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Concept of Increasing Energy Storage Capacity using Two Energy Banks via integrating a Bidirectional Switching System

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Abstract: An efficient bidirectional charging-discharging switching system for two energy banks application is proposed. The system accepts the regulated charges from the charge controller before storing into the respective energy bank. When extra solar energy is available, the system is able store the energy into the storage bank that is connected to the system. On the other hand, either energy bank will also be able to discharge or charge while the photovoltaic system is operating. The proposed system can draw maximum of 10 Ampere current to charge and discharge when it is connected to photovoltaic system. This paper is organized to discuss the flaw in solar energy application system, brief introduction about the conventional solar energy storage application system, research motivation, research methodology about the proposed system, overall system discussion and finally the conclusion.

Keywords: Bidirectional, charging, discharging, two energy banks, photovoltaic system.

I. INTRODUCTION

Solar energy is known has one of the most promising energy that can be used to accommodate the shortage or increasing demand of electricity demand. Usually the solar energy requires energy bank to store the harvested solar energy from the photovoltaic system. Means, the solar energy storing is dependent on the availability of the solar energy as well as the energy banks. However, due to some shortfalls and disadvantages related to the conventional method to store the harvested solar energy, only subjected amount of harvested energy can be stored into the energy bank while the remaining available solar energy is wasted not stored. Looking into this aspect, this paper proposed a concept to increase the energy bank capacity while maintaining the photovoltaic system size. This solution could reduce the photovoltaic system costing and still maintain the charging efficiency with same amount of photovoltaic panels.

As the world electricity demand continues to grow, the demand towards technological development to harvest the solar energy is also increasing [1]. Solar energy is known as clean, noise free and readily available source of electricity [1]. One of the methods that have been implemented to harvest the solar energy is through photovoltaic system developments. Photovoltaic systems are known because of their standalone capability to harvest the solar energy for satisfying most of the low electrical appliances connected to it [2]. Due to the capability to harvest the solar energy, two components are strictly required to have an operating photovoltaic system. Charge controller and energy banks are the two components required for harvesting the solar energy [3]. The primary function of photovoltaic system is to maintain highest solar energy harvesting capability which has the capability to disconnect the charging process when the energy banks are maximally charged. Most of the conventional photovoltaic systems have prefix method to collect and store the harvested solar energy. Figure 1 illustrates the conventional method used for collecting and storing harvested solar energy. Conventionally, the sunlight will directly strike the solar panels. The generated sunlight and heat emitted in the form of radiation is converted into electricity using the photovoltaic panels [4]. The energy then is regulated using the charge controller before storing into the energy banks. At the same time, the energy is converted into electricity charges which are usable to supply to the connected load or electrical appliances.

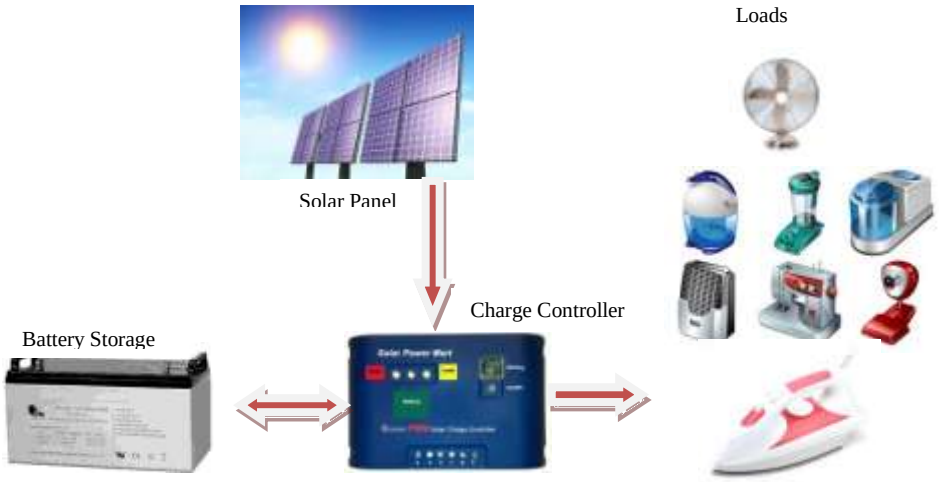

Figure 1. Conventional Method of Photovoltaic System Connected to Load

II. Research Motivation

Based on the conventional method illustrated in Figure 1, the paper is to explain a concept to increase the energy storage capacity using two energy banks via integrating bidirectional switching system. Conventionally to increase the storage capacity, increment of solar panels and battery storage is necessary. In this paper a concept of integrating switching system without increasing the solar panels is explained. The concept of energy banks switching charging-discharging system is introduced to increase the energy storing capacity to continuously provide electric energy during the unavailability of solar energy source. Also, if there is additional solar energy produced than it is required by the solar panels then the additional energy can be stored into the secondary battery bank as additional storage via the bidirectional switching system.

III. Proposed Concept of Integrating Bidirectional Switching System for Two Energy Banks

For an independent photovoltaic system energy harvesting, collecting and storing is an important factor. Considering these factors, the technological development in photovoltaic system development has improved vastly. Similarly to that, this paper proposes a concept to increase the storage capacity using two energy banks while keeping all the other equipment unchanged. Figure 2 illustrates the concept of integrating a bidirectional switching system for two energy banks. The integration of bidirectional switching system will operate to charge-discharge the energy banks based on the pre-programmed condition in the microcontroller.

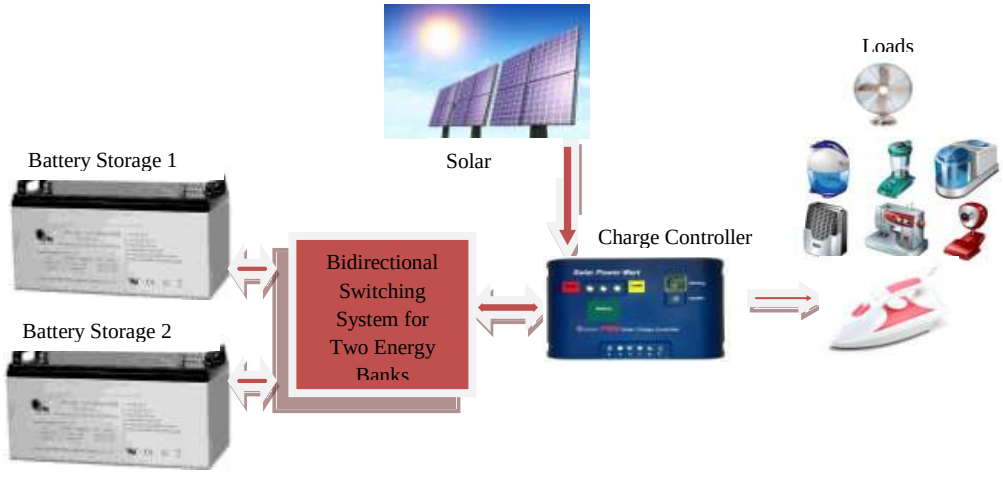

Figure 2. Concept of Integrating a Bidirectional Switching System for Two Energy Banks

a) Concept of the Bidirectional Switching System for Two Energy Banks

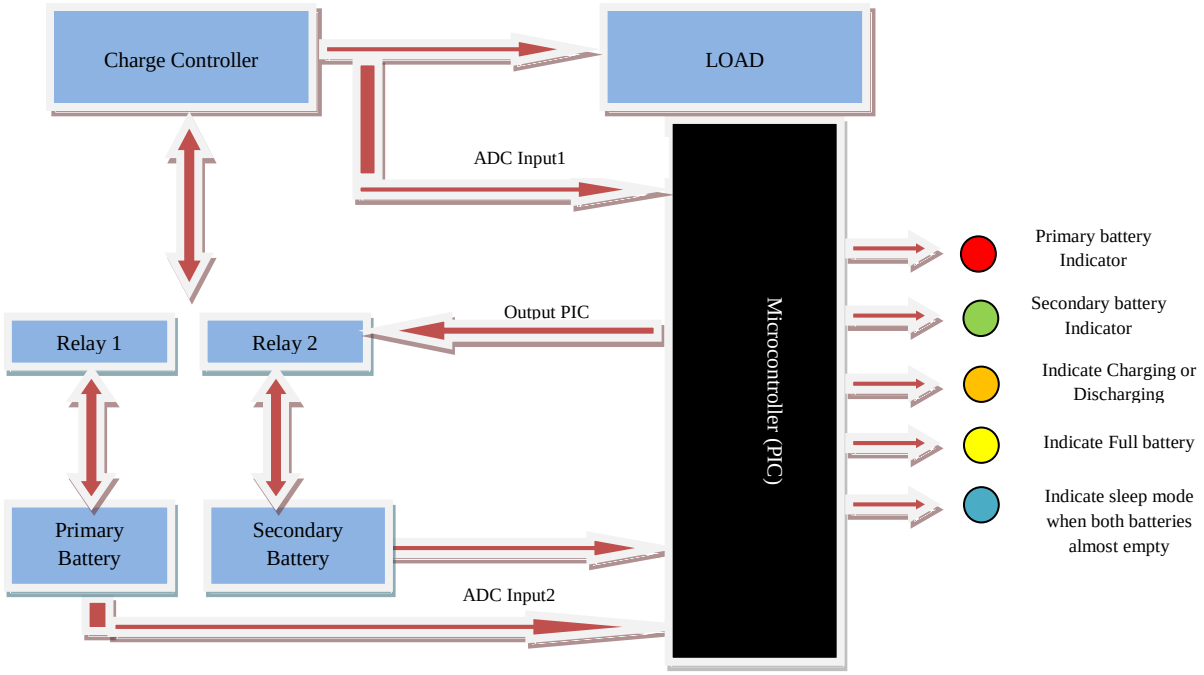

Figure 3. Architecture Overview of Bidirectional Switching System for Two Energy Banks

b) Operational:

i. The proposed bidirectional switching system starts its operation after the charge controller. The output from the charge controller is connected into two relays.
ii. Relay 1 and Relay 2 functions as switches to control the switching ON and OFF to connect and disconnect the energy banks. The voltage value from both of the energy banks are send to the microcontroller to determine which one of the energy bank is required to be charge and discharge. The output PIC will control the Relay 1 and Relay 2 switching ON and OFF based on the determine voltage value from ADC input2. At the same time, the microcontroller need to process the amount of voltage left in either energy banks.
iii. The ADC input1 is used when both relays are disconnected from the batteries connection, this occurs when the battery energy drops to the preset level due to not allowing the battery not over discharging. When both of the batteries energy drops till to a safety level which is to disallow over discharging, Relay 1 and Relay 2 will disconnect both of the batteries to prevent over discharging. The output PIC load will not receive any power or source from the batteries during the sleep mode until the solar panel have sufficient power to turn on the load (batteries charging could possible happen), this is when ADC input1 will sense the incoming voltage, it will interrupt and wake the microcontroller up from the sleep mode as well as start the system operation as normal again.
iv. Lastly, Light Emitting Diode (LEDs) is used to indicate the status of the bidirectional switching system during the operation of the system.

Discussion

This proposed method or concept is able to increase the energy storing capacity from the solar system application effectively. At the same time the proposed method will help to increase the charging efficiency of the energy banks without losing the charges unused. Also, increasing the number of energy banks would reduce the costing to install the solar panel which nowadays is getting expensive due to the high demand to install the solar system application for electrical appliance. Proper charging and discharging algorithm can be integrated in the bidirectional switching system to determine either battery is charging or discharging. This bidirectional switching system can be built as an independent device or module, which can accommodate different types of solar energy storage system.

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Conclusion

Nowadays, as the electricity demand and crisis is increasing, alternative to generate more electricity to accommodate the demand is necessary. Many technological type of systems has been developed, which indirectly increase the development costing. Hence, looking into some factors which would be able to explain basic concept to improve the energy storing capability, bidirectional switching system for two energy banks has been conceptualized. At the present state, this method or concept is under the research and development process.

References

[1]. M. Glavin and W.G. Hurley, "Battery Management System for Solar Energy Applications", Proceedings of the 41st International Universities Power Engineering Conference, 2006. UPEC '06., pp.79-83.
[2]. S.N. Singh and Snehlata, "Intelligent Home Energy Management by Fuzzy Adaptive Control Model for Solar (PV)-Grid/DG Power System in India", International Journal of Computing Communication and Information System (IJCCIS) Vol. 2 No.1 Jan–June 2011, pp. 46-51.
[3]. Eric W. Brown, "An Introduction to Solar Energy", http://www.ccs.neu.edu/home/feneric/solar.html. (accessed: 30th November 2012).
[4]. Daniels Farrington, "Direct use of the Sun's Energy", Ballantime Books, 1964.
[5]. Silicon Solar. (n.d.). Retrieved September 22, 2012, from Sealed Lead Acid Batteries: http://www.siliconsolar.com/sealed-lead-acid-batteries.html.