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Design of Solar Energy Harvesting System for Battery Charging Using Photovoltaic Panel

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Abstract—This paper presents a solar energy harvesting system. A Solar energy is one of the features that has been used in many application, specially the use of a photovoltaic panel because it provides clean, easy and endless to use energy of the photovoltaic panel .By using for Maximum Power Point Tracking (MPPT).The proposed topology is only one system that is required to harvest the maximum energy from the photovoltaic (PV) panel to charge batteries. Hence the energy from photovoltaic panel is available for limited time depending on weather & duration of sunlight means environmental conditions. This system may lack of reliability if it does not receive the maximum power from photovoltaic panel. The power management technique between the maximum power point tracking and the power charging processes is also proposed. It is to prove that the propose system can be utilize solar energy and control the charging of battery at maximum efficiency, therefore the lead-acid battery can be quickly and safely charged. This paper proposes to introduce new techniques that utilize solar energy & control the charging of battery at maximum efficiency

Keywords— *Photovoltaic panel (PV), Maximum Power Point Tracking(MPPT), battery charging and efficiency*

I. Introduction

Today ,a renewable energy is one of the features that has been used in many applications, especially the use of a photovoltaic (PV) panel because it provides endless, clean and easy to use energy of the PV panel [1]. To extract the maximum value, it is necessary to calculate how to keep the system running at the MPP. This method is called the method of Maximum Power Point Tracking (MPPT) [2]-[6]. The use of a PV panel at maximum efficiency is to extract the Maximum Power Point (MPP) of the PV panel [7]. There are many factors that affect the MPPT control such as temperature, light intensity and load. The temperature and light intensity are caused by the change of environment. If the light intensity is changed, it will directly affect the current produced by the PV panel resulting in the deviated MPP. Also if the temperature is changed, it will directly affect the voltage of the PV panel and the MPP is changed. If the load connected to the PV panel is changed, the MPP will be changed as well.

Since the energy from a PV panels is available for limited time, depending on the duration of sunlight and weather, or environmental conditions in each period. The system may lack of reliability if it does not receive the maximum power from the PV panel. As the result, the power will not be constant and will not be active at all times. To improve the system reliability, a battery is added to store energy when there is sunlight and supply power back to the system when there is no sunlight as shown in [8] and [9]. However, having only one huge battery may cause the systems lack of reliability and low efficiency because the power to charge the battery must take longer time and many steps which may not consistent with the period of sunlight and weather. Therefore the battery charging control process is needed to quickly charge the battery and also to prevent the overcharging or the undercharging which results in the decrease of the battery lifetime or permanent damage of the battery as shown in [10] and [11]. Thus, if the MPPT control and the battery charging control processes are combined in same the system, they will make the system more reliable and efficient as stated in [12] and [13].

II. PROPOSED BLOCK DIAGRAM SOLAR ENERGY HARVESTING SYSTEM

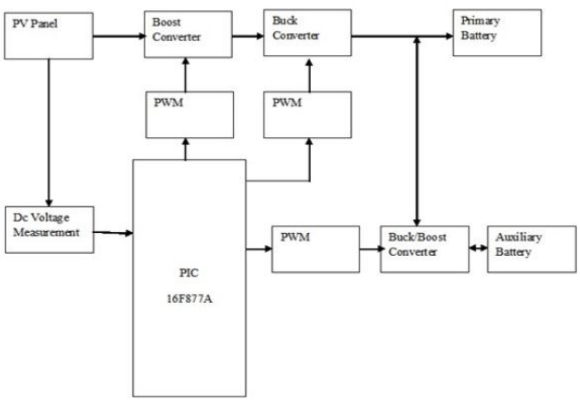

Fig. 1 Circuit architecture of solar energy harvesting system

The system will consists of three converter and two batteries. Out of the two batteries on battery will act as primary battery and the other one will act as the auxillary battery. The PV panel output will be given to the primary battery through buck and boost converter.

If the PV panel output will be low, then the boost converter will get enabled and will increase the voltage then given to the Primary battery. Similarly when the PV panel output is high, buck converter enabled and decrease the voltage then given to the Primary battery.

If excessive voltage is available from PV output then during this duration the buck/boost converter gets activated and supplies voltage to the auxiliary battery.

The microcontroller PIC 167F88 will be used to generate the PWM signal to control the buck Converter , the boost converter and the buck-boost converter.The PV panel output will be measured using the DC voltage measurement arrangement and will be forwarded as reference to the microcontroller.

1) Boost converter: A boost converter is that steps up voltage from its input supply to its output load. To reduce voltage ripple, filters made of capacitors are normally added to such a converter's output and input .The boost converter is selected and used to track the MPP because it is simple and high efficiency.

2) Buck Converter*:* A buck converter is which steps down voltage from its input supply to its output load. To reduce voltage ripple, filters made of capacitors are normally added to such a converter's output and input. The process of the buck converter will optimize charging voltage.

3)Buck/Boost Converter*:* The buck/boost converter has an output voltage that is less than or greater than the input voltage magnitude. Two different topologies are called buck–boost converter. Both can produce a range of output voltages, ranging from much larger than the input voltage, down to almost zero.This circuit allocate and harvests all power from the PV panel and controls the charging process of the primary battery. If the power of the PV panel is higher than the charging power of the primary battery, the bidirectional buck/boost converter will be the buck converter to transfer the excess power to the auxiliary battery. However, if the power of the PV panel is lower than the charging of the primary battery, the bidirectional buck/boost converter will be the boost converter to transfer the power from the auxiliary battery to the primary battery.

MPPT Technique

The photovoltaic (PV) system has developed rapidly in the past decade, and has become a mature technology. It is considered an important renewable energy as it is a clean energy that is easy to maintain and produces very low noise. However, as it can use sunlight for only a limited time within a day, and also depends on the weather and environmental conditions, the PV system must have a Maximum Power Point Tracking (MPPT) controller to enable the system to utilize solar energy most efficiently at any time.

III.Power supply circuit in proteus

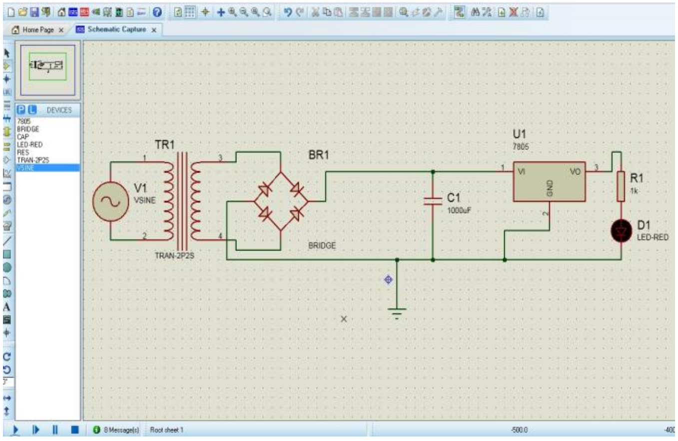

Fig2 Power supply circuit in proteus

IV.LCD Interface output in proteus

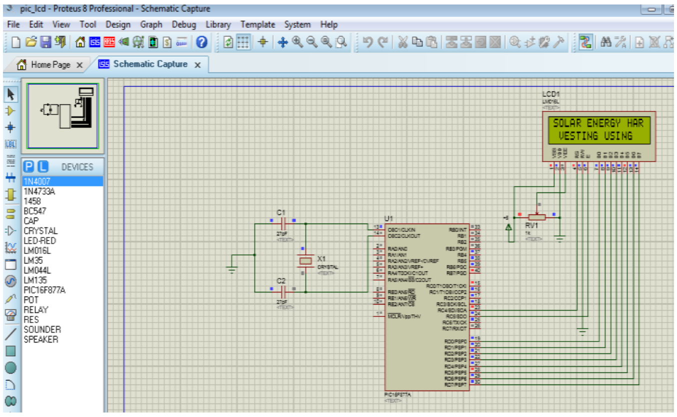
Fig3.LCD Interface output in proteus

V. Conclusion

This paper has design by provided a of Solar Energy Harvesting System for Battery Charging Using Photovoltaic Panel.This proposes to introduce new techniques that utilize solar energy &control the charging of battery at maximum efficiency.

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