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Design and Simulation of Improved Artificial Neural Netwok and Incremental Conductance HybridMPPT for Solar PV System Under Variable Irradiance Condition

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Abstract—The increasing concern about preservation of the environment, because of the damaging effects of fossil fuel consumption and the dramatic drop in reserves of this very popular energy source, have led to increased interest in the development of renewable energy sources Solar energy is one of the sources that is gaining more attention. The solar photovoltaic system uses the principle of the photovoltaic effect. Solar PV is regarded as a clean and environmentally friendly energy source. In two types of configurations, standalone and grid connected, PV system are practically used. Standalone PV generating systems are regarded as an attractive source of electricity, particularly in remote areas where it is difficult to use a conventional power plant. The PV system generates different energy conditions depending on the environment. The solar irradiance and temperature are the two major environmental factors affecting its performance. Due to this dependency, it is not possible to directly connect panels with the load. The Maximum Power Point Tracking (MPPT) technique has been applied to reduce the effects of changing environmental conditions and to improve the power generated by the PV system. It monitors the maximum power from the panel for energy generation improvements. MPPT controllers have certain basic functions, such as simple design, low cost, good performance characteristics with minimal output power fluctuations and the ability to track in changing conditions efficiently and quickly. The MPPT system based on improved neural network has been designed in the present research work. The results show less transient and a steady state response for the proposed system compared with the current software computing technologies and traditional power point monitoring methods. Comprehensive research has been developed and a prevision model for the analysis of the system is carried out on standalone solar photovoltaic system. In comparison with traditional power point monitoring methods, the results showed less transient and a steady state response for the proposed system.

Keywords:- Photovoltaic (PV), Matrix laboratory (MATLAB)), Artificial Neural Network (ANN), Mega Watt Peak (MWp), Soft Computing Techniques, Maximum Power Point Tracker (MPPT).

I. INTRODUCTION

Solar cell is a photovoltaic principle-based electronic device that directly converts light energy into energy. It depends directly on how much light strikes the cells, the more light on the cell and the more powerIt makes it. To maximise the power supply from installed solar panelsSpacecraft are so designed that the panels face the sun constantlyRest of the body of the spacecraft may move and face a different direction.As we are all aware, energy from the sun (not a limited source) is renewable and isElectricity source totally unpolluted. Fossil fuels have been excavated, not burned.solar panels are a finite source of energy from the ground of large power plantsDirectly convert sunlight to power without harmful emissions.Solar cell directly converts light energy to direct electricity (DC).[2][4]

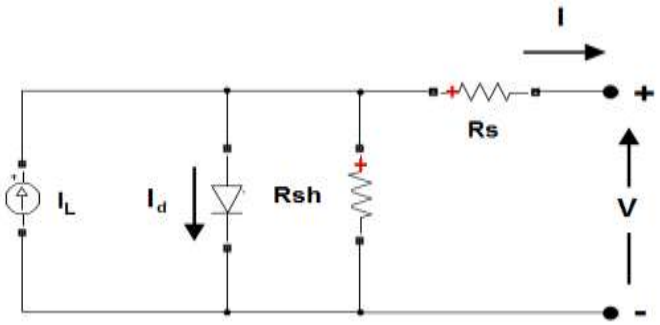

Fig. 1.1: Diode Modelling of Solar Cell

Solar cells do not use light-emitted heat energy to generate electrical energy.The photovoltaic effect of 1839 and the first thin film solar of 1883 were discovered. Solar cell production and the development of the first practical photovoltaic cell was done in 1954.Solar cell efficiency relies on many factors, such as cell shading, radiation, temperatur etc.Multiple junction cell achieved highest efficiency of 44.7% in 2014. Solar cell is the basic unit of one or more layers of solar panelsWafers like silicone in semiconductors. When light photons strike these cellsDue to the "photovoltaic effect," they lead to power generation in the sunlight.Electric currents fluctuate between cells[3].

Figure 1.1 discusses the solar cell modelling diode. The solar cell diode model is used to measure the I-V and P-V characteristics of solar cells. The regulating equations for the diode model are discussed in light of the Rs and Rp effects.

$$I = I_{sc} - I_{01}\left[e^{q\left(\frac{V+I.R_s}{kT}\right)} - 1\right] - I_{02}\left[e^{q\left(\frac{V+I.R_s}{kT}\right)} - 1\right] - \left(\frac{V+IR_s}{R_p}\right) \quad (1.1)$$

$$I = I_{sc} - I_0\left[e^{q\left(\frac{V+I.R_s}{nkT}\right)} - 1\right] - \left(\frac{V+IR_s}{R_p}\right) \quad (1.2)$$

Single PV cell generates usually less than 2 W with about 0.5 V DC. So, to get therePower and voltage level desired, number of PV cells have to be connectedin a parallel-series setup.Tens of these PV cells, called solar modules, are packed togetherPacked into a single unit for the formation of solar panels on the roof once more,Arranged for maximising their direct sunlight exposure hours. Electrical powerThe direct current (DC) generated by all of these solar cells is whyCurrent is then sent to an inverter which makes it the alternative equivalent(AC).The obtained AC is then ready for home use or even for local use by appliancesNetwork for the distribution of electricity.Solar cells form a "module" which supplies current and voltage (and therefore power). For example, in a framework to frame a 12-volt module, 24 solar cells must be connected. A solar cell series is also known as a photovoltaic module. Current voltage opportunities are correlated with power. The power rating of a PV module is often quoted as the power output of the Module when sunlight occurs at 1000 watts/meter2 and the temperature is 25° C. This is a middle of the unmistakable summer day with average sunlight. Therefore, a 1 square module with an efficiency of 15% would achieve a return of 150 Watts early afternoon. A photovoltaic (PV) exhibit contains a range of photovoltaic modules designed to generate power. A PV display can consist of a single module and, depending on the number and output, its output can move from a few watts to a large amount of megaWatts. A photovoltaic display generates the direct current From battery charging to a suitable device powering a structure or town in a mini-computer. When a PV cluster is connected to the utilities network, an inverter should be initially connected, which will change the current immediate current. The efficiency of most inverters is around 90 percent. The new inversion systems are advanced and produce extremely clean, constantly voltage electricity. [12]By clean power one means that the spinning current is like a sine wave almost without mutilation or harmonics. The aim is to improve solar photovoltaic system operational efficiency through maximum power point surveillance. The source impedance and the load impedance can be adapted by the adjustment of the corresponding boost cycle and a complete power transfer monitoring can be achieved from the photovoltaic system.

II. MAXIMUM POWER POINT TRACKING

A maximum operating point is obtained at every Power-Voltage or Curve of a solar panel, where the solar panel provides the maximum power to the load. This separate point is referred to as a solar panel's maximum power point (MPP).The solar panels are photovoltaic in nature (Power-Voltage or currentvoltage)Temperature and irradiance (radiant energy flows per) depend on curvesLevels of unit area.In other words, the sun depends on the size of the panels per areaThe curve varies therefore the

maximum point or the MPP varies accordingly.The current and voltage that maximise can therefore be deduced.With environmental conditions, power output will change.

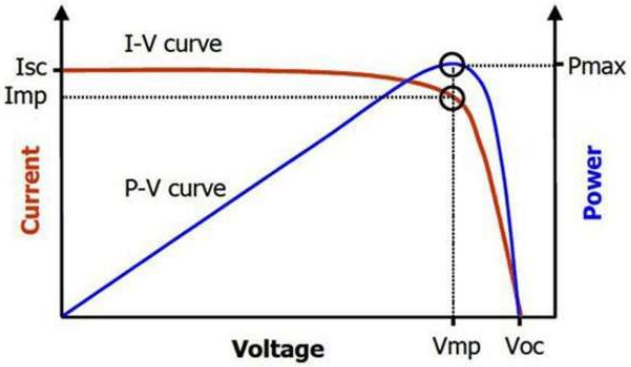

Fig. 1.2: Maximum Power Point of Solar Cell

Figure 1.2 shows that the MPP depends on some conditions like theThe level of irradiance is here referred to by the symbol "G," for example. In other waysG values, the corresponding shift can be seen from the graphMPP's values.A MPPT algorithm must therefore be used to continuously track the MPP.The maximum power instance leads to higher system efficiency. InThe demand for load can be higher than that provided by the PV for various applicationsSystem. There are therefore many different approaches that range from simple to simpleParameter relationships to time-based analysis to maximisePV systems power generation.

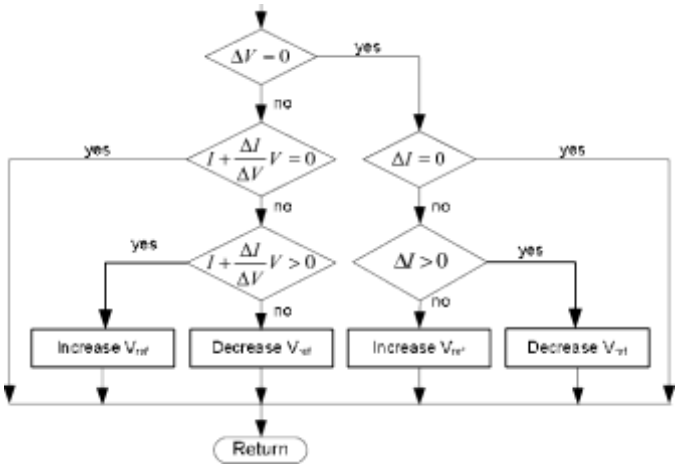

Fig. 1.3: Incremental Conductance MPPT Method

In determining solar cell efficiency, temperature also plays an important role. By theincrease of temperature, increases the rate of photon generation, leading to band gap reduced because of the reverse saturation current is increasing. This process therefore leads to aMarginal current change but considerable voltage difference.With each of themThe cell voltage reduces by a step 2.2V[5] the temperature rise degree.Thus, solar cell performance and temperature share a negative relation. In cold and bright sunny days, cells show their best performance rather than warm and hot.Sunny days luminous. Solar panels are currently produced with non-silicon materialsThose that are insensitive to temperature. They are thus used under or near the roomConditions of temperature. The incremental is based on the observation of the P-V curve.The method of INC was proposed to track maximm power. It is to overcome this algorithmThe P&O algorithm has some of the disadvantages. The highest power wastracked by the relationship between the current variation and the variationvoltage and the negative voltage power ration, i.e. dI/dV and -I/V.The fundamental principle governing the progressive behaviour method is thatThe photovoltaic module P-V curve is zero at the highest point of power, positiveThe maximum point on the left and the negative on the right. This is possible by,Therefore, the maximum power point to the right of

the point, i.e. dI/dV<-I/VTo reach the MPP, the PV panel operating voltage must then be decreased.The method of incremental conductivity gives greater efficiency than the method of P&O.It reduces power loss by significantly reducing oscillations and thus the systemcost has been lowered.

III. ARTIFICIAL NEURAL NETWORK

Human Brain is a powerful tool and can easily accomplish very difficult tasks.Artificial neural networks are based on artificial recreation of the human brain. Although it is not possible to mimic the exact brain of man at this point, certain limits to what the available technology can achieve artificially. A simplified artificial neurons and an artificial neural network can be established. The interconnections of the neurons can be obtained. The ANNs may be developed in different ways to imitate the brain.The Artificial Neural Network works excellently to recognise simple patterns or the resolution of complex problems. They are artificially used in research in intelligence because they have excellent training abilities.Using data sets that include a large volume of data, ANNs are trained. For the first time the neural network is, for example, trained with information containing photos of different kindsonce trained, the input provided to the network can be identified and categorised, even if the given data input exceeds the neural network's data set. Therefore, we do not have to define the characteristics explicitly. The network learns through training from a mammal for identificationdistinguish.ANN was chosen to implement multilayer feeds, the most common feed.Depending on the input value, the outputs are returned.The following is the manner in which an ANN feed is executed:The input is reception via the layer, and then the output is returned by the output layer and is passed through all hidden layers

$Y(x) = g(W_{n+1} \sum_{l=0} W_1 x_i)(1.3)$
$g(x) = 1/(1 + e^{25x})(1.4)$
To get an output, it is easy to spread the input via an ANN feeder's network.

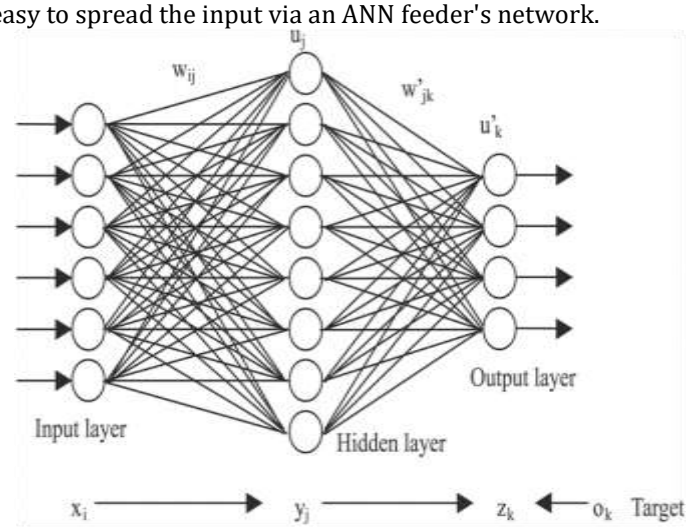

Fig. 1.4.Fully linked multi-layer feed to a hidden layer

The problem arises when we are dealing with a network where connections (as in the brain) are in all directions and need to calculate output. Because connections are created throughout the network, these loops can be processed with the help of recurrent networks, recurrent networks can code time dependence, but forward networks can better provide feedback for issues that are not time dependent.[13] Figure shows a multifaceted feed for ANN that connects all the neurons in each layer to the next layer of neurons. This network is referred to as a fully linked network, and the ANNs are usually fully connected, but not necessary. The one is the mass given to the various inputs, and the other is the value in activation functions. When train a single ANN, there are two parameters to adjust. Such an arrangement is not practical and the system would be easier to control if only one parameter is adjusted. A bias neuron is invented to deal with this problem. Now, as the bias neuron does, the result is always 1. The neuronal bias is only linked to the next layer of neurons and is not linked to the previous layer. Because the result of a partial neuron is always 1 the weights of the ANN type. The initial layer is an input layer and the last layers are an output layer. There are three main layer categories. A number of layers is connected between the twomulti-layer feed forward ANN contains hidden layers. The link is from the initial layer to the next layer and move only forward.Feed forward with multilayer Two different phases of ANNs: First is known as the learning phaseThe training phase provides a certain output if a particular input is givenThis is done

through ongoing training on a set of training data provided to the ANN. Second phase of implementation consist of the cumulative or combined sum of the remaining weights is directly added and processed through the activation function value similar.The addition of the bias neuron helps to delete the t of the activation function.Weights only need to be adjusted if the ANN is trained. Without adding a bias neuron, the value "t" is not removed as it is the total If all inputs are zero, Function will indicate irrespective of the weight value. [17]

IV. PROPOSED METHODOLOGY

New Neural Artificial Network (ANN) based on information collected from the Incremental (Inc-Cond) method. The neuron based artificial network comprises three layers: input, hidden and output .

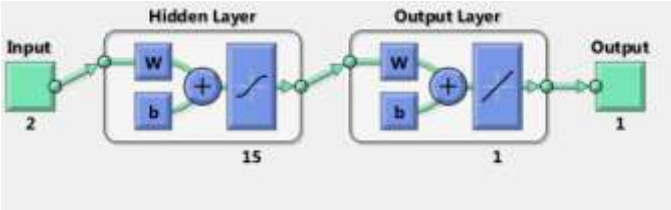

Fig. 1.5. Design of Neural Network

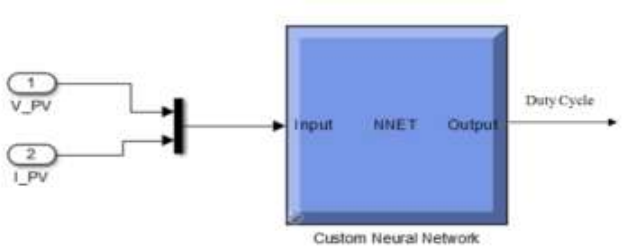

Fig. 1.6 Neuron Model for MPPT System

Figure 1.6 shown.PV voltage, current and solar irradiance can be used to train ANN.or any combination of these temperatures.Neural network learning is carried out by feed-forward weight updating. 200000 data collected from INC algorithm are used for training. Part ofthe data used for training is shown in Table below.

$E_{mse} = \sum_{k=0}^{n} = \frac{1}{12}[m(k) - o(k)]^2 (1.5)$

Propagation of back Levenberg- Marquardt algorithm with PV and PV current, where m(k) refers to the output measured and o(k) refers to the output required and N refers to the number of training patterns.ANN's input.The hidden layer contains 15 neurons and is activated tangently by the sigmoidproduces output from hidden layer while neurons are trained linearly output layerEnable the output layer output function.The neural network performance function is analysed with its medium error (MSE).

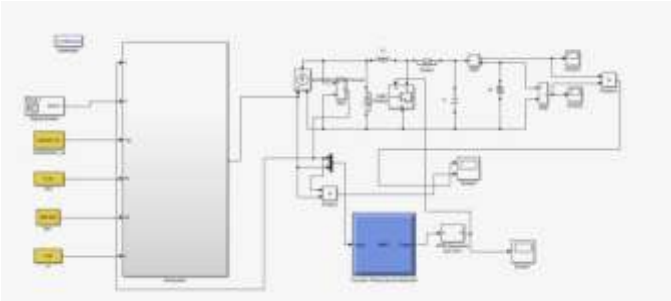

Fig. 1.7. Design of Simulink Model for Proposed System

The benefit of the proposed algorithm is that it takes more time to track MPP. EveryonePV array parameters alter with time, the neural network must therefore be trainedTo ensure accurate MPP tracking regularly. Input to the subsystem of the PV panel, i.e.Irradiation was as follows varied. quantitatively.

V. RESULTS

In this research a soft Computer Baed charge Controller was designed to efficiently monitor the maximum IV power points of PV systems with variable irradiances and complex working conditions and has managed soft computer-based control systems with enhanced incemental conductance based trained artificial neural network configuration and duty cycles.

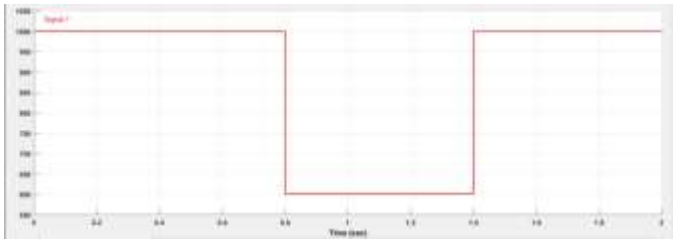

Fig. 1.8 Creation of Variable Signal Block for Irradiation

The load controller is connected in high energy applications to the PV modules and the battery on the storage system and on the inverter. In accordance with current research aspects, an improvement is made in the operating efficiency of the photovoltaic solar system through the use of an efficient power converter equipped of a soft-computer MPPT controller.

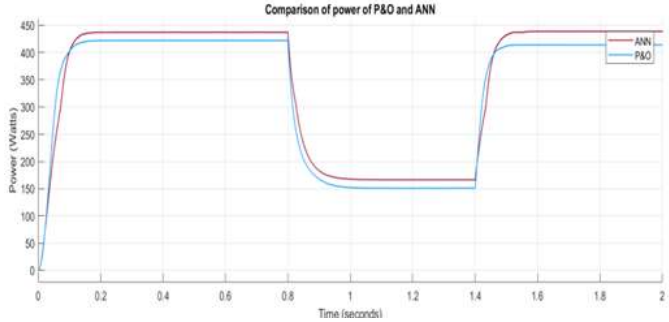

Fig. 1.9 Comparative Analysis of Power for Proposed System

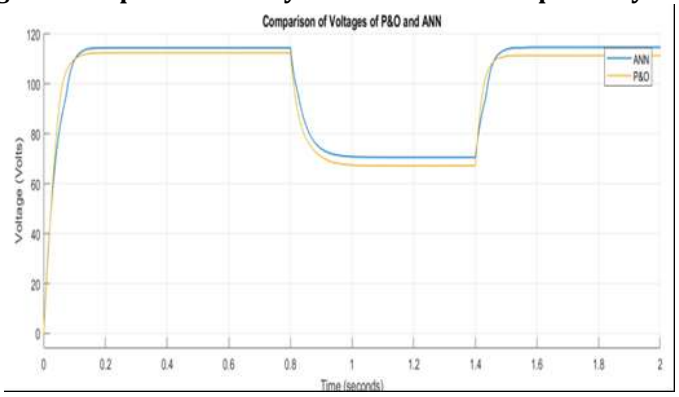

Fig. 1.10 Comparative Analysis of Voltages for Proposed System

Table-1 Analysis of Results

MPPT	Power	Efficiency	Vmax	Imax	Ripples
P and O	421 W	84 %	113 V	3.48 A	0.08
ANN-INC Hybrid	440 W	88 %	115 V	3.9 A	0.048

The introduction of an efficient charge controller based on an intelligent maximum energy monitoring system increases solar photovoltaic system operating efficiency. With Solar Photovoltaic system storage applications and high power inversors, a battery-contaminated charging controller can be interacted.

VI. CONCLUSION

During this research, ANN-INC based power point controller has been designed to monitor efficiently with variable irradiance and complex operating conditions. The maximum power point was extracted from I V characteristics of photovoltaic systems, and has managed the soft computer program based controls with boost configuration and operating cycles based on enhanced ANN methodology. The controller is connected to the PV modules and the battery on the storage system and on the inverter. In accordance with current research aspects, an improvement is made in the operating efficiency of the photovoltaic solar system through the use of an efficient power converter equipped of a soft-computer MPPT controller. The introduction of an efficient charge controller based on an intelligent maximum energy monitoring system increases solar photovoltaic system operating efficiency. The research can be extended to include inclusion of deep learning convolutional neural network for design and analysis of photovoltaic system.

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