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Design Optimization of Solar Power Inverter

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Abstract

Optimizing the design of solar power inverters aims to improve efficiency, dependability, and performance. Effective circuit design, component selection, and advanced power electronics design are all involved. Effective methods for trouble identification and heat control guarantee long-term dependability. Complex control algorithms and filtering techniques enable the generation of high-quality AC output. Different system sizes can be integrated thanks to scalability. Monitoring and communication features enable remote control and real-time performance monitoring. Safety features adhere to all relevant standards and laws. For the highest return on investment, cost-effective design selections balance performance and affordability. Check to see if any specific aspects, such as dependability, power quality, scalability, cost-effectiveness, or efficiency, need to be improved. data collection Collect all necessary data, such as details on solar panels, load specifications, grid standards, environmental factors, and any other details that might affect the design. Modelling and simulation an electronic or mathematical model of the solar power inverter system should be created. This model should be able to accurately represent the inverter's electrical properties, control structures, and operating behavior. Utilise simulation tools to assess the system's performance under various conditions. Utilizing optimization techniques, algorithms are used to discover the optimal design solution. These algorithms could be based on methods for machine learning, evolutionary algorithms, or mathematical optimization methods. Define the objective function and constraints of the optimization process. Iterative Refinement for Modify the design in response to the optimization's results. Iterate through the design exploration, performance evaluation, and optimization stages to reach a superior design solution. The parameters of the model are continuously updated and modified as required. Taken as alternate parameter is Air Conditioner, Fan, Iron Box, Laptop Charger, Microwave Oven, UPS, Cooler. Taken as evaluation parameter is Battery, Filter capacitor (C1), Filter inductor (L1), Switching Frequency, DC link Capacitor (C2) 2 nos.

Keywords: Battery, Filter capacitor (C1), Filter inductor (L1), Switching Frequency, DC link Capacitor (C2) 2 nos.

1. INTRODUCTION

The monthly variation in solar radiation in Indonesia is 9%, with an average yearly variation of 4.5 kWh/m2/d. Neither the formation of greenhouse gases nor the manufacturing of hazardous waste occurs when the sun is used as a source of energy. Renewable energy sources are becoming more popular due to environmental concerns on a global scale. By considering the unique qualities of prospective PV module candidates as well as the efficiency curves and operating areas of potential grid-tie inverters, the method selects the ideal device and system configuration for a given site. A plant's location, the space that may be used for installation, and the probabilistic nature of the solar and ambient temperatures are all taken into account in the optimal design. A number of case studies are also provided to examine the design's robustness in the presence of changing ambient temperature, solar irradiation, and available area. Three different goals—including maximising annual gathered energy, maximising overall financial advantages, and minimising payback time—are all optimised for using Taboo Search (TSA). By considering the distinct qualities of prospective PV module candidates as well as the efficiency curves and working areas of potential grid-tie inverters, the technique determines the ideal device and system configuration for a given location.The most efficient designs take into account the deterministic solar and ambient temperatures of the plant's location as well as the installation area. Taboo Search (TS) is used as the optimal approach for three separate objectives, including: maximum annual gathering energy, maximising overall financial gains, and limiting payback time. Many case studies are offered to examine the resilience of the design in order to precisely anticipate the lifetime energy output and total revenues realised by PV energy production system. The approach calculates the best device and system configuration for a particular site by taking into account the various attributes of potential PV module candidates as well as the efficiency curves and working areas of potential grid-tie inverters. The best strategies take into account the plant's location as well as the steady sun and temperature in the installation region. The most effective tactic is Taboo Search (TS), which combines three separate objectives—maximizing total cash rewards, minimising payback time, and increasing annual gathering energy—to achieve all three. Lifetime energy output and PV energy production received by the system and the total revenue Expect precision In terms of design To check the regression Several case studies are presented. RO desalination systems are brackish and desalination of seawater Can be used for activities. A lot of electricity in a battery bank Often in production blocks Related to being arranged PV and W/G input Power sources, in general A leading one Shared DC Basti Battery Connected to the bank Using battery chargers To charge the battery bank is used -Acid type, Excess produced save electricity, Insufficient sunlight or When there is no wind speed For RO desalination units Also used to provide power. DC Battery voltage is DC/AC Inverters Using RO desalination Connected to the AC requirements of the machines. By desalination method Unused excess Desalinated water A water tank is stored.

2. MATERIALS AND METHOD

Battery: When there is not enough sunshine or wind speed, the RO desalination machines are powered by A battery bank, it usually is Made of lead-acid batteries. Generated additional electricity Battery bank to save energy is used. DC/AC Inverters Using DC battery The voltage is connected RO desalination equipment's AC requirements. The extra desalinated water produced that the desalination system does not need is stored in a water tank.

Filter capacitor (C1DC-conn Function of capacitor, Irregularity of the inverter Due to high current requirements Fluctuations So much by reducing Constant DC voltage is to provide. Aluminum Electrolysis, Film, Canceram Various DC-Link capacitors such as Technologies are used. In a design.

Filter inductor (L1LCL filters have a rectifier input stage and are specifically made to decrease harmonic current absorbed by power converters. (Frequency converters for UPS, motors, etc.). They mostly consist of reactors and capacitors connected in parallel and series and are designed to lower the THD(I) of rectifiers.

Switching Frequency: LCL Filters Power absorbed by the converters Harmonic current are designed to reduce and a rectifier input have status. (Frequency for motors converters, UPS etc.). They are the THD(I) of the rectifiers. are developed to reduce and furnaces in general and Capacitors parallel and are connected in series. DC link capacitor (C2) 2 numbers; DC-link The work of the capacitor, Irregularity of the inverter Due to high current demands Fluctuations By reducing the DC voltage is to stabilize. Aluminum Electrolysis, film and Various types of ceramics DC-Link capacitor technologies Can be used in design.

Method

When there is not enough sunshine or wind speed, the battery bank, which is normally constructed of lead-acid batteries, is utilised to store extra electric energy created and to run RO desalination equipment. Using DC/AC converters (inverters), the DC battery voltage is coupled to the RO desalination equipment's AC requirements. A water tank is used to store any extra desalinated water that is generated but is not used by the desalination plant. The basic phases of the Weighted Product Model are as follows: It is important to identify the criteria that apply to the decision-making issue. These specifications should be measurable and relevant to the objectives of the decision.

Weighting the criteria: Assign a weight to each criterion to reflect its relative importance. The weights are typically normalised to ensure that their total is 1. The weights are usually determined using expert judgement, stakeholder input, or analytical hierarchy process (AHP) techniques.

Score Normalisation: A weight should be assigned to each criterion to reflect its relative importance. The weights are typically normalised to ensure that their total is 1. The weights are often determined using analytical hierarchy process (AHP) methods, stakeholder feedback, or professional judgement. Calculate the weighted product by multiplying each alternative's normalised scores by the the weights that each criterion was given. The weighted scores for each choice are then multiplied to arrive at the weighted product.

Prior to making a decision, rank the alternatives in order of their weighted product ratings. The option with the highest weighted product score is the one that is thought to be the most desirable or desired. Decision-makers can employ both quantitative and qualitative factors in their decision-making process by using the weighted product model. It provides a logical approach to weighing several variables in relation to one another while evaluating options. By assigning appropriate weights and averaging the outcomes, the WPM aids decision-makers in making informed decisions and prioritising choices based on their particular requirements and preferences. It should be noted that the Weighted Product Model,

3. RESULT AND DISCUSSION

TABLE 1. Design Optimization of Solar Power Inverter

	Battery	Filter capacitor (C1)	Filter inductor (L1)	Switching Frequency	DC link Capacitor (C2) 2 nos
Air Conditioner	18.52309641	9.70002332	56.28265296	63.39022504	77.88997549
Fan	39.43654687	17.13130448	53.55452748	3.454106282	79.33513504
Iron Box	27.91074513	72.0459112	59.06074677	2.636672438	28.29096467
Laptop Charger	13.97490443	27.66685504	21.41694809	26.2642638	49.35090143
Microwave Oven	76.11116866	42.7453185	33.74397747	47.65912068	53.77272231
UPS	23.64825172	22.985705	22.67493453	51.51275631	73.43080798
Cooler	61.41836965	21.69926512	74.87344094	41.53663789	64.75319481

TABLE 1 shows wpm method Air Conditioner, Fan, Iron Box, Laptop Charger, Microwave Oven, UPS, Cooler. And evaluation parameter Battery, Filter capacitor (C1), Filter inductor (L1), Switching Frequency, DC link Capacitor (C2) 2 nos.

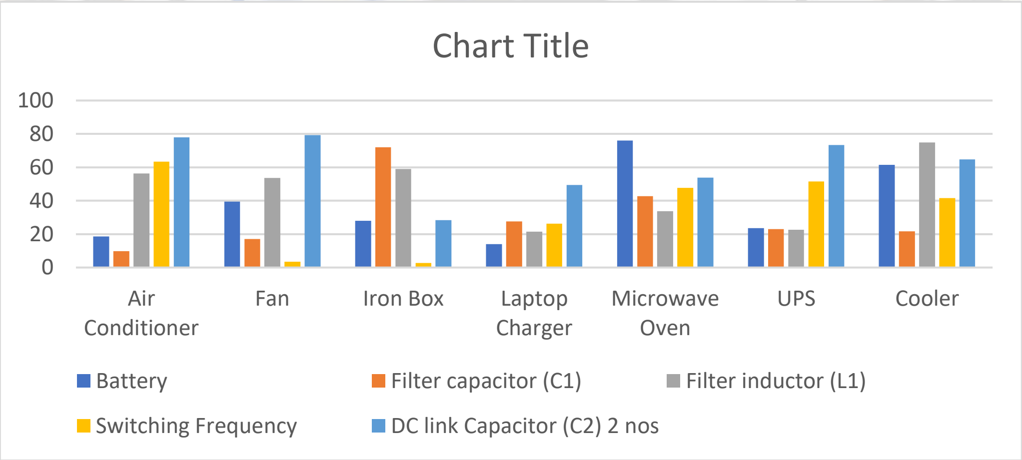

FIGURE 1. shows wpm method dataset

Figure 1 Shows wpm method Air Conditioner, Fan, Iron Box, Laptop Charger, Microwave Oven, UPS, Cooler. And evaluation parameter Battery, Filter capacitor (C1), Filter inductor (L1), Switching Frequency, DC link Capacitor (C2) 2 nos.

TABLE 2. Shows performance value of wpm

Air Conditioner	0.24337	0.13464	0.75170	1.00000	0.98178
Fan	0.51814	0.23778	0.71527	0.05449	1.00000

Iron Box	0.36671	1.00000	0.78881	0.04159	0.35660
Laptop Charger	0.18361	0.38402	0.28604	0.41433	0.62206
Microwave Oven	1.00000	0.59331	0.45068	0.75184	0.67779
UPS	0.31071	0.31904	0.30284	0.81263	0.92558
Cooler	0.80696	0.30119	1.00000	0.65525	0.81620

TABLE 2 based on the table you provided, it appears to be a performance value table for various appliances. The table consists of different appliances such as Air Conditioner, Fan, Iron Box, Laptop Charger, Microwave Oven, UPS, and Cooler. Each appliance has been evaluated based on five performance metrics.

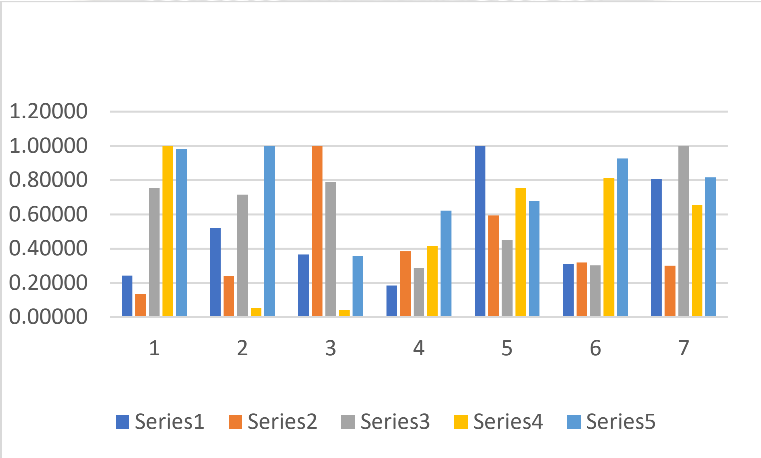

FIGURE 2. shows performance value of wpm

Figure 2 Performance value is displayed in It seems to be a table of performance values for different appliances. The table has a variety of equipment, including a cooler, fan, iron box, laptop charger, microwave, and microwave oven. There are five performance metrics that have been used to evaluate each appliance.

TABLE 3. weightages

Air Conditioner	0.20	0.20	0.20	0.20	0.20
Fan	0.20	0.20	0.20	0.20	0.20
Iron Box	0.20	0.20	0.20	0.20	0.20
Laptop Charger	0.20	0.20	0.20	0.20	0.20
Microwave Oven	0.20	0.20	0.20	0.20	0.20
UPS	0.20	0.20	0.20	0.20	0.20
Cooler	0.20	0.20	0.20	0.20	0.20

Table 3. Shows Each technology or solution is represented by a row in the table, and the values in each row (0.20 for each category) seem to indicate equal weight or importance assigned to each criterion. However, without further context or information, it is difficult to determine the specific meaning or interpretation of these values.

TABLE 4 weighted normalization decision matrix

Air Conditioner	0.75379	0.66963	0.94452	1.00000	0.99633
Fan	0.87678	0.75030	0.93518	0.55881	1.00000
Iron Box	0.81821	1.00000	0.95366	0.52943	0.81365
Laptop Charger	0.71249	0.82579	0.77855	0.83843	0.90942
Microwave Oven	1.00000	0.90086	0.85266	0.94455	0.92517
UPS	0.79154	0.79574	0.78749	0.95935	0.98465
Cooler	0.95801	0.78662	1.00000	0.91893	0.96019

TABLE 4 shows wpm method Air Conditioner, Fan, Iron Box, Laptop Charger, Microwave Oven, UPS, Cooler. And evaluation parameter Battery, Filter capacitor (C1), Filter inductor (L1), Switching Frequency, DC link Capacitor (C2) 2 nos. in weighted normalization decision matrix

TABLE 5. Preference Score

Air Conditioner	0.47501
Fan	0.34378
Iron Box	0.33613
Laptop Charger	0.34928
Microwave Oven	0.67123
UPS	0.46854
Cooler	0.66493

Table 5 these values represent the performance of each appliance according to the respective performance metrics. However, without additional information about the specific meaning or context of these metrics, it is challenging to interpret the significance of the values.

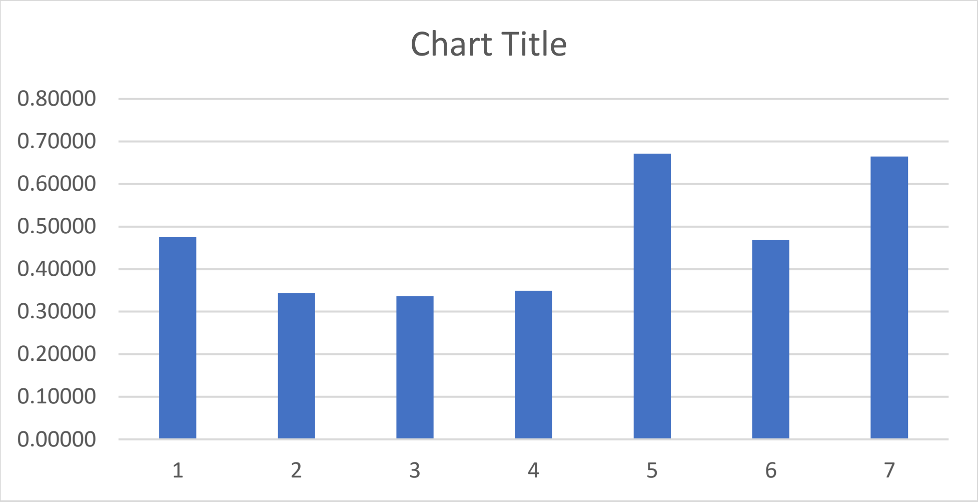

FIGURE 3. Preference Score

Figure 3 shows Microwave Oven is first value, Cooler , Air Conditioner is 2nd value, UPS is third value, Laptop Charger is fourth value, Fan is fifth value, Iron Box is value rank.

Table 6 ranking

Air Conditioner	**2**
Fan	**5**
Iron Box	**6**
Laptop Charger	**4**
Microwave Oven	**1**
UPS	**3**
Cooler	**2**

Based on the rankings provided in Table 6, the appliances are ranked as follows: Microwave Oven is first rank, Cooler , Air Conditioner is 2nd rank, UPS is third rank, Laptop Charger is fourth rank, Fan is fifth rank, Iron Box is sixth rank.

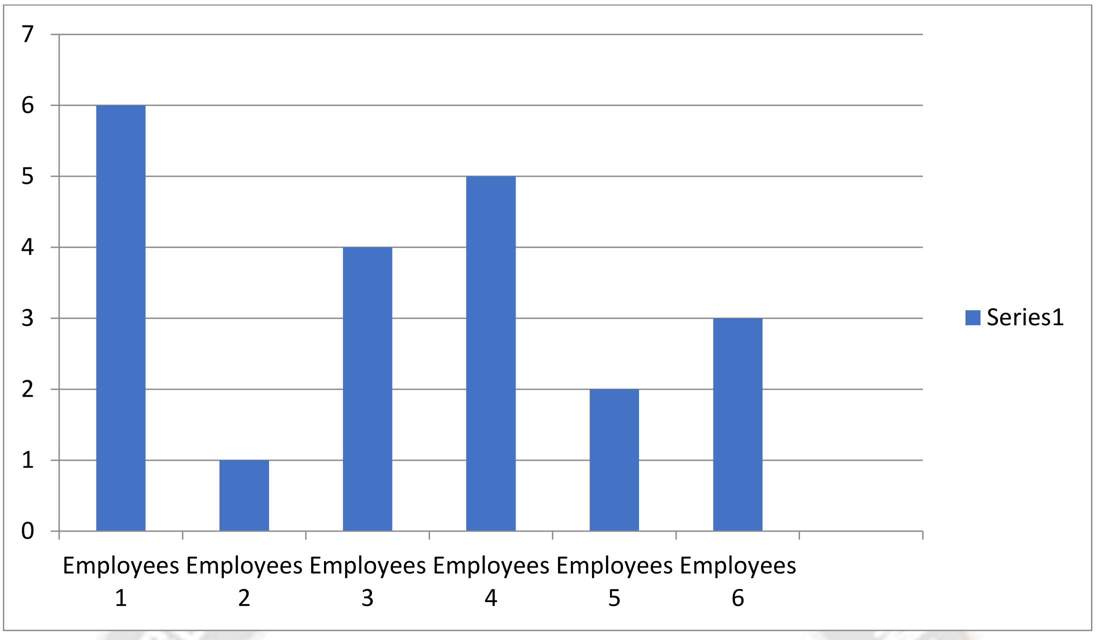

FIGURE 4. Rank

Figure 4 shows Microwave Oven is first rank, Cooler , Air Conditioner is 2nd rank, UPS is third rank, Laptop Charger is fourth rank, Fan is fifth rank, Iron Box is sixth rank.

4. CONCLUSION

PV energy conversion model In addition to describing, federal of office building Substantial solar on the roof Design for zone These optimization techniques The paper presents A 43.2 kW Grid-connected solar Family performance is structured, In local climatic conditions Tested figuratively. Photovoltaic system Operational issues When examined, economic Analyzed. This analysis two power plants shows that while the PV plant has a substantially greater Coe owing to its extremely high NCC, the ST plant has a significantly higher electrical output than the PV plant. Urban environment land use and such as terrain Depends on the components. Additionally, In this sector PV technology It has seen improvements. Consequently, PV is May be seen as capital and of each component Maintenance costs are also included Shortened 20-year cycle Total setup cost determine. evolution Using the methods, Customers' water Fully meet the requirement While doing so, 20 Annual Total Computer Cost is reduced. straightforward Using calculations Using genetic algorithms Global in aggregate position space Optimum can be determined. capitalization of each component and maintenance costs 20 Year-round total computing together to determine the cost are compiled. Full Universal in state space as well They are quick to optimize can be identified Since, total cost to reduce activity Genetic methods are used.

REFERENCES

[1]. Balachandran, Swaminathan, and Fred CY Lee. "Algorithms for power converter design optimization." IEEE Transactions on Aerospace and Electronic Systems 3 (1981): 422-432.
[2]. Colak, Ilhami, Mehmet Demirtas, and Ersan Kabalci. "Design, optimisation and application of a resonant DC link inverter for solar energy systems." COMPEL: The International Journal for Computation and Mathematics in Electrical and Electronic Engineering (2014).
[3]. Awan, Ahmed Bilal, Muhammad Zubair, and Kotturu VV Chandra Mouli. "Design, optimization and performance comparison of solar tower and photovoltaic power plants." Energy 199 (2020): 117450.
[4]. Koutroulis, E., and D. Kolokotsa. "Design optimization of desalination systems power-supplied by PV and W/G energy sources." Desalination 258, no. 1-3 (2010): 171-181.
[5]. Lipu, MS Hossain, Md Golam Hafiz, Md Safi Ullah, Ahad Hossain, and Farzana Yasmin Munia. "Design optimization and sensitivity analysis of hybrid renewable energy systems: A case of Saint Martin Island in Bangladesh." international journal of renewable energy research 7, no. 2 (2017): 988-998.
[6]. Chowdhury, Nusrat, Chowdhury Akram Hossain, Michela Longo, and Wahiba Yaïci. "Optimization of solar energy system for the electric vehicle at university campus in Dhaka, Bangladesh." Energies 11, no. 9 (2018): 2433.

[7]. Agai, Florin, Nebi Caka, and Vjollca Komoni. "Design optimization and simulation of the photovoltaic systems on buildings in southeast Europe." International Journal of Advances in Engineering & Technology 1, no. 5 (2011): 58-68.
[8]. Son, Yeongrack, Satyaki Mukherjee, Rahul Mallik, Branko Majmunovi'c, Soham Dutta, Brian Johnson, Dragan Maksimović, and Gab-Su Seo. "Levelized Cost of Energy-Oriented Modular String Inverter Design Optimization for PV Generation System Using Geometric Programming." IEEE Access 10 (2022): 27561-27578.
[9]. Camm, E. H., and S. E. Williams. "Solar power plant design and interconnection." In 2011 IEEE Power and Energy Society General Meeting, pp. 1-3. IEEE, 2011.
[10]. Weerakoon, AH Samitha, Byung-Ha Kim, Young-Jin Cho, Deepak Divashkar Prasad, M. Rafiuddin Ahmed, and Young-Ho Lee. "Design optimization of a novel vertical augmentation channel housing a cross-flow turbine and performance evaluation as a wave energy converter." Renewable Energy 180 (2021): 1300-1314.
[11]. Mokhtara, Charafeddine, Belkhir Negrou, Noureddine Settou, Abdessalem Bouferrouk, and Yufeng Yao. "Design optimization of grid-connected PV-Hydrogen for energy prosumers considering sector-coupling paradigm: Case study of a university building in Algeria." International Journal of Hydrogen Energy 46, no. 75 (2021): 37564-37582.
[12]. Liu, Jia, Xi Chen, Hongxing Yang, and Yutong Li. "Energy storage and management system design optimization for a photovoltaic integrated low-energy building." Energy 190 (2020): 116424.
[13]. Shi, Yanjun, Hui Li, Lu Wang, and Yu Zhang. "Intercell transformer (ICT) design optimization and interphase crosstalk mitigation of a 100-kW SiC filter-less grid-connected PV string inverter." IEEE Open Journal of Power Electronics 1 (2020): 51-63.
[14]. Abbes, D., A. Martinez, and G. Champenois. "Eco-design optimisation of an autonomous hybrid wind–photovoltaic system with battery storage." IET Renewable Power Generation 6, no. 5 (2012): 358-371.
[15]. Hithaish, Doddamani, Tapas K. Das, Manabu Takao, and Abdus Samad. "Design Optimization of a Fluidic Diode for a Wave Energy Converter via Artificial Intelligence-Based Technique." Arabian Journal for Science and Engineering (2022): 1-17.