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DEVELOPMENT OF SOFTWARE FOR SIZING AN STAND-ALONE PHOTOVOLTAIC/BATTERY SYSTEM BASED ON MATHEMATICAL MODELS.

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***Key words:* -**
Solar Photovoltaic system, Battery energy storage, Optimal Sizing, Sizing Software, Stand-alone system.

Abstract

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Photovoltaic (PV) solar energy is recognized as one of the most reliable and ecological sources of electricity generation. PV systems are currently used to provide electricity in remote areas far from the main local electricity grids and can be cost-effective and even provide energy security. Optimal sizing of PV systems in remote locations is a crucial challenge. It must take into account the solar potential of the study area, the tilt angle of the modules, the energy demand and the characteristics of the system components. This work develops software for sizing isolated solar PV power generation systems with battery energy storage. This software is a free offline desktop application that is developed based on empirical equations for sizing the components of a PV system. The languages java (Netbeans) and SQL (SQLite) are used to design the graphical interface and the database respectively. The jasper report plugin was integrated into Netbeans to design the report. The 3040kWh/day load profile of the Kankan Coura health centre, Kankan, Guinea was used to validate the software. Based on this data, the simulation results showed a south-facing tilt angle of 11°, a peak power of 790Wp, a 160Ah battery bank, a 60A charge controller, a 0.5kVA inverter and a cable with a cross-section of 25mm². The results also specified a configuration of 3 series of 2 modules for the PV array and a row of 2 batteries for the battery bank.

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Introduction:

Nowadays, electricity is essential in the socio-economic development of every nation. All sectors of human life depend on it [1]. However, it is a rare commodity for a large part of the world's population, especially Sub-Saharan Africa (SSA). Already in 2021, the electrification rate is around 60% in the Economic Community of West African States (ECOWAS) area [2]. Most of the energy produced comes from fossil fuels (oil, natural gas and coal) which cause environmental pollution leading to global warming [3, 4]. According to the World Health Organization (WHO), approximately 4.2 million people die prematurely each year due to air pollution, and climate change will cause the deaths of an additional 250,000 people each year between 2030 and 2050 [5]. For the survival of our species, the use of renewable energy sources (RES), namely solar energy, wind energy, biomass, hydropower and geothermal energy from natural energy sources could solve the problems of energy crisis and global warming for a

2 sustainable and green future [4, 6, 7, 8, 9]. Among all these RES, solar energy is considered the most abundant and
30 available in all regions of our planet [7]. Photovoltaic (PV) solar energy has become a major source of alternative
energy in the electricity sector [10]. It is obtained by converting sunlight into electricity [11] via a photovoltaic
6 module. The latter is a set of solar cells connected in series and/or parallel, whose operation is influenced by
climatic conditions and the geographical position of the installation site [12-16]. Its efficiency depends on its
operating temperature and the irradiation of the site [17-19]. The biggest obstacle to PV energy production systems
is the intermittency of its source, hence the need to size PV system components [1, 5]. Due to advances in science,
27 there are various simulation software tools available, such as PVsyst, PV Planner, HOMMER Pro, etc., for sizing
PV systems [20-25]. However, these software tools are not accessible to everyone due to their price and the fact that
they require a high-speed internet connection. Making free sizing software that does not require an internet
connection available to everyone (PV equipment vendors, independent buyers and installers) will help to reduce the
3 failure rate in solar PV installations. The aim of this work is to develop optimal sizing software for isolated PV
2 systems. Specifically, the aim is to design a calculator for each of the sizing elements of a PV system, namely the
8 daily energy consumption, the peak power required, the number of modules and energy storage batteries, the
6 amperage and voltage of the charge controller, the cross-section of the DC cables and the tilt angle). To this end, the
paper is structured as follows: section II is devoted to a description of the methodology, the results and discussions
are dealt with in section III and the conclusion in section IV.

Methodology:

The adopted methodology is structured in four parts:
1) Mathematical models of dimensioning.
2) Design of the new software,

PV array sizing

16 The sizing of the entire PV system in an isolated site requires prior knowledge of many important parameters (solar irradiation, ambient temperature and wind speed, consumption profile) [27]. In this study, we used RETScreen software to find these meteorological parameters.

-Total daily energy

The daily energy consumption (E_{Cons}) of a given site is calculated by equation 1 [33]:

$$E_{Cons}\left(\frac{Wh}{Day}\right) = \sum_{i=1}^{N} P_i(W) * N_i * t_i\left(\frac{h}{Day}\right) \qquad (1)$$

With:

$P_i(W)$ is the rate power of an electrical device, N_i is the number of device types and t_i is the usage time of the device.

-The installed peak power

5 The corresponding peak power (P_c) in Wp of the PV generator is calculated based on the total daily energy consumption, all losses in the system and the average daily solar radiation according to equation 2 [27, 28, 29].

$$P_c\,(Wp) = \frac{E_{cons} * I_0}{I_i * D_{ep}} \qquad (2)$$

With:

I_0 is the irradiance in standard test conditions (STC) which is worth 1kWh/m2, I_i is the average daily irradiation of the study location and D_{ep} is the set of total losses (loss in the power lines, the inverter, the regulator and the battery) recorded in the system. Its value is between 0.55 and 0.75 [27, 28].

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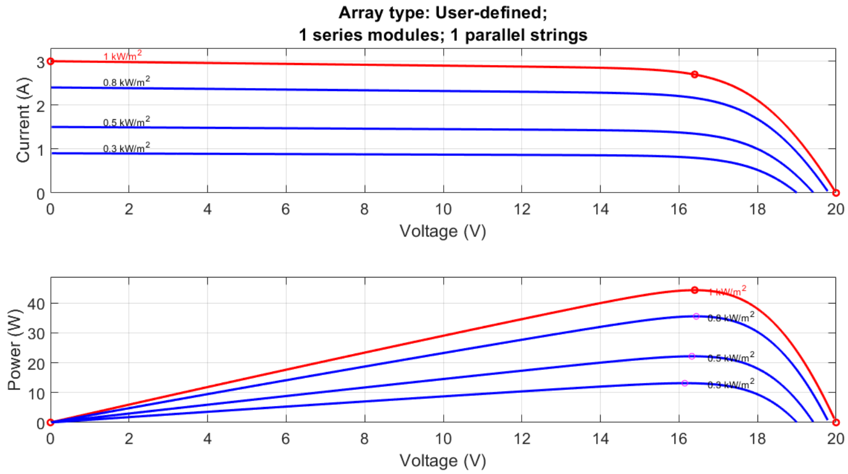
31 Figure 1 shows the influence of irradiation on the electrical characteristics (current - voltage) of the PV module.



32 **Figure 1:** Effect of irradiation on the power of a PV module.

21 **-Total number of PV modules**

29 Given the value of installed power and the model of the PV module, the total number of modules (N_{PV}) of the PV field is calculated by equation 3 [28].

$$N_{PV} = \frac{P_c}{P_{panel}} \qquad (3)$$

With:

P_{panel} is the peak power of a PV module.

-Number of series modules: N_S

5 The number of modules in series in a PV field is obtained by equation 4.

$$N_S = \frac{U_{Sys}}{U_{mpp\_module}} \qquad (4)$$

With:

18 U_{Sys} is the installation voltage of the PV system and U_{mpp_module} is the voltage at the maximum power point of a module available from the supplier.

19 **-Number of modules in parallel N_p**

The number of strings connected in parallel in the PV field to obtain the desired power is given by equation 5 [33]:

$$N_p = \frac{N_{PV}}{N_S} \qquad (5)$$

Battery bank sizing

4 **-Battery bank capacity**

The storage capacity of the battery park is determined based on the number of days of autonomy by equation 6 [33, 27, 28, 29]:

$$C_{st} = \frac{E_{cons}.A_{ut}}{\eta_{bat}.DoD.U_{sys}} \qquad (6)$$

With:

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C_{st} is the storage capacity of the battery bank (Ah), A_{ut} is the number of days of autonomy expected for the system, η_{bat} is the battery efficiency and DoD is the desired depth of discharge.

-**Number of batteries in series**

The number of batteries connected in series (N_{bat_S}) to obtain the system installation voltage is determined by equation 7 [8, 33, 30]:

$$N_{bat\_S} = \frac{U_{sys}}{U_{bat}} \qquad (7)$$

With:

U_{bat} is the voltage of a storage battery.

-**Number of series in parallel**

The number of battery strings in a storage park is obtained by equation 8 [8, 33]:

$$N_{bat\_p} = \frac{C_{st}}{C_{bat}} \quad (8)$$

With:

C_{bat} is the unit capacity of the battery.

-Total number of batteries in the fleet

The total number of batteries N_{bat} required for a fleet is expressed by equation 9 [28] [8]:

$$N_{bat} = \frac{C_{st}}{C_{bat}} * \frac{U_{sys}}{U_{bat}} \qquad (9)$$

Sizing of the charge controller, inverter and cable section

-The regulator

The size of a charge controller depends mainly on two factors: the total short-circuits current and the total open-circuit voltage of the PV array. However, it is strongly recommended to increase the current and voltage by 25 to 30% of their total values. The input current of the charge controller ($I_{in\_charger}$) is determined by equation 10 [31]:

$$I_{in\_charger} = \frac{I_{max}}{K_{temp}} \qquad (10)$$

With:

$I_{max} = N_p * I_{sc} * 1.3$ et I_{sc} is the short-circuit current of a PV module and K_{temp} is the temperature reduction factor of the inverter which is 0.8 in this study [31]:

-Inverter

The power of an inverter expressed in VA is calculated by the formula given by equation 11:

$$P_{inverter}(\text{VA}) = \frac{P_{total} * 1.3}{cos\varphi * K_{temp}} \qquad (11)$$

With:

$P_{total} = \sum_{i=1}^{N} P_i(W) * N_i$

P_{total} is the total power of all electrical loads, cosφ is the power factor of the inverter [31].

-Cable section

The cable section depends not only on the length of the cable but also on its resistivity (ρ), the total current (I_{max}) flowing through it, the voltage at its terminals (U_{sys}) and the voltage drop (ε). It is calculated by equation 12 [32]:

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$$S = 2 * \frac{\rho * l * I_{max}}{\varepsilon * U_{sys}} \qquad (12)$$

-Determination of the tilt angle

For a PV solar panel to receive the maximum possible sunlight in a latitude zone Φ, it must be tilted at an optimal angle β determined by equation 13 [33]:

$$\beta_{opt} = 3.7 + 0.69\ \Phi \qquad (13)$$

Design of the new software

The database design.

The database for this project is designed in SQLite. It is named 'bd_solution_solr.sqlite' and comprises nine (9) tables (evaluator, equipment, site, project, consumption, result, generator_panel, generator_battery and standard_section) as shown in Figure 2 of the relational model below. The model is produced in MySql Workbench version 6.2 CE

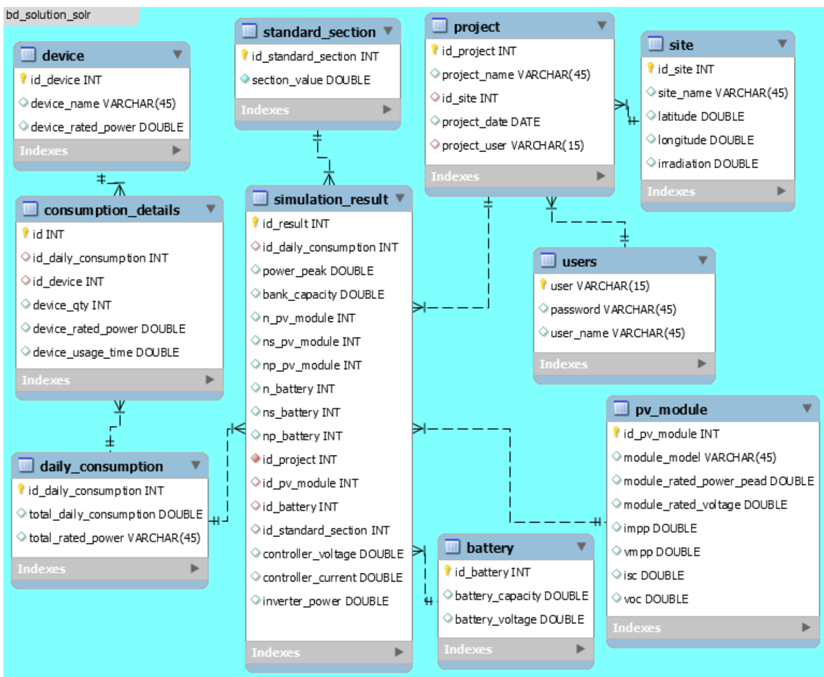

Figure 2: Relational model of the 'bd_solution_solr' database

Graphical User Interface Design

The configuration adopted for this software is a Pentium with 512 MB RAM. The system runs in single-user mode under Windows XP, Windows 7, 8, 10 and more recent versions. The database part of the software is based on SQlite, a DBMS that can be embedded on mobile systems. It was chosen here because of the portability of the software, which means it can be deployed on any workstation without the need to install a database server. NetBeans IDE version 7.4 was used to design the software's graphical user interface. The software comprises five (5) windows accessible via buttons: Project definition, Definition of daily energy requirements, Sizing of PV modules and energy storage batteries and Sizing of charge controller, inverter and DC cable cross-section. The sizing algorithm used in the software is illustrated in the figures 3&4.

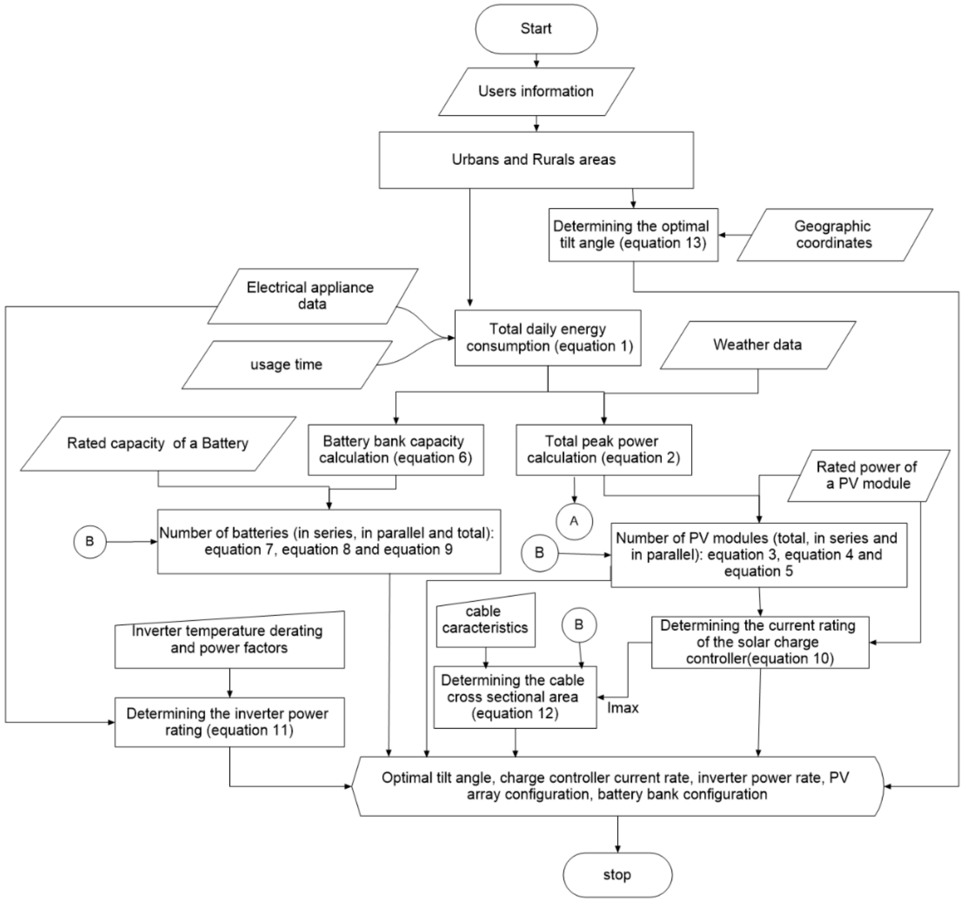

Figure 2: Flowchart 1 for execution of the whole sizing process

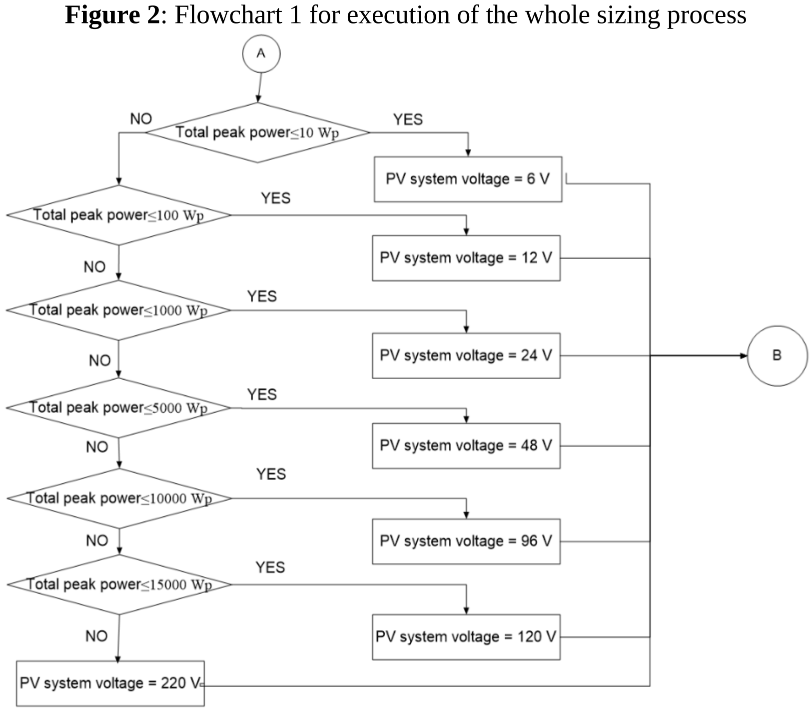

Figure 4: Flowchart 2 for calculating the PV system optimal voltage

Results and discussion

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Software validation: Case study

The case studied in this paper for the validation of the developed software is a dispensary located in Kankan Coura, in the Urban Commune of Kankan, Republic of Guinea. The dimensioning processes are described in the following steps:

Step 1 consists in giving title to the dimensioning project and in choosing the study site; this allows to find the latitude, the longitude, the irradiation of the place and the inclination and orientation of the PV field (see figure 5).

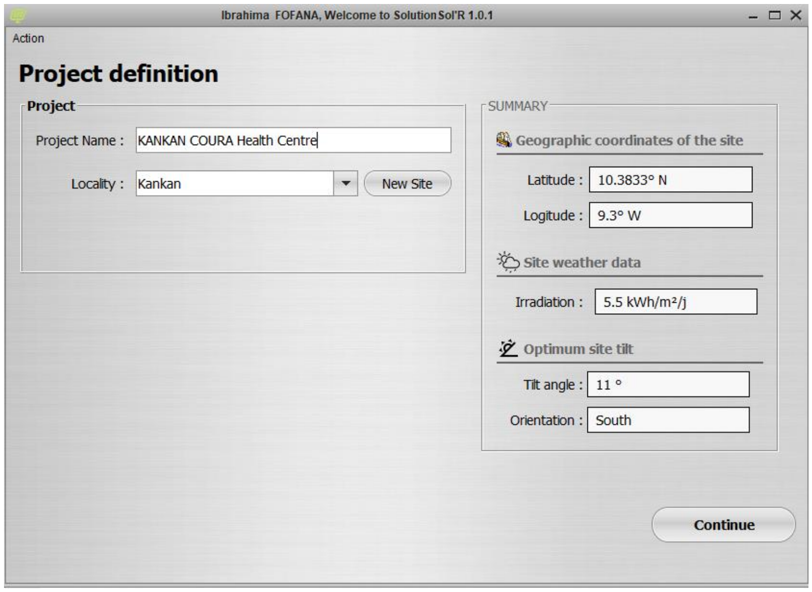

Figure 5: Tilt angle determination

Step 2: this is the load profile definition step. In this section, the user selects the devices concerned from the list and defines their power ratings, numbers and usage times. This will allow both the total power and the total daily energy consumption to be calculated. The Kankan Coura health centre contains several types of electrical device, an extensive list of which is given in Figure 6.

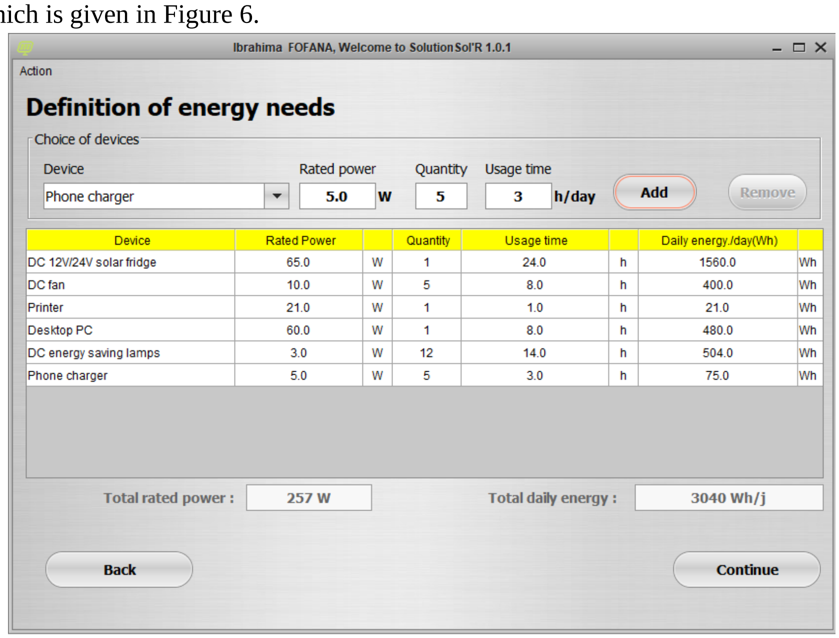

Figure 6: Calculation of total power and total daily energy consumption.

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5 Step 3: In this step, the peak power of the PV array, the storage capacity of the battery bank and the system installation voltage are calculated directly by the software. The user can choose a PV module and battery model
13 available from his supplier. This will allow the user to find the total number, in series and in parallel of the PV module and battery.
8 According to the total daily energy consumption obtained in step 2, the configuration of the PV array and the battery bank of the health centre of KANKAN COURA is illustrated in figure 7.

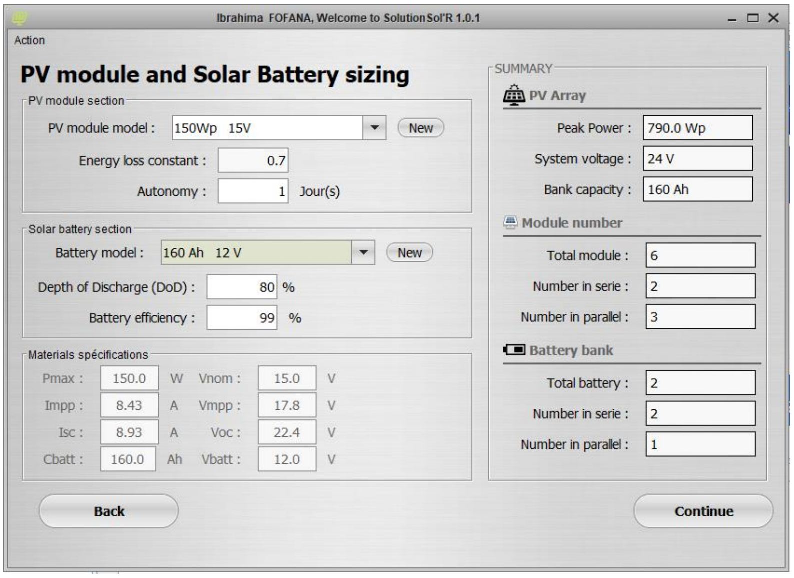

Figure 7: PV array and battery bank configuration

3 Step 4: This is the final sizing step, which involves determining the ampere rating and voltage of the charge controller, the cable cross-section and the power of the inverter. The values for the inverter and charge controller temperature derating factor, the charge controller voltage drop and the inverter power factor are already incorporated into the software. All the user has to do is define the length of the DC cable (10 m in this study). The load profile
3 defined in step 2 and the configuration of the PV array and battery bank allow the software to obtain the values shown in Figure 8.

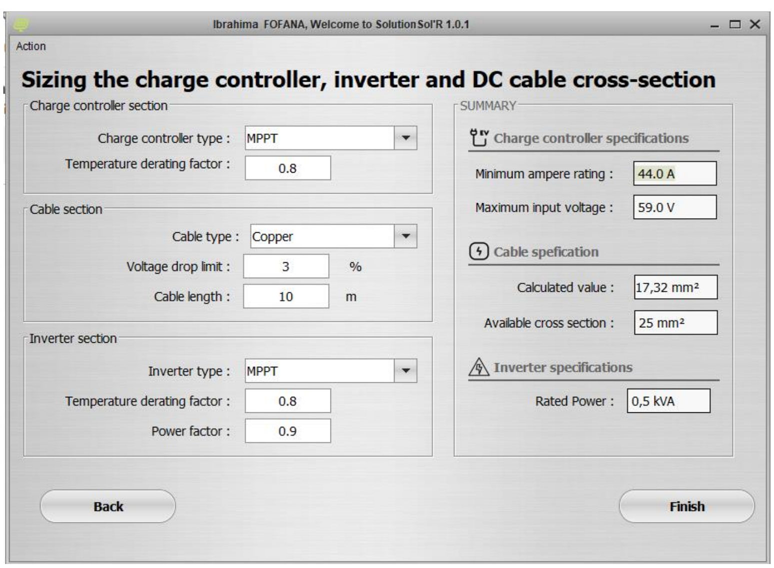

Figure 8: Sizing the charge controller, inverter and cable cross-section.

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After the last step, the software automatically manages the simulation report presenting all the details of the study project. This report is a kind of specification for the system installer. It provides information on the tilt angle of the modules and the characteristics of the charge controller, the inverter and the connection cable between the PV array and the battery bank. In addition, the installer will find the type, number and configuration of the modules in the PV array and the battery bank. In the case of this study (KANKAN COURAN health centre), the report generated after simulation is shown in Figure 9.

Design report for an off-grid PV system

SolutionSol'R

Project	KANKAN COURA HEALTH CENTRE			
	Number :	24	Date :	2025-03-04
	Author :	Ibrahima FOFANA		

Site locality	
Place :	Kankan, GUINEA
Latitude :	10.3833° N
Longitude :	-9.3° W
Irradiation :	5.5 kWh/m²/day
Optimal tilt angle :	11 °
Orientation :	South

System configuration	
Peak power :	790.0 Wp
Bank capacity :	160.0 Ah
System voltage :	24.0 V

PV module		Battery	
Number in serie :	2	Number in serie :	2
Number in parallel :	3	Number in parallel :	1
Total number :	6	Total number :	2

Charge controller sizing	
Type :	MPPT
Maximum input current :	44.0 A
Maximun input voltage :	59.0 V

Inverter sizing	
Type :	MPPT
Inverter rated power :	0,5 kVA

Cable sizing	
Cable type:	Copper
Cable length :	10.0 m
Cable cross section :	25.0 mm²

Charge profil

Device	Power	Qty	Usage time	Daily consumption
DC energy saving lamps	3.0 W	12	14.0 h	504.0 Wh
Printer	21.0 W	1	1.0 h	21.0 Wh
Phone charger	5.0 W	5	3.0 h	75.0 Wh
Desktop PC	60.0 W	1	8.0 h	480.0 Wh
DC fan	10.0 W	5	8.0 h	400.0 Wh
DC 12V/24V solar fridge	65.0 W	1	24.0 h	1560.0 Wh
Total rated power :	257.0 W	Total daily energy :		3040.0 Wh/day

Figure 9: Simulation report

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Conclusion

6 In this paper, a new software for the optimal sizing of a photovoltaic system with storage battery has been developed. Java languages under Netbeans and SQL under SQLite are used for its design. The software allows to generate a final simulation report using jasper report. A mathematical sizing model was used for each component of the isolated system. Simulation results from a case study of the Kankan Couran health centre, Kankan, Guinea, showed a PV/battery system with 6 modules (2 in series and 3 in parallel) and 2 batteries in series with a charge controller and an inverter of 60A and 0.5kVA respectively.
In the future, we intend to improve the software by integrating the calculation of the investment cost and the amount of carbon dioxide that can be reduced by a PV system.

Reference

[1] S I Abba, Gafai Najashi, Abdulazeez Rotimi, Bashir Musa, Nasser Yimen, J Kawu, S M Lawan, and Mustafa Dagbasi. Engineering Emerging Harris Hawks Optimization based load demand forecasting and optimal sizing of stand-alone hybrid renewable energy systems – A case study of Kano and Abuja , Nigeria. 12(February), 2021.
[2] F. Antonanzas-torres, J. Antonanzas, and J. Blanco-fernandez. Environmental life cycle impact of off-grid rural electrification with mini grids in West Africa. *Sustainable Energy Technologies and Assessments*, 47 :101471, 2021.
[3] Asif Khan and Nadeem Javaid. Jaya Learning-Based Optimization for Optimal Sizing of Stand-Alone Photovoltaic, Wind Turbine , and Battery Systems. 6 :812– 826, 2020.
[4] Hadi Nabipour, Ateeb Hassan, Yuhani Pamodha, Jubaer Ahmed, Kamyar Mehranzamir, San Chuin, and Zulkurnain Abdul. Sizing and economic analysis of standalone hybrid photovoltaic-wind system for rural electrification : A case study Lundu, Sarawak. *Cleaner Engineering and Technology*, 4 :100191, 2021.
[5] Yali Zhang, Azhu Han, Shizhou Deng, Xiaowen Wang, Huanhuan Zhang, Shakoor Hajat, John S Ji, Wannian Liang, and Cunrui Huang. The impact of fossil fuel combustion on children' s health and the associated losses of human capital. *Global Transitions*, 5 :117–124, 2023.
[6] Yuhong Xie, Yuzuru Ueda, and Masakazu Sugiyama. Greedy energy management strategy and sizing method for a stand-alone microgrid with hydrogen storage. 44, 2021.
[7] Kosmas A Kavadias, Emily Karamanou, A Pina, P Ferr˜ao, J Fournier, B Lacarri`ere, and O Le Corre. Meteorological input data effect on sizing Meteorological input data effect on sizing stand-alone photovoltaic systems. *Energy Procedia*, 159 :90–95, 2019.
[8] Zulkifli Othman, Shahril Irwan, Ismail Musirin, and Ahmad Maliki. Handling multiple models of system components in stand-alone photovoltaic system sizing via iterative sizing algorithm. *Energy Reports*, 8 :674–680, 2022.
[9] M Thirunavukkarasu, Himadri Lala, and Yashwant Sawle. Reliability index based optimal sizing and statistical performance analysis of stand-alone hybrid renewable energy system using metaheuristic algorithms. pages 387–413, 2023.
[10] Uzmah Javed and Mummadi Veerachary. Battery-integrated ZVT boost converter based stand-alone PV system. 155(November 2023), 2024.
[11] Novel Approach Based on Artificial Neural Networks (ANN) for Controlling the Three-phase Inverter of a Photovoltaic System Connected to the Grid, *J. P. Soaphys,* Vol 3, N°1 (2021), http://dx.doi.org/10.46411/jpsoaphys.2021.01.09
[12] D. Gueye, A. Ndiaye, M. Abdou Tankari, M. Faye, A. Thiam, L. Thiaw, G. Lefebvre. Design Methodology of Novel PID for Efficient Integration of PV Power to Electrical Distributed Network. *International journal of smart grid*, Vol.2, No.1, March, 2018, https://www.ijsmartgrid.org/index.php/ijsmartgridnew/article/download/14/pdf
[13] Mamadou Traore, Alphousseyni Ndiaye, Amadou Ba, Ibrahima Ngom, and Senghane Mbodji. Adaptive control of single-phase DC/AC converter for grid connected photovoltaic applications, *IEEE Xplore*, 26 August 2021, https://doi.org/10.1109/PVSC43889.2021.9518524

[14] W.S. Ebhota, P.Y. Tabakov. Influence of photovoltaic cell technologies and elevated temperature on photovoltaic system performance, *Ain Shams Engineering Journal*, 14 (2023) 101984, https://doi.org/10.1016/j.asej.2022.101984
[15] Anthony Umunnakwe Obiwulu, Nald Erusiafe, Muteeu Abayomi Olopade, Samuel Chukwujindu Nwokolo. Modeling and optimization of back temperature models of mono-crystalline silicon modules with special focus on the effect of meteorological and geographical parameters on PV performance, *Renewable Energy* (2020), https://doi.org/10.1016/j.renene.2020.02.103
[16] Oussama Idbouhouch, Nabila Rabbah, Nassim Lamrini, Hicham Oufettoul, Ibtihal Ait Abdelmoula, Mourad Zegrari. Assessing PV inverter efficiency degradation under semi-arid conditions: Acase study in Morocco https://doi.org/10.1016/j.heliyon.2024.e36906
[17] Amir A. Imam, Abdullah Abusorrah, Mousa Marzban. Potentials and opportunities of solar PV and wind energy sources in Saudi Arabia: Land suitability, techno-socio-economic feasibility, and future variability, *Results in Engineering*, 21 (2024) 101785, https://doi.org/10.1016/j.rineng.2024.101785
[18] El hadji Mbaye Ndiaye, Mactar Faye, Alphousseyni Ndiaye. Comparative Study Between Three Methods for Optimizing the Power Produced from Photovoltaic Generator. *Advances in Science, Technology and Engineering Systems Journal* Vol. 5, No. 6, 1458-1465 (2020). https://dx.doi.org/10.25046/aj0506175
[19] Zhen Yea, Andre Nobrea, Thomas Reindla, Joachim Luthera, Christian Reise. On PV module temperatures in tropical regions, *Solar Energy*, 88 (2013) 80–87, http://dx.doi.org/10.1016/j.solener.2012.11.001
[20] Z. Gao, S. Li, X. Zhou, Y. Ma, An overview of PV system, in: In: 2016 IEEE International Conference on Mechatronics and Automation, 2016, pp. 587 592.
[21] T.K. Das, A. Banik, S. Chattopadhyay, A. Das. (2019) Sub-harmonics Based String Fault Assessment in Solar PV Arrays. In: Chattopadhyay S., Roy T., Sengupta S., Berger-Vachon C. (eds) Modelling and Simulation in Science, Technology and Engineering Mathematics. MS-17 2017. Advances in Intelligent Systems and Computing, vol 749. Springer, Cham.
[22] T.K. Das, A. Banik, S. Chattopadhyay, A. Das. FFT based Classification of Solar Photo Voltaic Microgrid System, 2019 Second International Conference on Advanced Computational and Communication Paradigms (ICACCP), Gangtok, India, 2019, pp. 1-5.
[23] A. Banik, A. Sengupta. Scope, Challenges, Opportunities and Future Goal Assessment of Floating Solar Park, 2021 Innovations in Energy Management and Renewable Resources (52042), Kolkata, India, 2021, pp. 1-5, https://doi. org/10.1109/IEMRE52042.2021.9386735.
[24] S. Muthulingam, K.B. Bae, R. Khan, I.-H. Lee, P. Uthirakumar. Improved daylight-induced photocatalytic performance and suppressed photocorrosion of N-doped ZnO decorated with carbon quantum dots, RSC Adv. 2(1) 46247 46462.
[25] N. Loganathan, C. Muniraj, S. Chandrasekar. Tracking and erosion resistance performance investigation on nano-sized SiO2 filled silicone rubber for outdoor insulation applications, IEEE Trans. Dielectrics Electric. Insulat. 16(2) 2014 2172-2180.
[26] Mohamad Abed, Amarendra Reddy B, T R Jyothsna, and Nabil Mohammed. Optimal sizing and performance assessment of stand-alone PV systems using optimum hybrid sizing strategy. 25(December 2024), 2025.
[27] S. Boulmrharja, Y. NaitMaleka, M. Khaidarb, M Bakhouya, R. Ouladsine, K. aculty of Comp, M. Khaidar, R. Abid. Approach for dimensioning stand-alone photovoltaic systems. *Energy Procedia*, 153 :56–61, 2018.
[28] A Djafour, M S Aida, and B Azoui. Photovoltaic assisted fuel cell power systems. *Energy Procedia*, 50 :306 313, 2014.
[29] Jean Gu, Daniel Yamegueu, and Etienne Tchoffo. Heliyon Review on sizing and management of stand-alone PV / WIND systems with storage. 10(September), 2024.
[30] Godfrey T Udeh, Stavros Michailos, Derek Ingham, Kevin J Hughes, and Lin Ma. Optimal sizing of a hybrid PV-WT-battery storage system : Effects of split-ST and combined ST + ORC back-ups in circuit charging and load following. 256(February), 2022.
[31] Rabindra Satpathy, Venkateswarlu Pamuru. Design, Manufacturing and Applications from Sand to Systems, 2021, Pages 267-315 https://doi.org/10.1016/B978-0-12-817626-9.00007-1

[32] Sami Ekici and Mehmet Ali Kopru. Investigation of PV System Cable Losses. International journal of renewable energy research, Vol.7, No.2, 2017.
[33] Ogbonna Chima Otumdi, Constance Kalu, and Idorenyin Markson. Determination of Loss of Load Probability for Stand-Alone Photovoltaic Power System. 1(1) :27–32, 2017.