A Neural Network-based System Identification Model to Predict Output Current and Voltage of Solar Photovoltaic Panels

Publisher: IEEE

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Abstract:
Solar irradiance is the energy per unit area received by the Sun as electromagnetic radiation. It is one of the most important renewable energy sources. Photovoltaic or other solar technologies are used to generate power more accurately than direct sun irradiation. Solar irradiance research and measurement have a variety of critical applications, including forecasting power generation from solar power plants, climate modeling, and weather forecasting. This paper presents a neural network-based system identification model developed using measured parameters from solar panels with various wattage specifications, namely, 10W, 20W, 40W, and 100W. The parameters that were measured to train the ANN model for the prediction of the output current and voltage include the angle of panel orientation, panel temperature, ambient temperature, irradiance, and wattage. Several training experiments were conducted and the best ANN model produced at 500 epochs gave an accuracy of 99.81% and a loss of 0.1940. The model was deployed into an intelligent Web App that was also developed in this study. This app could be a potential tool for renewable energy engineers and researchers.

Published in: 2023 International Conference on Science, Engineering and Business for Sustainable Development Goals (SEB-SDG)
Date of Conference: 05-07 April 2023
Date Added to IEEE *Xplore*: 22 May 2023
ISBN Information:
INSPEC Accession Number: 23199921
DOI: 10.1109/SEB-SDG57117.2023.10124569
Publisher: IEEE

Conference Location: Omu-Aran, Nigeria

I. Introduction

Renewable energy sources are increasingly entering the market, and the contemporary power system is quickly adopting them. Traditional central power plants, with their environmental problems, will almost certainly be replaced by cleaner, smaller power plants located closer to the loads. The sun's energy is one of the most promising, non-polluting, and free energy sources. Among their advantages are the following: It is simple to expand a solar-powered system. Photovoltaic systems installed worldwide are increasing at a

practically exponential rate, despite their still relatively expensive cost. The most fundamental component of a PV system is the PV cell, which transforms sunlight directly into energy. PV systems have proved capable of powering a wide range of devices, from small electronic gadgets to large-scale PV power plants. The most basic component of a PV system is a PV panel, which is made up of a series of prewired cells. The panels are then linked in series to raise the voltage and in parallel to increase current, yielding electricity. A PV array is made up of PV panels that are linked in series and parallel [1].

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