ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 5, May 2015

Solar powered robotic vehicle

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Abstract: The robots are used more commonly in all the fields. In this paper the focus is on the design of a charging system for batteries with the help of tracked solar panels. And we will apply it to a robotic vehicle. The use of a solar tracking system for increasing the robot's power. The design of power system performance is with a pack of two batteries. The aim is complete the process of charging a battery independently while the other battery provides energy consumed by the robotic vehicle.

Index Terms: robotic vehicle, solar panel, battery, photovoltaic (PV).

I. INTRODUCTION

The robots are used more commonly in all the fields. Because of its accuracy and toughness. As the battery used for charging in the robots is carried by the human, its power supplying unit is being a drawback to its reliability. Even though there is a system available for the automatic recharging of batteries with the solar panels, it's not practically used in the robots which does another function.[1]

The, solar robotic systems are often used for many years. However, when there is scarcity of sunlight the batteries can not be recharged when depleted. Photovoltaic are used for the conversion of sunlight into electricity. Photovoltaic were initially used to power small and medium applications, that are powered by a single solar cell to off-grid homes powered by a photovoltaic array.[2]

Today increasing efficiency of solar energy technology has given rise to use it in practical applications like powering personal devices. solar-generated energy provides abundant and pollution free energy.

II. IMPLEMENTATION & BLOCKDIAGRAM

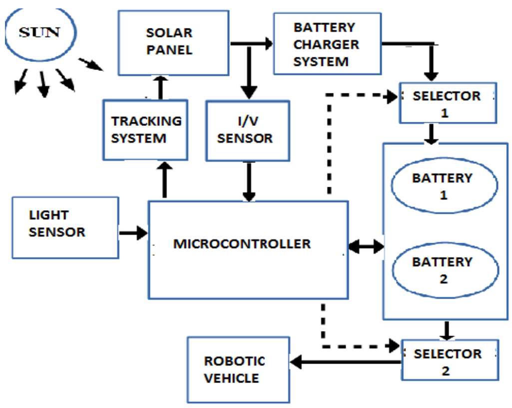

Figure1.

The framework for system is shown in figure1.[3] System contains The robotic vehicle developed to be guided and has a set of four wheels coupled to a plane chassis that can rotate independently and the individual control of each wheel allow different types of movement. The robotic system runs autonomously on a PIC micro-controller.

The robotic System is powered by solar panel. One of the main proposals of this project is the implementation of solar tracking mechanism (MPPT) Maximum power point tracking [4].MPPT varies the electrical operating point of the modules so that able to deliver maximum available power. Which is based on I/V sensors[5].

The charger system is used here. It consists of DC to DC converter which is controlled by the micro-controller using a PWM signal applied to one of its terminals and supplies each battery according to a programmed algorithm. Between the PV system and the charger system there are a capacitor used for voltage conditioning. The capacitor prevents voltage at the charger input from falling below the charge voltage of the battery cells when solar power is not capable of providing appropriate voltage level[6].

The design consists of two separate battery units working alternately. Thus, one of the batteries receives the charge current from the PV system while the other provides energy required to robotic vehicle.

The switching system consists of two selectors with Their function is connecting electrically the charge and discharge paths between the batteries, the charger module, and the load system (see Fig.1). That is, selector 1 is inserted between the charger and the dual-battery pack. Its function is routing the current from the PV panels to the input of the charger

III. PHOTOVOLTAIC SYSTEM WITH SOLAR TRACKING

The solar cells characteristics influence the design of the converter and the control system, so the P V characteristics will be briefly reviewed here. The solar array is a device with nonlinear characteristics and can be represented as a current source model. The traditional I-V characteristics of a solar array, when neglecting the internal shunt resistance, are given by the following equation(1):

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IJARCCE

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$$I_o = I_g - I_{sat}\left\{\exp\left[\frac{q}{AkT}(V_o + I_o R_s)\right] - 1\right\} - \frac{V_o + I_o R_s}{R_{sh}} \quad (1)$$

where I_o and V_0 are the output current and output voltage of the solar array; K is the generated current Boltzmann constant; A is the ideal factor for a PN junction; T is the array temperature; R and R_{sh} are the intrinsic series and shunt resistances of the solar array.

Equation is used in the development of output for the solar array. the output characteristics are nonlinear and greatly affected by the solar radiation, temperature, and load condition. It has a maximum power point which is the efficient operating point for the use of the solar array[4].

To this end, PCB allows calibrating photosensors' sensibility by means of variable resistors, which has the advantage of adapting to different brightness locations and lighting conditions. Tracking the most powerful light source is possible because analog signals are obtained by the photo sensors since they already include both amplifier and signal conditioner integrated circuits. Proportional light values are compared in pairs and, from their difference, adjusting the control signal for azimuth and elevation required by the tracking system. Each servo is controlled by a pulse width modulation (PWM),signals duty cycle determines the required rotation. Instead of increasing or decreasing the duty cycle at fixed values until servos face the light source, rotations are achieved by means of PWM signals generated as follows:

$$y = \exp\left(\frac{x + 30}{20}\right). \quad (2)$$

This mathematical expression (equation (2)) responds programmed algorithm where 'y 'stands for servo displacement, 'x' is the difference of illumination between each couple of photo sensors.[3]

IV. MPPT ALGORITHM:

The MPPT helps to determine the maximum output power of a PV cell that can be fully utilized efficiently. Using a voltage or current sensor with the appropriate detector circuit, the voltage and current value could be monitor. by looking at the drop in current, that is where the peak voltage value can be obtained. Perturb and Observe method is used here gradient of the output power is calculated by the means of varying the operating current till a point where the curve will look like the peak of a hill until the gradient reaches almost zero. This method actually takes references from the actual output power detection of the photovoltaic and thus the Maximum Power Point Tracking can be obtained even if the optimum operating points fluctuate due to irradiation and temperature problems. The algorithm flowchart is as shown in figure 2 [7].

V. BATTERY CHARGING & SWITCHING SYSTEM

The charger system is controlled using a PWM signal applied to one of its terminals and supplies each battery according to a programmed algorithm. Between the PV system and the charger system there are a voltage conditioning capacitor and anI/Vsensor. The capacitor prevents voltage at the charger input from falling below the charge voltage of the battery cells when solar power is not capable of providing appropriate voltage. During that instant the capacitor is discharged with a current through the dc–dc converter. The role of the I/Vsensor is detecting the current and voltage levels that solar panels provide to the charger device. The algorithm implemented in the controller consists of a charge regulation by increasing the output current of the charger module according to the MPPT.

The aim of the monitoring system is maximizing the life and energy storage of battery.The use of a dual battery monitor system was required for control and parameter measurement. This module consists of two selectors. Each of these is connected to the batteries in parallel. The main advantage of the dual monitoring system is that it allows continuous measurement of both the capacity of the battery in charge as well as of the one being discharged.[8]

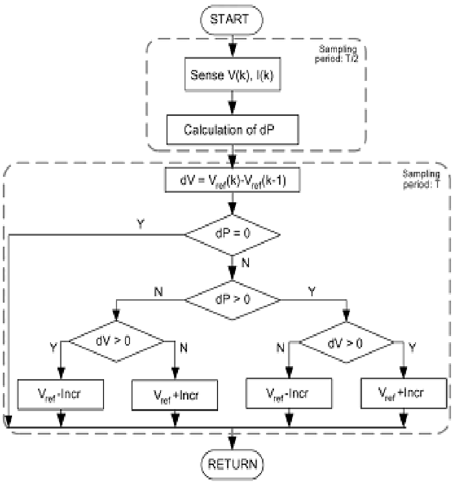

Figure 2

VI. CONCLUSION

This paper has presented a smart energy organizing system applied to a robotic vehicle. The proposed paper includes the construction of a solar tracker mechanism based on mobile PV panels aimed at increasing system energy. Here main advantage is that amount of generated power is independent from the robots mobility, since the system is capable of tracking maximum light intensity.

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 DOI 10.17148/IJARCCE.2015.4589

ISSN (Online) 2278-1021
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Vol. 4, Issue 5, May 2015

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