International Archive of Applied Sciences and Technology
Int. Arch. App. Sci. Technol; Vol 5 [3]September 2014: 08- 12

[ISO9001: 2008 Certified Organization]
www.soeagra.co/iaast.html

IAAST
ONLINE ISSN 2277- 1565
PRINT ISSN 0976 - 4828

CODEN: IAASCA

ORIGINAL ARTICLE

The use of Photo Voltaic systems with Electrical Energy storage Systems for Scattered Electric energy Consumers

Saeid Nahi[1]* Soodabeh Soleymani[2]
1. Department of Electrical Engineering, Ilkhchi Branch, Islamic Azad University, Ilkhchi, Iran.
2. Department of Electrical Engineering, Tehran Science and Research Branch, Islamic Azad University, Tehran, Iran.
*E-mail: saeidnahi@gmail.com

ABSTRACT
Consumer systems distributed in different geographical areas needs without reliable electricity system to be turned off. On the other hand, due to the remote location of some of them, there is no access to the national grid. Therefore, these papers introduce the launch of the solar system with battery and provide electrical power for the operation of household equipment that we installed. Each of the major energy sources in the world are having their own advantages and disadvantages. The use of renewable energy sources because consistent with the nature and the infinite variety of ways are increasing. Stand-alone photovoltaic power system design and analysis provided in this paper with chemical batteries without shutting down equipment to set up consumer has been presented. The different components behavior these can be analyzed by system after modeling. Solar Charging System is one of the essential parts. In this paper, a method of controlling voltage and load current automatically according to changes in voltage and current moment and the quality will be provided. Finally, a practical graph of voltage and current at the time of the circuit is given. The simulations were performed using MATLAB software.
Keywords: *photo voltaic cell, rechargeable battery, control, renewable energy*

Received 10/04/2013 Revised 12/06/2014 Accepted 23/07/2014

Introduction

Nowadays, many questions isabout the future of energy in the world. The role of renewable energies in the range of terrestrial and space applications is well known. Among the main problems of using fossil fuels, damage to nature and the limitations of their resources All of them come from renewable energy, solar energy, to solve the above two issues are of particular interest. However, because of economic and environmental factors cannot be local, renewable resources, can be used alone to feed the whole time.
The prediction of solar energy, including renewable energy future is bright. In this system, solar energy is converted into electrical energy using photovoltaic methods. According to forecasts by the turn of the century most of the world's energy needs will be met in this way.
The system design can be produced by combining two or more single issues such as modeling, control, connected to other systems, power quality, delivery reliability and economy system is discussed. In this paper, a block matching is depicted in Figure (1) design and analysis can be combined to provide a stand-alone photovoltaic system with the battery is done[1].Using the current method maximum power from the PV panels is delivered to a common bus[2].Chemical battery as a secondary power source is selected by a control circuit, charge and discharge current with the bass exchanges. And it is the rechargeable source. Changes the voltage and current sources are considered , as well as how to control and modeling. Circuits with MATLAB simulation results will be shown in the next sections.

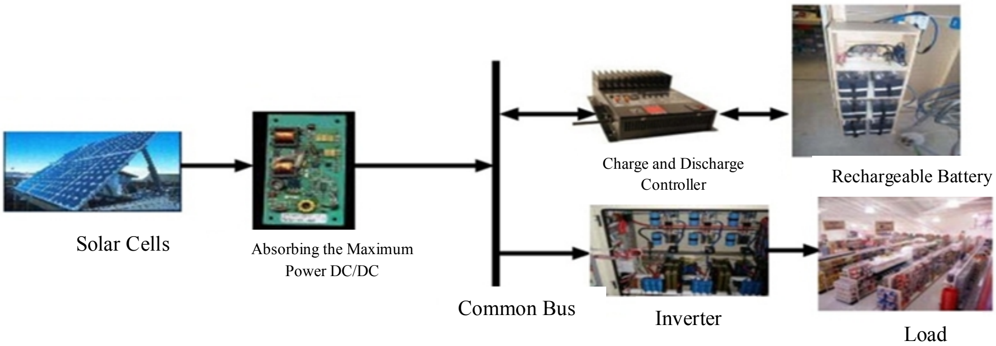

Figure 1. Solar panel with electrical energy storage system , load and power electronic equipments.

Modeling solar panels

Solar photovoltaic cell circuit in Figure 2 is shown[3]. The series resistance Rs may limit the efficiency rate. In Figure 3 the curve in terms of voltage and current at different temperatures and solar radiation are shown.

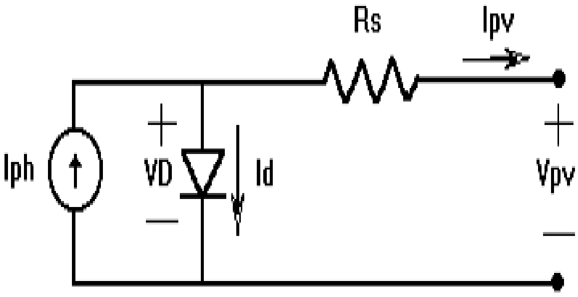

Figure 2. Equivalent circuit of photovoltaic panels

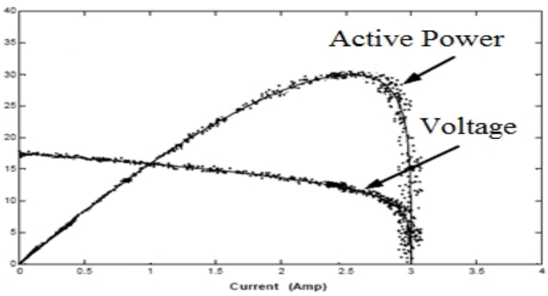

Figure 3. Characteristics of photovoltaic panels at various temperatures and radiation

Voltage-current equation of photovoltaic panels during a series in parallel with the NP and Ns cells in series, each series is calculated as follows:

$$v_{PV} = \frac{N_s}{\Lambda} \ln\left(\frac{N_P I_{ph} - i_{pv}}{N_p I_0} + 1 \right) - \frac{N_s}{N_p} R_s i_{pv}, \Lambda = \frac{q}{aKT} \quad (1)$$

In above equation the cell current$I_{ph}$is proportional to radiation (cell short circuit current per amp), q is electric load of an electron, a is correction factor dependent cells, T is the absolute temperature in degrees Kelvin, K is Boltzmann's constant and I_0 is the reverse saturation current cells be.
Characteristic equation of a solar panel manufacturing plant fiber with a 36 cell series (details in Table 1) in a field at 25 ° C in equation (2) is shown.

$$v_{sa} = 1.77 \ln\left(\frac{I_{sc} - i_{sa} + 4e-5}{4e-5} + 1 \right) - 0.95 i_{sa} \quad (2)$$

Table 1. Electrical characteristics of a solar cell

Characteristic	value
Dimension [cm2]	10 * 10
Cell short circuit current Isc [A]	2/9
Open circuit voltage V_{oc} [V]	0.58
Current temperature coefficient [mA/^{0}C] a_I	0.144
Voltage Temperature Coefficient [mA/^{0}C]a_V	-7/7

In this paper we used absorbs the maximum power in current shape model at a constant stream of light. In this method, the maximum power of the solar array is proportional to the short circuit current source is calculated.

Nonlinear modeling of chemical battery

The theoretical and experimental analysis in this paper is presented a nonlinear model for rechargeable battery (Figure 4). Relations of this type of battery and its circuit are shown below. [4]

$$R_s = f_1^{lin}(I_{bat}) = R_{so} + K_{rs}\,(I_{bat}\text{-}I_0),\ C_s = f_2^{lin}(I_{bat}) = C_{so} + K_{cs}\,(I_{bat}\text{-}I_0) \qquad (3)$$

$$C_p = f_3^{lin}(I_{bat}) = C_{po} + K_{cp}\,(I_{bat}\text{-}I_0),\ R_p = f^{nonlin}\,(I_{bat}) = K_{p1}I_{bat}^2 + K_{p2}I_{bat} + K_{p3}$$

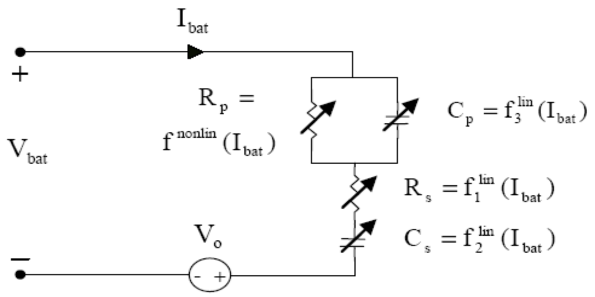

Figure 4. Non-linear equivalent circuit model of rechargeable batteries

The circuit and control system combining solar cell , battery and load

Figure (5) shows the Simplified schematic of the power and control of the composition of the solar cell, battery and charge controller. The circuit consists of three main power source parts including a Photovoltaic cell, a rechargeable battery,load and a control part The purpose of this circuit is to supply load demand during the whole day . Note that the electric energy generated by the solar cells are dependent on sunlight as a result of solar power during night hours is not able to generate electricity. Therefore, we have added a storage system to the circuitwith automatic control system and intelligent battery status so that when the solar resource is capable of generating electricity. The energy required to meet consumer needs and supply store used batteries. And when the night or shadow energy stored by the battery during the day will be used to respond to consumers.

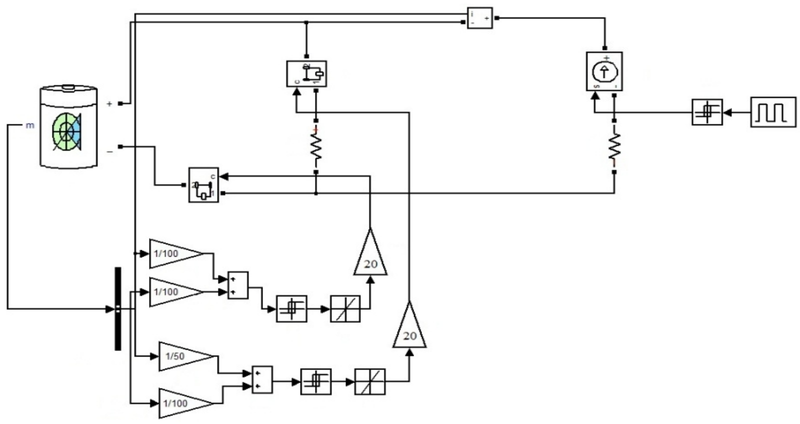

Figure 5. The circuit includes a photovoltaic cells source, rechargeable battery, load and control section

Describe the performance characteristics of the control circuit to charge and discharge the battery

According to this model of the solar system, 12 hours a day and 12 hours at night is considered. Resulting in a 12 -hour load demand and charging the battery , if required will be provided by the solar system . And in the next 12 hours, the battery will provide power for the load. Figures (6) and (7) of this operation are shown. One advantage of constant communication transceiver system loads can be requested. The purpose of this study we have considered a constant current load. The perfect time to recharge the battery at 80 % of maximum voltage switching is considered. And the figure we see that the time required to charge the battery in this case is slightly less than the discharged battery. Since inception we have considered a full battery in the first 12 hours of battery condition characterized by a flat face is drawn.

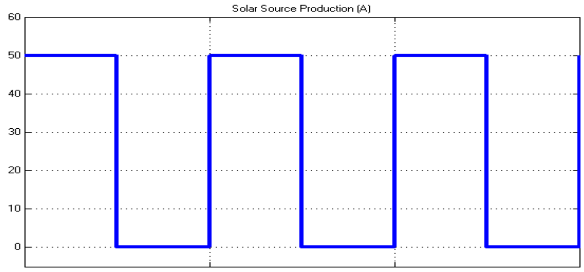

Figure 6. Solar cell production status during various hours over three days

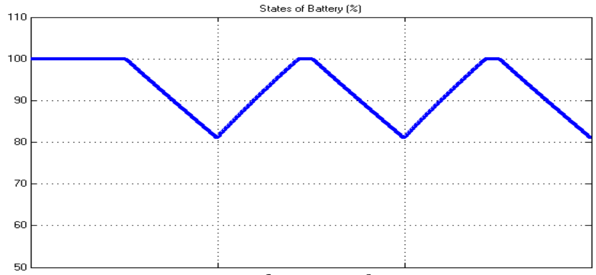

Figure 7. In terms of storage battery status in percentage at different hours during three days

Draw conclusions of current and voltage of battery and load

At times when there is enough sun light load current and charge of battery,as shown in (8) and (9), are supplied by photovoltaic cells . As a result the battery voltage rises When the battery capacity reaches up to 100 percent, and then help to avoid disruption of the consumer in the dark solar system peak load demand. Batteries and photovoltaic systems work together to provide the load if needed. This causes a decrease in the voltage level of the battery after charging is completed, which is not so much. But this change will lead,does not face to a definitive moment in time, when keying a solar source and we have available the more power.

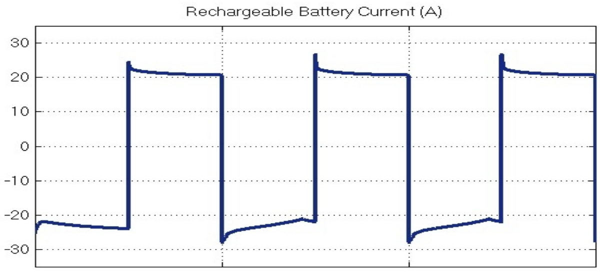

Figure 8. The battery current in charge and discharge times during the three days

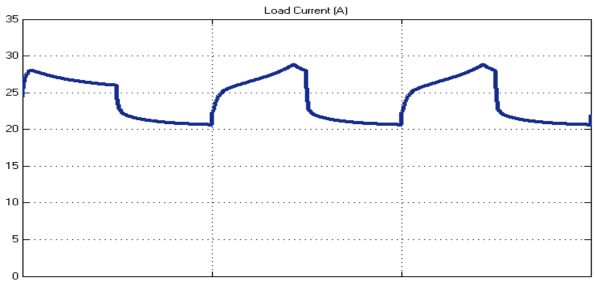

Figure 9. Load current supplied by batteries and solar power during the three days

During the evening hours of battery alone provides power for the load. The figure (10) Consequently, the circuit voltage drops to about 205 voltsand when charging is charged to 280 volts. That can be used with a regulated DC output voltage in output of the battery or tap changer transformerin output of the inverter recive to certain amount of stabilizeload voltage.

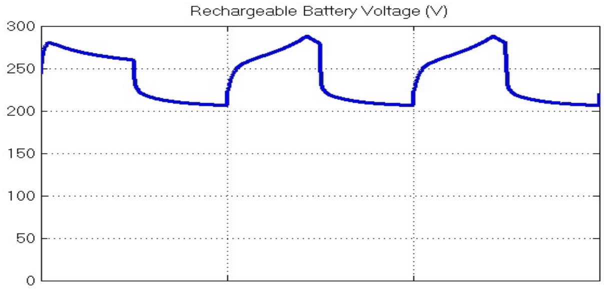

Figure 10. Charge and discharge the battery voltage changes over time during the three days

RESULTS AND CONCLUSION

In this paper the design and analysis of autonomous photovoltaic system behavior combines battery - to respond to the needs of consumers has been presented. First, considering the needs of the times, for the supply and control circuitry are provided by renewable sources (Figure 5). Equations and models for equipment used in systems such as photovoltaic panels , battery and load chemical equations (1-3) have been investigated in detail for chemical battery , a nonlinear model is used to (Figure 4). Furthermore, the possibility of production per unit of PV-battery for uninterrupted power supply with the terms in the figures (6-10) were studied. In these structures, figures and photovoltaic power source and the battery voltage and current as well as the entire system with the characteristics and behavior of chemical battery has been investigated and modeled.

ACKNOWLEDGMENTS

Hereby commend and thank the authors of the Ilkhchibranch,Islamic Azad University for financial support of this research project and plan are reported.

REFERENCES

1. Badawy, M. O., Yilmaz, A. S., Sozer, Y., & Husain, I. (2014). Parallel Power Processing Topology for Solar PV Applications. *Industry Applications, IEEE Transactions on, 50*(2), 1245-1255. doi: 10.1109/tia.2013.2277546
2. Ceraolo, M. (2000). New dynamical models of lead-acid batteries. *Power Systems, IEEE Transactions on, 15*(4), 1184-1190. doi: 10.1109/59.898088
3. Ciabattoni, L., Cimini, G., Grisostomi, M., Ippoliti, G., Longhi, S., & Mainardi, E. (2013, Feb. 27 2013-March 1 2013). *Supervisory control of PV-battery systems by online tuned neural networks.* Paper presented at the Mechatronics (ICM), 2013 IEEE International Conference on.
4. Das, N., Wongsodihardjo, H., & Islam, S. (2013, 21-25 July 2013). *Photovoltaic cell modeling for maximum power point tracking using MATLAB/Simulink to improve the conversion efficiency.* Paper presented at the Power and Energy Society General Meeting (PES), 2013 IEEE.
5. Nahi, S. (2006, Nov. 28 2006-Dec. 1 2006). *Load Forecasting on Special Days & Holidays in Power Distribution Substation Using Neural & Fuzzy Networks.* Paper presented at the Computational Intelligence for Modelling, Control and Automation, 2006 and International Conference on Intelligent Agents, Web Technologies and Internet Commerce, International Conference on.
6. Dinesh, P., Kowshick, B., Raghav, P. P., Govindarajan, R. K., & Ilango, G. S. (2013, 4-6 April 2013). *Solar Power Based Intelligent Battery Charging System Compatible with Existing Home Inverters.* Paper presented at the India Educators' Conference (TIIEC), 2013 Texas Instruments.
7. Eghtedarpour, N., & Farjah, E. (2014). Distributed charge/discharge control of energy storages in a renewable-energy-based DC micro-grid. *Renewable Power Generation, IET, 8*(1), 45-57. doi: 10.1049/iet-rpg.2012.0112
8. Nahi, S., Hajforoosh, S., & Nabavi, S. M. H. (2011). Automation System Software and Dispatching of Electricity Networks. *International Review on Modelling and Simulations, 4*.
9. Gordillo, C., Rodriguez, E., Lopez, A., Hurtado, J., Diaz, J., Vazquez, N., . . . Nunez, C. (2009, 15-19 Feb. 2009). *Battery Charger with Maximun Charge Tracking Current for PV Systems.* Paper presented at the Applied Power Electronics Conference and Exposition, 2009. APEC 2009. Twenty-Fourth Annual IEEE.
10. Halder, T. (2011, 28-30 Jan. 2011). *Charge controller of solar photo-voltaic panel fed (SPV) battery.* Paper presented at the Power Electronics (IICPE), 2010 India International Conference on.
11. Nahi, S., & Nabavi, S. M. H. (2011). *Estimated Production Potential Types of Wind Turbines Connected to the Network Using Random Numbers Simulation.* Paper presented at the International Conference on World Academy of Science, Engineering and Technology.
12. Nikhil, P. G., & Subhakar, D. (2013). Sizing and Parametric Analysis of a Stand-Alone Photovoltaic Power Plant. *Photovoltaics, IEEE Journal of, 3*(2), 776-784. doi: 10.1109/jphotov.2013.2247792

Ciation of this article

Saeid Nahi and Soodabeh Soleymani. The use of Photo Voltaic systems with Electrical Energy storage Systems for Scattered Electric energy Consumers. Int. Arch. App. Sci. Technol; Vol 5 [3] September 2014: 08-12. http://dx.doi.org /10.15515/ iaast.0976-4828.5.3.812