A NEW TEACHING LEARNING ARTIFICIAL BEE COLONY BASED MAXIMUM POWER POINT TRACKING APPROACH FOR ASSESSING VARIOUS PARAMETERS OF PHOTOVOLTAIC SYSTEM UNDER DIFFERENT ATMOSPHERIC CONDITIONS

DOKALA JANANDRA KRISHNA KISHORE

DOCTOR OF PHILOSOPHY

UNIVERSITI MALAYSIA PAHANG
AL-SULTAN ABDULLAH

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Doctor of Philosophy.

_____

(Supervisor's Signature)

Full Name : DR. MOHD RUSLLIM MOHAMED

Position : PROFESSOR

FACULTY OF ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY.

UNIVERSITI MALAYSIA PAHANG AL-SULTAN ABDULLAH

Date : 06 JAN 2024

_____

(Co-supervisor's Signature)

Full Name : DR.SUDHAKAR KUMARASAMY

Position : SENIOR LECTURER

FACULTY OF MECHANICAL AND AUTOMOTIVE ENGINEEING TECHNOLOGY

UNIVERSITI MALAYSIA PAHANG AL-SULTAN ABDULLAH

Date : 06 JAN 2024

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang Al-Sultan Abdullah or any other institutions.

_____

(Student's Signature)

Full Name : DOKALA JANANDRA KRISHNA KISHORE

ID Number : PES20003

Date : 01 JAN 2024

A New Teaching Learning Artificial Bee Colony based Maximum Power Point Tracking Approach for Assessing Various Parameters of Photovoltaic System Under Different Atmospheric Conditions

DOKALA JANANDRA KRISHNA KISHORE

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ABSTRAK

Dalam beberapa tahun kebelakangan ini, halangan terbesar di alam semesta ialah pencemaran alam sekitar dan kekurangan tenaga akibat penggunaan pesat bahan api fosil konvensional. Jelas sekali ia mempunyai kesan yang serius terhadap keadaan cuaca, sumber air, dan mata pencarian penduduk. Oleh itu, banyak negara cuba melaksanakan sumber tenaga boleh diperbaharui/mampan untuk memelihara alam sekitar. Bagi industri elektrik, sumber tenaga boleh diperbaharui (RES) memainkan peranan penting dalam memenuhi kekurangan tenaga dan memuaskan hati pengguna tanpa sebarang gangguan. Walau bagaimanapun, tugas yang sukar dalam sistem elektrik adalah untuk mengimbangi kedua-dua pengeluaran kuasa dan permintaan beban yang dikehendaki tanpa sebarang perubahan voltan, arus dan frekuensi. Satu lagi kesukaran dalam sistem elektrik dengan penyepaduan RES adalah untuk meminimumkan keseluruhan kos, termasuk kos permulaan, kos operasi, kos penggantian dan kos penyelenggaraan. Selain itu, prestasi sistem berasaskan Tenaga Boleh Diperbaharui (RE) perlu diperkaya dengan mengambil kira masa penyelesaian, ketepatan, kelajuan dan kecekapan. Oleh itu, untuk mengoptimumkan kos penyepaduan RES melalui kaedah pengoptimuman berasaskan titik kuasa maksimum (MPPT) yang baru dibangunkan seperti algoritma pengoptimuman belalang (GOA) telah diperkenalkan. Kos penyepaduan PV/WT/Bateri ialah $408540. Selain itu, faktor Kos Tenaga Bertingkat (LCE) ialah 0.502 pada 210 kWj/hari. Selain mempertingkatkan prestasi berasaskan RE dari segi masa penyelesaian, ketepatan, kelajuan dan kecekapan melalui pengoptimuman serigala kelabu hibrid dengan evolusi pembezaan (GWO-DE). Mengikut hasil simulasi, GWO-DE mengekstrak kuasa puncak maksimum (MPP) sebanyak 674.6W dalam 0.06 saat dengan kecekapan 99.88%. Di samping itu, untuk meningkatkan prestasi pengajaran pembelajaran berasaskan kaedah koloni lebah tiruan (TLABC) telah digunakan pada keadaan cuaca yang berbeza. Bagi memastikan keberkesanan kaedah yang dicadangkan, kaedah yang dicadangkan telah dibandingkan dengan kaedah lain yang dikaji. Mengikut hasil simulasi, kaedah TLABC menunjukkan tindak balas yang lebih baik dari segi purata masa pengesanan, kelajuan penumpuan 0.5175 saat, 9 lelaran dan kecekapan 99.99% dalam pelbagai keadaan atmosfera. Selanjutnya, sistem yang dicadangkan telah dibangunkan di makmal PV dan disahkan dengan hasil simulasi.

ABSTRACT

In recent years, the greatest obstacle in the universe has been environmental contamination and shortage of energy due to the rapid utilization of conventional fossil fuels. It is evident that it has a serious impact on weather conditions, water resources, and people's livelihood. Hence, many countries are trying to implement renewable/sustainable energy sources to preserve the environment. For the electrical industry, renewable energy sources (RES's) perform a prominent role in fulfilling the energy shortage and satisfying consumers without any blackouts. However, the difficult task in the electrical system is to balance both power production and desired load demand without any voltage, current and frequency changes. Another difficulty in the electrical system with the integration of RES's is to minimize the entire cost, including initial cost, operational cost, replacement cost, and maintenance cost. Besides, the performance of the Renewable Energy (RE)-based system has to be enriched with regard to settling time, accuracy, speed, and efficiency. Hence, to optimize the cost of integrating RES's through newly developed maximum power point tracking (MPPT) based optimization method such as grasshopper optimization algorithm (GOA) has been introduced. The cost of integration of PV/WT/Battery is $408540. In addition, the Levelized Cost of Energy (LCE) factor is 0.502 at 210 kWh/day. Besides enhancing the RE-based performance in terms of settling time, accuracy, speed, and efficiency through hybrid gray wolf optimization with differential evolution (GWO-DE). As per simulation outcome the GWO-DE extracts maximum peak power (MPP) of 674.6W in 0.06 sec with 99.88% efficiency. In addition, to enhance the performance teaching learning-based artificial bee colony (TLABC) method has been used at distinct weather conditions. In order to ascertain the effectiveness of the proposed methods, the proposed methods have been compared with other studied methods. As per the simulation outcomes, the TLABC method shows a better response in terms of average tracking time, convergence speed of 0.5175 sec, 9 iterations, and efficiency of 99.99% under various atmospheric circumstances. Further, the proposed system has been developed in the PV laboratory and validated with simulation results.

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