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Research Article

Pv/T Systems For Energy Efficiency By Using Advanced Deep Neural Network (DNN) And Nanofluid In Solar Systems

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https://doi.org/10.5281/zenodo.10119483

Received : 18.09.2023 **Accepted** : 12.11.2023 **Pages** : 26-31

ABSTRACT: Today, solar energy is a very popular alternative energy source due to its enormous availability in nature. In this study, focusing on the electro-mechanical production industry of advanced PV/T solar panels, studies carried out on the development of new methodological methods for the efficiency of existing asset management practices of the infrastructure of this industry and the optimal improvement. For this, it is to integrate a power-generating PV/T panel and a solar thermal heating panel within the same collection surface. PV/T systems are one of the subjects that scientific studies have focused on in recent years. The main reasons for this are to increase the electricity generation performance of PVs, as well as to obtain thermally hot fluid from the system. In this research, it was implemented using a new roof-mounted PV/T multi-reflection panel, which not only increases the power output of the PV/T panel, but most importantly, the aesthetic aspect is a major barrier to large-scale uptake of PV/TIn this study, we developed a new advanced MPPT (maximum power point tracking) algorithm such as Deep Neural Network (DNN) controller especially for photovoltaic system. The proposed DNN based MPPT algorithm is developed PV/T voltage, current and corresponding duty cycle.

KEYWORDS: PV/T, MPPT, DNN, Türkiye, İran, Nanofluid

1. INTRODUCTION

In the near future, the demand for electrical energy is expected to increase rapidly due to world population growth and industrialization. Solar Photovoltaic PV/T systems are one of the most promising renewable energy sources that convert solar energy into electrical energy in a way that is compatible with the environment. However, the efficiency of these systems is low and their relative costs are high. In order to overcome these disadvantages, a grid-connected PV energy system is needed to meet the load requirement requirements. The proposed microgrid system and its controller block diagram are shown in figure -1.

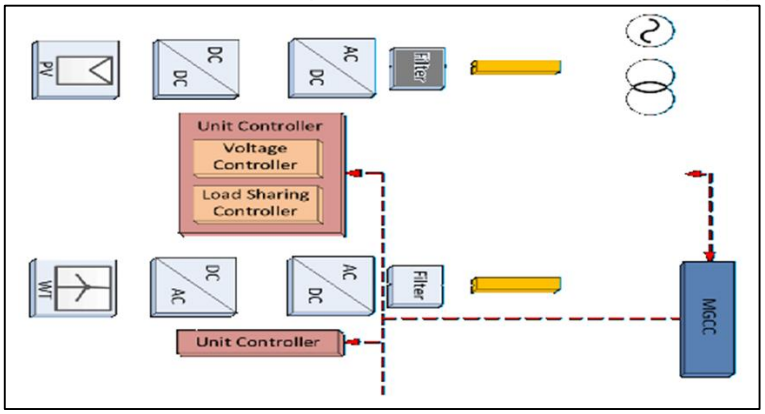

Figure 1. Micro Grid System and Controller Block Diagram

The amount of electricity produced in Turkey, one of the developing countries, does not meet the energy needs. More than half of our energy needs go to neighboring countries (Russia, Bulgaria, Iran, etc.) we need in a connected country. Decarbonized coal, lignite, oil and natural gas are among the domestic energy sources. Approximately 97% of the grid electricity in Turkey is

produced from fossil fuels that emit harmful CO_2 gases into the atmosphere. In the energy sector, CO_2 emissions can be reduced by increasing the share of renewable energy sources among electricity suppliers [1-5]. Based on what is expected from this model and what the existing software is, the best software that can be used for modeling has been developed by scanning the literature, and the necessary data and the necessary data analysis have been carried out step by step. In the near future, it is expected that the world's population increase and the demand for electrical energy will increase rapidly due to industrialization. This increase in energy demand requires electricity companies to increase their production. Nowadays Iran, Turkey, Europe, Asian and Europen have focused on both useful and advanced innovation of ergonomic systems for renewable energy systems. Recent scientific research shows that world net electricity production increased from 17.3 Gwh in 2005 to 24.4 Gwh in 2015 and to 33.3 Gwh in 2030 (92.5%)[6-10].According to the results of the Turkey National Energy Plan study, electricity consumption is expected to reach 380.2 TWh in 2025, 455.3 TWh in 2030 and 510.5 TWh in 2035.In 2023, 34.6% of our electricity production will come from coal, 22.2% from natural gas, 20.6% from hydraulic energy, 10.8% from wind, 4.7% from solar, 3% from solar energy. 3% obtained from geothermal energy and 3.7% from other sources. As of the end of July 2023, our country's installed power has reached 105,135 MW (Republic of Turkey Ministry of Energy and Natural Resources-2023) [10-12].

2. MATERIAL AND METHODS

2.1. Deep Neural Network for PV/T

It is a new advanced maximum power tracking algorithm developed as deep neural network controller for photovoltaic systems PV/T. The proposed DNN-based MPPT algorithm developed using 80000 data such as PV/T voltage, Current and corresponding duty cycle, as shown in Deep and Artificial Neural Network based Figure -2 [13-17]. The algorithm of PV system simulation model developed and Matlab. The proposed simulation model was used with a 50 Kw [18-22].

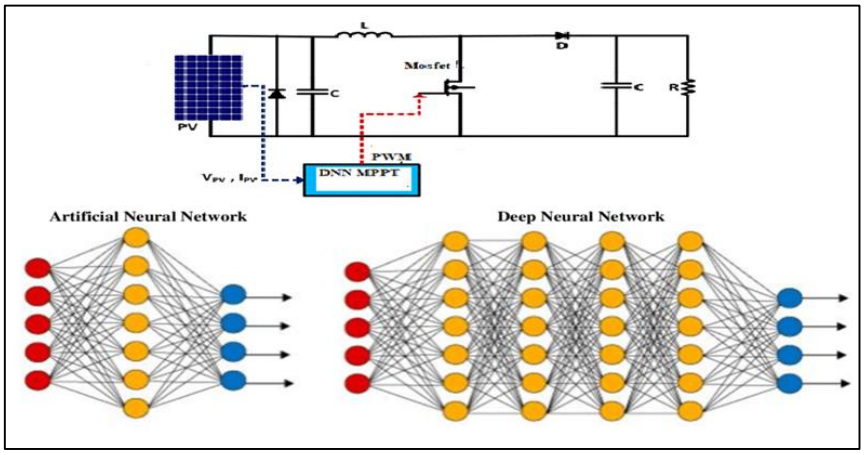

Figure 2. Deep and Artificial Network Based Maximum Power Tracking [23-25].

2.2 Artificial Neural Network(ANN)

ANN is a numerical representation of the ANN in an individual's brain, consisting of a large number of nerve cells called interconnected neurons [25-30]. Communication between neurons is established by short-term interactions of electrical signals produced by the mass of cells, called Decays. Information is transmitted from one neuron to another as electrochemical intersections called neurotransmitters, and these intersections, called dendrites, which carry the signals, are located on the branches that connect them to the body of the cell. Information is transmitted from one neuron to another as electrochemical assemblies called neurotransmitters. These junctions are located in the branches that connect them to the cell, transmit the signals it receives from a large number of neurons to the nerve cell. For analytical explanation, a simple many-layer feedforward ANN is given,

$$n1 = F1(w1x1 + b1) \quad (2.1)$$
$$n2 = F2(w2x2 + b2) \quad (2.2)$$
$$n3 = F3(w3x3 + b3) \quad (2.3)$$
$$n4 = F4(w4x4 + b4) \quad (2.4)$$

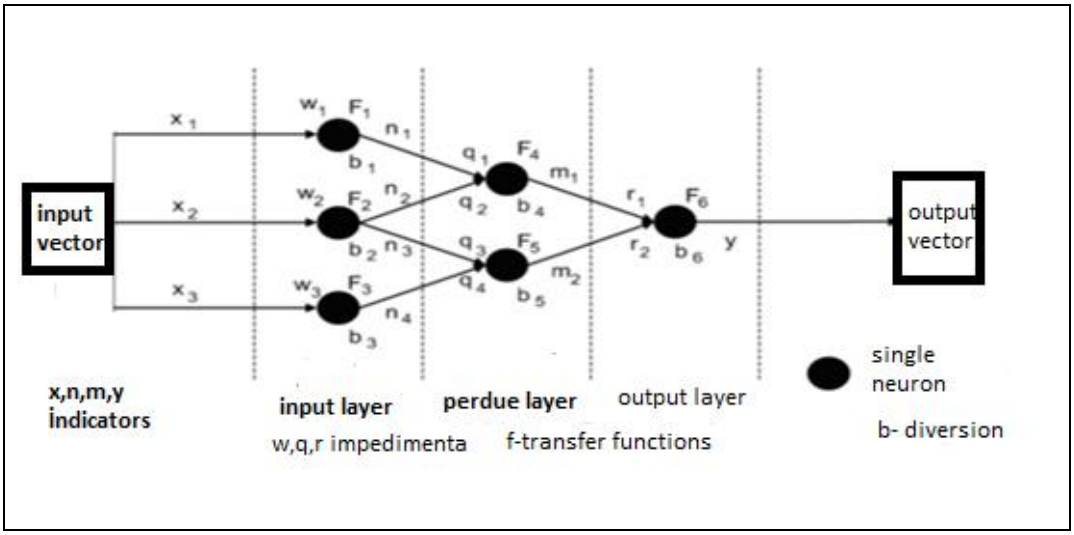

Figure 3. Advanced Feed Deep Neural Network with Single Neuron Model [27-32].

2.3 Measurement of the PV/T

The base fluid and hybrid nanofluid for different thermal physical properties calculated. The specific heat value of the hybrid nanofluid as follow,

$$Cp_{hna} = \frac{\rho_{Fe_2O_4} cp_{Fe_2O_4} + (1-\Phi)\rho_{pure\ water} C_{Ppure\ water}}{\rho_{hna}} \quad (2.5)$$

where Cp_{hna} is the specific heat of the hybrid nanofluid, ρ_{Fe_32} is the density of Fe_2O_4 nanoparticles, $\rho_{Fe_2O_4}$ is the density of Fe_2O_4 nanoparticles, $\rho_{pure\ water}$ is the density of the base liquid, ρ_{hna} is the density of the hybrid nanofluid, $Cp_{Fe_2O_4}$ is the specific heat [27-32]. The calculated thermophysical properties of the hybrid nanofluid are given in Table 1.

Table 1. Thermophysical Properties of Hybrid Nanofluid [5-8].

Hybrid Nanofluid	Density (kg/m^3)	Specific heat (J/Kg K)	Thermal conductivity (W/m K)
(Fe_2 O_4)/water	5.326	702.3	120.3

The necessary theoretical analysis was carried out using the data, recorded as experimental results. The heat production of PV/T panels can be expressed as follows:

$$\dot{Q}_{PVT} = \dot{m}_{PVT} c_p (T_{PVT,o} - T_{PVT,i}) \quad (2.6)$$

3. RESULTS and CONCLUSION

The study carried out in the climatic conditions of simulation results and experimental discussed for the implementation of the model, Matlab 2021a.The maximum surface temperature difference is 14°C, it observed that the cooling of the panel reached to a significant degree. In the PV/T system, the cooling amount increased by using different fluids, water, and hybrid nanofluid. It give to figure- 4 and figure-5. The variation of inlet and outlet temperatures of serpentine with time, according to the type of fluids used in the cooling circuit. Mains water primarily used as the cooling fluid in the experiments carried out according to the values measured at certain times of the day [7-10].

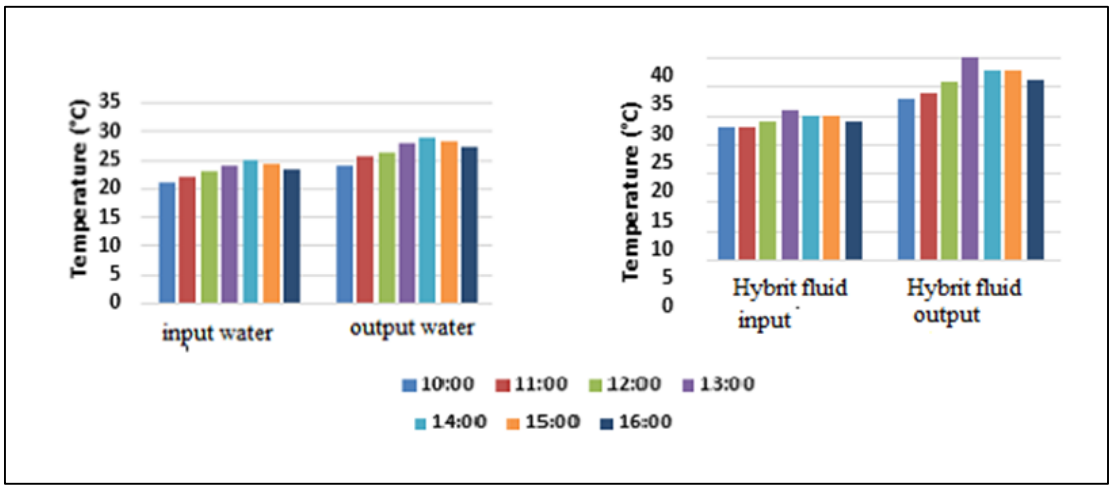

Figure 4. I/O temperature according to the fluids by using cooling circuit.

As shown in figure 5, there are three launch capacities that are often used. It has been shown that NNs with ReLU initiation capacities are much superior to other enactment capacities in terms of execution. Due to the non-linearity of the calculations, the necessary elements can be determined and the result can be calculated from the contributions.

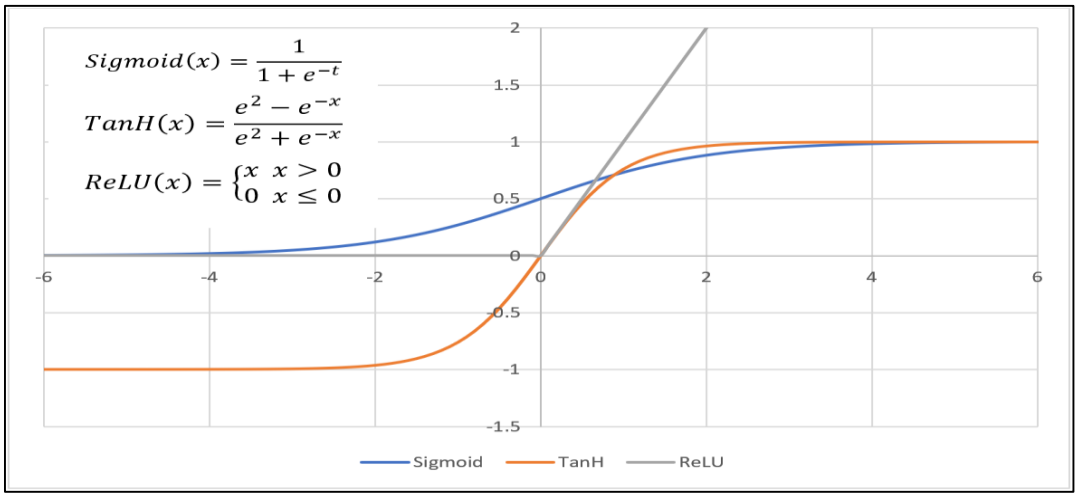

Figure 5. The Activation Function of Neurons [27-32].

In this study, investigating of providing electricity from PV/T systems connected to the electricity grid for Iran and Turkey. The most important feature and originality of our study was that until this time the studies required numerical.The fact that the obtained hot fluid has many application areas such as space heating, heating of greenhouses, use in drying systems, use as a heat source in heat pumps also causes PV/T systems to gain importance. The installation of the photovoltaic power system and its integration with the electric grid have become more common [30-35]. In this study, it can be concluded that the hybrid nanofluid containing nanometer-sized Fe_2O_4 particles is aimed to replace pure water with properties such as high thermal conductivity and heat transfer coefficient. The aim of this thesis is to analyse the operation, design and performance of a grid-connected PV system and to present the modeling of PV module behavior and characteristic features based on a mathematical model equivalent circuit based on the Matlab-Simulink 2021a version. In addition, cooling the system by using a hybrid system (water +nanofluidics) instead of water, which is traditionally used, in a certain environment, and how the output parameters and energy efficiency are affected have been experimentally studied. Considering the climatic conditions and energy needs of Turkey and Iran, successful development of the proposed system have significant economic impact and help global investment achieve the target of reducing emissions as required by both Turkish and Iranian governments. Hybrid PV/T modules with thermal units PV/T are heat-releasing systems that are installed together with a solar cell. In addition to increasing the electricity production performance of PV systems, the importance of PV/T systems is to obtain thermally hot fluid from the system. The importance of the PV/T system has also increased due to the wide application area of the produced hot fluid, which can be used as an energy source in heat pumps in industrial drying systems and for heating rooms/areas and greenhouses [33-35].

ACKNOWLEDGES

The authors sincerely thank Türkiye Scholarships (22IR013805) number research fellowship programme (YTB) and Kastamonu University and Gazi University Energy Central Laboratory staff for helping.

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