



NEURAL NETWORK BASED PHOTOVOLTAIC SYSTEM FOR THREE PHASE INVERTER

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Abstract

A novel method of introducing neural network for generation of DC power from PV module is implemented. The neural network produces the generated DC power to the load. The power produced on a certain day dependences on temperature and irradiances. The network is activated using the sigmoid function. The maximum power from panels is produced by training the network by using feedforward algorithm, where the values of temperature and irradiances of the sun on a particular day can be predicted. Neural network is implemented using mat lab coding to reduce the complexity of operation.

Keywords: PV Module, Neural Network, Feedforward Method, Backpropagation Algorithm.

1 INTRODUCTION

Generation of power from solar depends on many factors like climate and geographical status of earth. The power generated is transformed for further usage [1]. The new era of using renewable resources for generation of electricity came into exist due to the scarcity of available electrical resources [2]. For solar energy conversion the photovoltaic cells are used which are constructed using silicon semiconductor materials and various new technologies have been adapted for the improvement of solar module structure for maximum power consumption [3]. The neural network (NN) is a branch of artificial intelligences where computers are trained as human brains for complex calculations [4]. Algorithms have been implemented for training neural network operations [5]. The computations of the network is reduced by using back propagation method which predicts the data processing [6]. Authentication of data is also accompanied by neural network for security purpose by training the ANN [7]. Several techniques has been performed for validation of data using feedforward backpropagation for reducing mean square errors [8]. Neural network is also performed through the mat lab coding where classification is done by backpropagation algorithm [9]. For fast switching and to reduce harmonics various converter topologies have been introduced in neural networks [10].

2 METHODOLOGIES

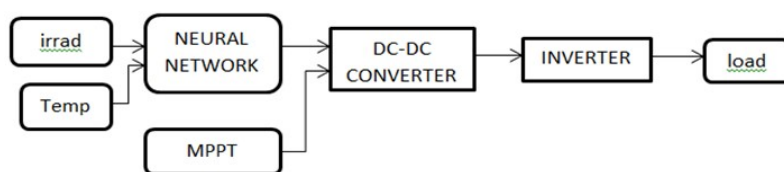


Figure 1: Block diagram of proposed system

The block diagram shown in figure 1 consists of neural network for dc power generation, mppt, dc-dc converter, inverter section driving the load.

NEURAL NETWORKS

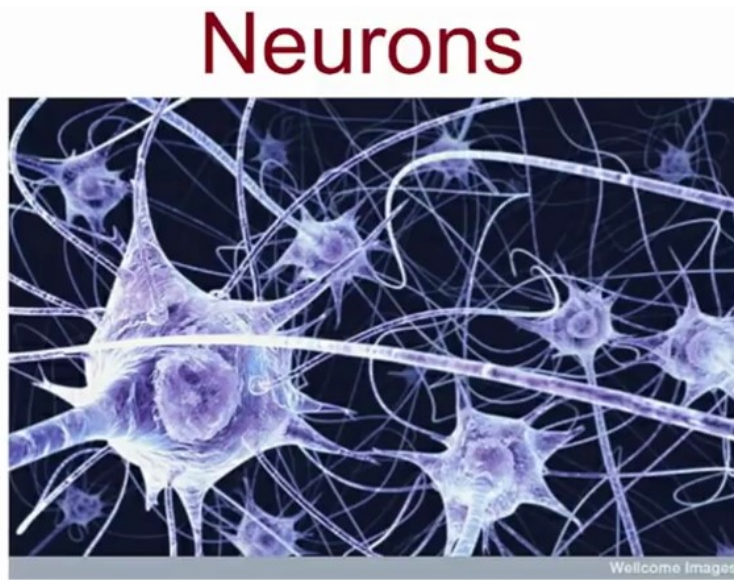


Figure 2: Neural Networks

Neural network shown in figure 2, neural network is structured as the human brain. The human brain has about 100 billion cells called neurons. Neurons are connected to each other through pathways that transmit electrical signals. These connections give neurons the ability to send and receive electrical impulses which in turn are responsible for the brain's function on a larger scale. So each brain cell on the brain can be seen as a mathematical function. Each neuron has inputs and outputs when it receives electrical impulses from a cell it sends it to other cells connected to it.

The neural network is used to train the computers as human brains to reduce the complexity of pattern recognition and security. The network structure resembles the human brain where it is a collection of neurons which receives input and sends the corresponding output as shown in figure 3.

We need to designate some cells as input cells and other cells as output cells as shown in figure 4. So to make things simpler cells are put in layers, we can think of the input cells on the far left

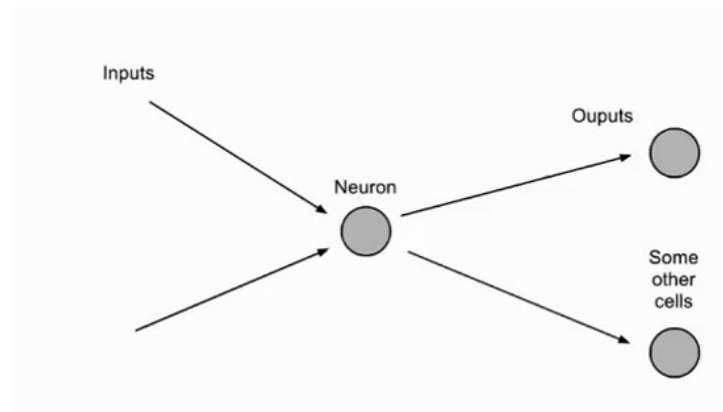


Figure 3: Neuron Connections

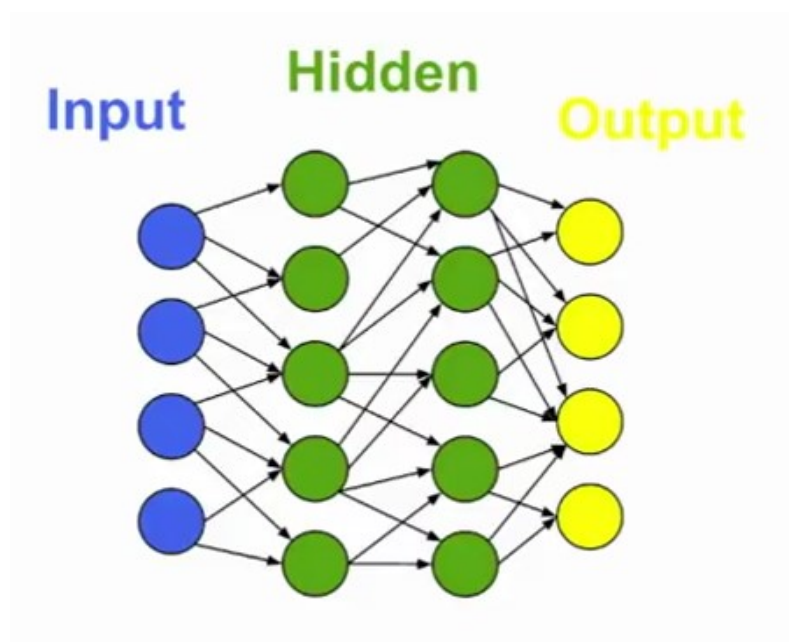


Figure 4: Hidden Layers

layer the hidden cells are located in the middle layer followed by the output cells. The middle layer or hidden cells can be more

than one layer but is simpler, just to illustrate one hidden layer the connections between cells can be strong or weak. The operation of neural networks is to collect the inputs data and assign the result to the outputs with the processing completed in the hidden layers which are between inputs and outputs. Each individual cell is a function, it takes some inputs from other cells and it also considers how strong those connections for those cells are and then it gives an output. For a given cell we'll multiply each input signal by that inputs strength and then all of these will be added together. For every input in this way, weak inputs are multiplied by a really small connection strength number so they're almost zero. Conversely cells with strong connection strength numbers mean that they have their inputs multiplied by high numbers and they have a large effect in the function. The function itself takes it's a function of the sum of these inputs.

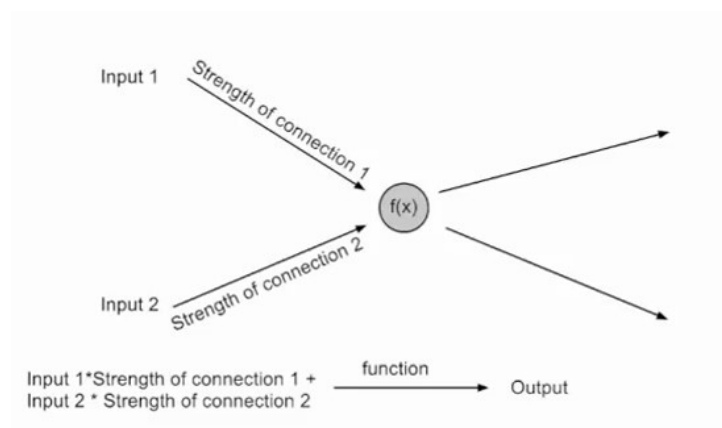


Figure 5: Connection Strength

Time connection strength is shown in figure 5, figure 6 and a lot of Different functions can be used but hyperbolic tangent generally works best. Hyperbolic tangent applies the function of the former sum and then it outputs a number between minus 1 and 1.

Types of neural network:

Single neuron-Single neuron network is shown in figure 7. neural networks consists of a single neuron or a perceptron or linear unit. A single cell with inputs squashing function and the output

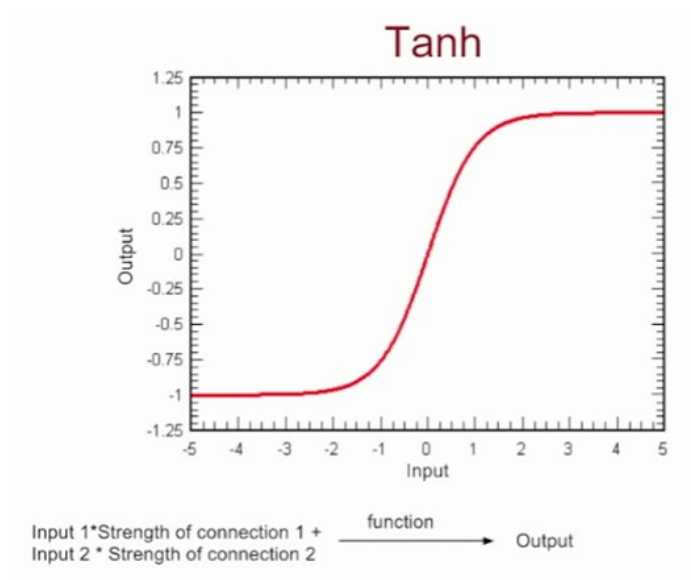


Figure 6: Tanh Function

and the output is just the squashed version of a weighted sum of the inputs.

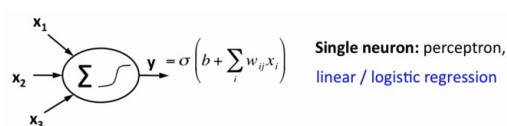


Figure 7: Single Neuron Network

Feed forward network- The network shown in figure 8 is arranged with all the weights pointing in one with all the connections going in one direction and without any cycles is called a feed-forward network. The information is passed from one layer to another layer to reach the final output. The total computing is based on the logistic equation and is done in the middle layers. The middle layers are called hidden layers the convention is if you have more than one of them it is called a recurrent network.

Symmetric network- Network is shown in figure 9 where the

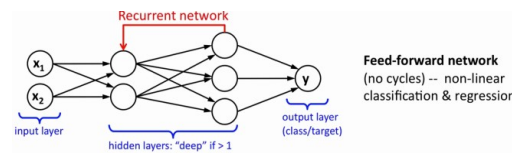


Figure 8: Feed Forward Network

edges are undirected, where the inputs feed to the outputs or the outputs feed to the inputs.



Figure 9: Symmetric Network

Activation functions:

In neural network the nodes of the network are called neurons, which are similar to the neurons of our brain. If the signal received from the dendroid is strong enough, having minimum threshold, the signal is passed to the axon, if the signal is not strong enough it cancels the signals. The input signal multiplied with the weight reaches the neuron; it checks the minimum threshold value and send to the axon. To calculate the minimum threshold value we use activation function, depending on the linear and nonlinear functions outputs, we apply activation functions like sigmoid, hyperbolic tangent, soft max.

SIGMOID:

The sigmoid function is given by the equation and is shown in figure 10.

$$f(x) = \frac{1}{1 + e^{-x}} \quad (1)$$

$$Df(x) = f(x)[1 - f(x)] \quad (2)$$

Minimum threshold value is calculated by applying the sigmoid function, whose value ranges between 0 and 1. If the value of x

goes on to negative value unto minus of infinity, the function is represented as $f(x)=0$ and the function $f(x) = 1$, when the value of x goes unto positive infinity value..

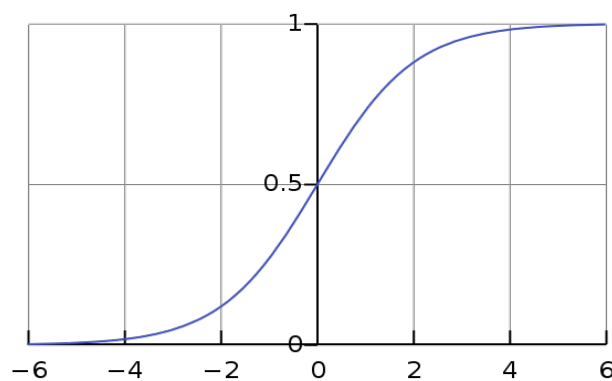
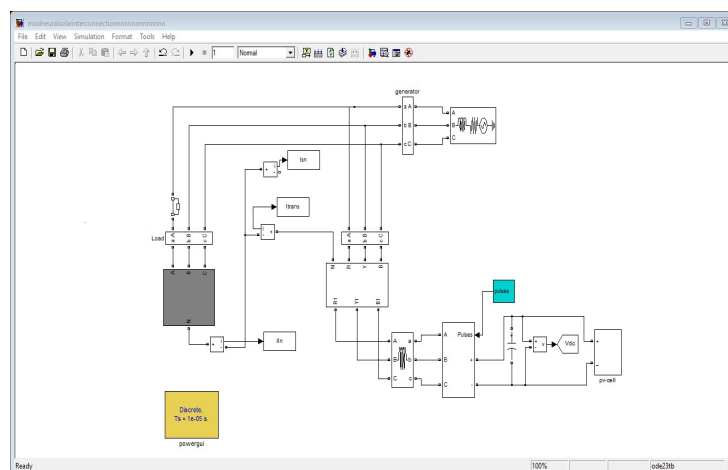
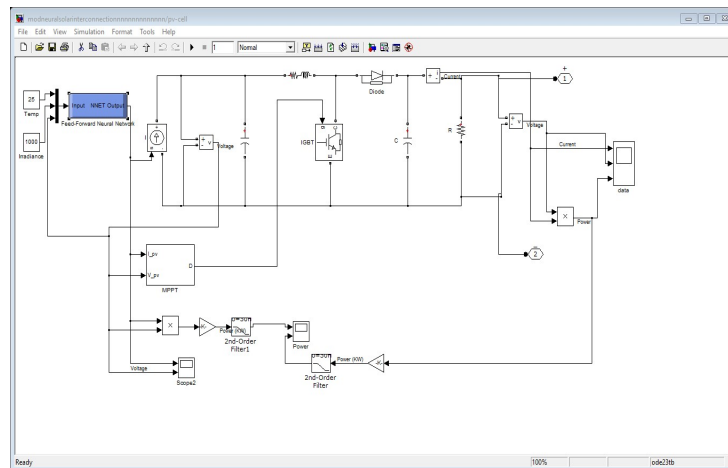


Figure 10: Activation Function

3 PROPOSED SYSTEM

The proposed system is modelled in Simulink.





NEURAL NETWORK:

The PV model is implemented using feed forward neural network with temperature-25, irradiances-1000. neural network is trained to perform the PV-array operation. The feed forward algorithm is shown in figure 11 and training the network is shown in figure 12.

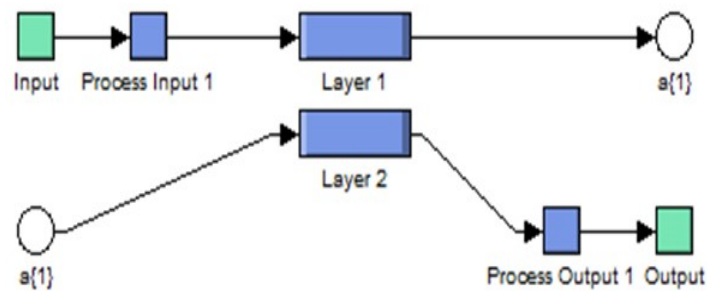


Figure 11: Feedforward Neural Network



Figure 12: Training Neural Network

4 RESULTS

The proposed model is designed in SIMULINK. The output of the PV module is shown in figure 13 and figure 14 where the I-V and P-V characteristic of PV panel are specified. The output of the PV module by training the neural network is shown in figure 15. The output of Boost converter is shown in figure 16. The output of inverter is shown in figure 17.

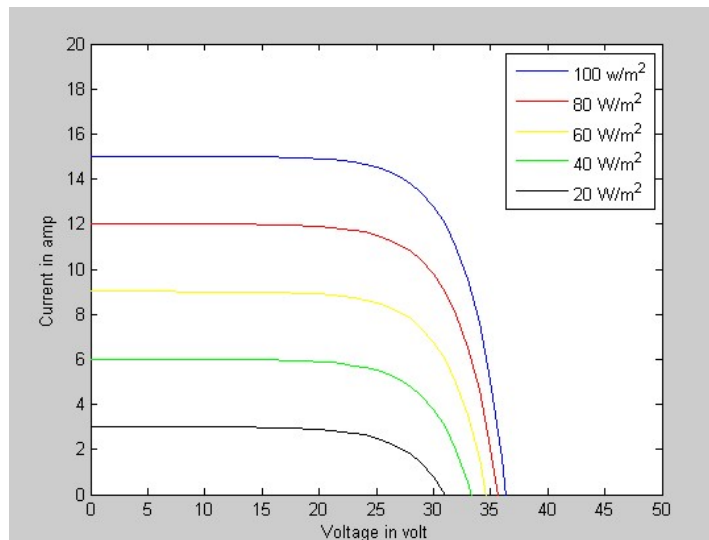


Figure 13: I-V Characteristics at cell temperature of 25C

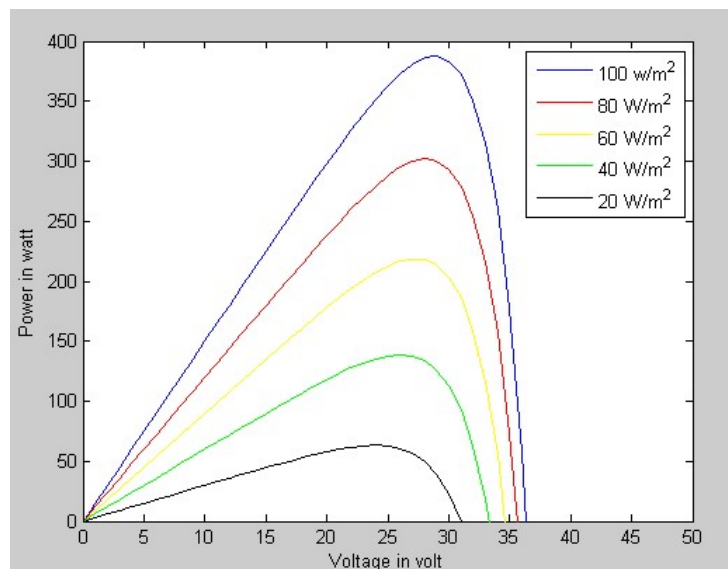


Figure 14: P-V Characteristics at cell temperature of 25C

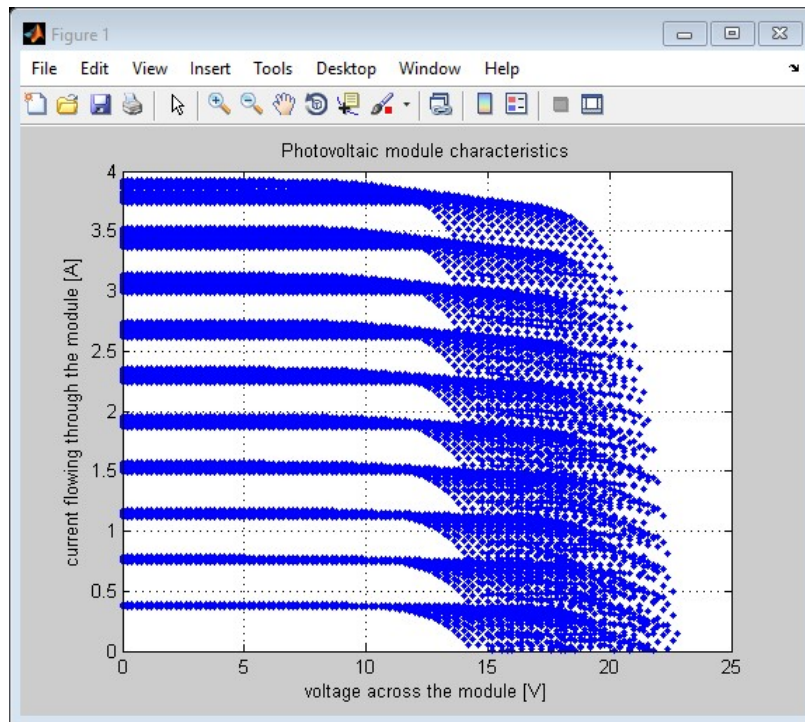


Figure 15: I-V characteristics of PV module

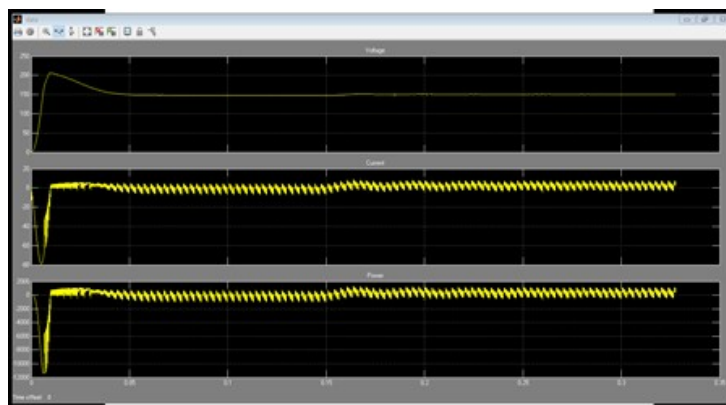


Figure 16: Boost converter output

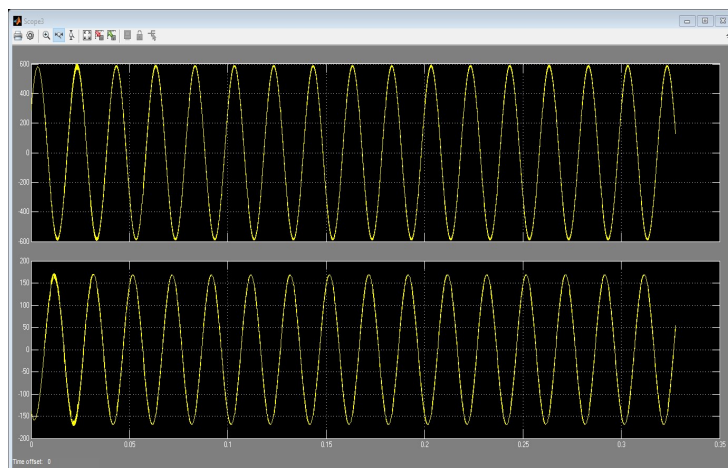


Figure 17: Inverter output

5 CONCLUSION

In the proposed system neural network (NN) is used for the DC power generation from solar panels. Various back propagation methods have been adopted to predict the values. The feedforward algorithm is used for driving the converter section, thus reducing the complexity computations. Neural network is designed in mat lab coding and further we can use the neural network for driving the MPPT section.

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