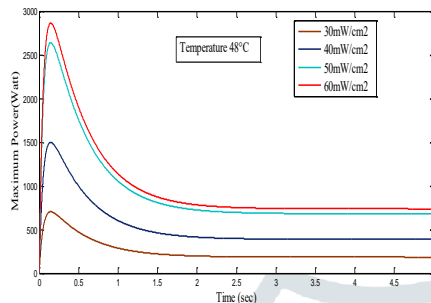


Fig 6. Graph between maximum power (Pmax) and time at constant temperature and varying solar isolation.

CONCLUSION

The best and fastest maximum power point tracking method was discussed and implemented successfully. Of all the techniques, The proposed MPP algorithm was verified using Artificial Neural Network. The performance of the interconnected system has been investigated and analyzed. MATLAB/Simulink simulations and experimental analyses were presented to demonstrate the performance of the system. Thus we can shown from the graph that MPPT increases the efficiency and performance of panel. The proposed MPP algorithm was evaluated for robustness, high efficiency comparatively to other MPPT techniques, low cost. The system was able to respond within an order of milliseconds.

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