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Solar Power based Optimal Battery Charging Mechanism using Microcontroller in Robotic Vehicle

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Abstract: **This paper focuses on the look associated construction of an optimisation charging system for Li Po batteries by suggests that of caterpillar-tracked star panels. Thus, the implementation of an entire energy management system applied to a robotic exploration vehicle is hints. The projected system was tested on the robotic platform an autonomous pilotless exploration vehicle specialized in recognition. The interest of this robotic system lies within the style conception, supported a sensible microcontroller. On this basis, our proposal makes a twofold important contribution. On the one hand, it presents the development of a star chase mechanism aimed toward increasing the rover's power in spite of its quality. On the opposite hand, it proposes an alternate style of facility performance supported a pack of 2 batteries. The aim is finishing the method of charging electric battery severally whereas the opposite battery provides all the energy consumed by the robotic vehicle.**

Key words: Solar, PV, Robot, Vanter, ISM, MPP

1. INTRODUCTION

Solar power systems in autonomous robotic vehicles are usually used for a few years. a true example is that the So journer rover, during which most of the provided energy is generated by a reduced-size electrical phenomenon (PV) panel . However, just in case of scarce to no star lightweight, the rover ought to minimize consumption, since its batteries in line couldn't be recharged once depleted. The utilization of reversible batteries in an exceedingly house mission was used for the primary time within the Mars Exploration Rovers. All the same, the necessity for bigger operation autonomy by Spirit and chance was solved by suggests that of larger deploy star panels . This resolution works because the basis for the look of star panels for the longer term Exo Mars mission. This rover, due to its high-efficiency ultrathin-film semiconducting material cells created on carbon-fiber strengthened plastic, is capable of providing higher power. National Aeronautics and Space Administration styles galvanized totally different generations of exploration vehicles. This is often the instance of K9, a rover for remote science exploration and autonomous operation; field integrated style and operations, associate degree advanced-technology image by reaction propulsion Laboratory for long-range mobile planetary science and Micro, a series of robotic vehicles devised for satellite exploration. As its main style advantage, this rover series incorporates a twin solar battery system coupled to associate degree power-assisted suspension mechanism. This prevents the manipulator arm mounted on the center of the rover from having to minimize solar battery-generated power and permits it to mud star panel surface. Other robotic exploration vehicles have additionally been developed in educational spheres. This is often the case of SOLERO, developed by the Ecole Polytechnique Federale American state city, that reached best energy consumption by a mixture of a wise power management associate degreed an economical locomotion system . On the opposite hand, the Carnegie financier University developed Hyperion, a rover during which the foremost technological milestone was the implementation of star-synchronous techniques to extend the quantity of energy generated by solar panels ; and Zoe,¨ a rover capable of long-distance traverses underneath extreme environmental conditions dedicated to science investigation at the desert . With an academic approach, Carnegie financier University additionally developed a private exploration vehicle referred to as PER. additional recently, Lever and coworkers and have delineated the ideas of modeling, design, and fabrication of a robot-box image to be utilized in polar environments. The platform known as Cool Robot uses a sway algorithmic program of most wall plug (MPP) aimed toward maximizing system-supplied power for 5 PV modules designed as a cube. Finally, there square measure some noteworthy comes that main accomplishment is that the best choice of solar power and different power sources per the operation conditions of a automaton.

2. PROPOSED SYSTEM

The main aim of this paper is to design and implement solar based robot. The purpose of the paper to implement a complete energy management system applied to a robotic using solar power supply. In this project we mainly focus on how to control and mange the solar power that is used for robotic vehicle. In the above block diagram you find two figures Robot section Remote section. In Rx section a solar panel is used to convert the solar power to electrical power. With electrical power we charge two batteries not at once but

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one after another. These batteries are used to power up the robots. While one battery is used to give power supply another one is in charging, if first battery is discharged then next one is turn on to give supply at that time discharged battery is get charged by the solar panel. Motor driver controller is used control the direction of the robot based on the key received from the Remote section. By implementing this paper we can control the solar power for optimal battery charging.

3. ROBOT TERMINAL UNIT

The PIC16F877 microcontroller, which monitors VANTER consumption and decisions in a completely autonomous way. The microcontroller has two main functions: 1) detecting environmental light level and controlling the solar tracking system to obtain the highest power; and 2) interpreting operation data from batteries and solar panels to control the working mode of the charger accordingly shown in fig[2].

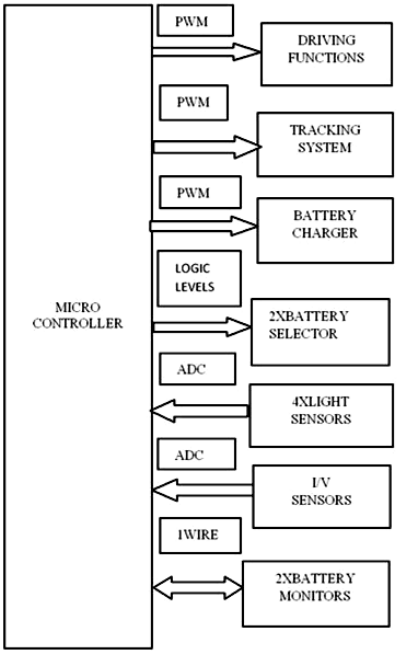

Fig. 2. Block diagram of the hardware architecture for VANTER.

The robotic vehicle generally uses four different kinds of sensors: They are Temperature sensors, voltage sensors, Light sensors and Humidity sensors. The sensors that used in a robotic vehicle observes the remote environmental conditions and the observed data can be measured and simulated by the help of MP LAB software in nearby PC. Thermistor is a type of resistor used to measure temperature changes, relying on the change in its resistance with changing temperature. Thermistor is a combination of the words thermal and resistor. The LM 324 consist of four independent, high gains, internally frequency compensated operational amplifier which were designed specifically to operate from a single power supply over a wide voltage range. A photo resistor or LDR is an electronic component whose resistance decreases with increasing incident light intensity. The light sensors generally observes the intensity of light that coming from sun. The robotic vehicle uses humidity sensors for observing the moisture content of the atmosphere. The voltage sensors are generally used for observing the voltage level of the Li-Po batteries. The wireless camera fixed infront of the robotic vehicle captures the image of the environment and the captured image can be monitored in our nearby PC through Zig-Bee wireless technology shown in fig [3].

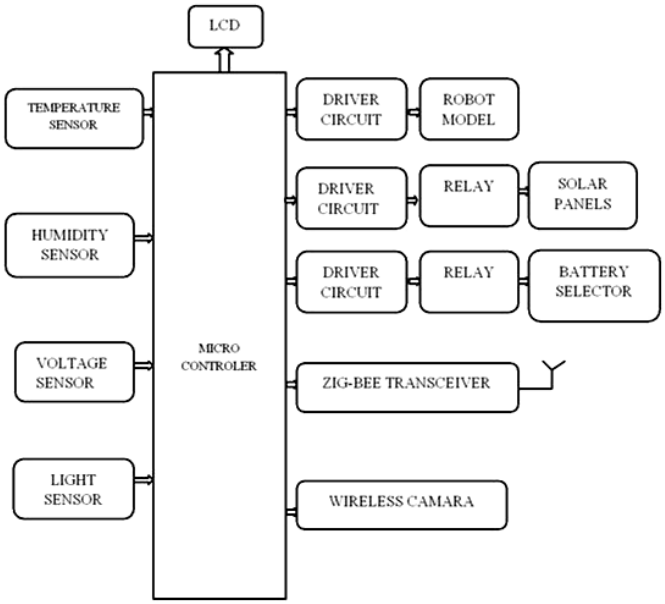

Fig. 3. Architecture of Robot terminal unit

4. SYSTEM TERMINAL UNIT

Zig-Bee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Zig-Bee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20 to 900 kilobits/second. The Zig-Bee network layer natively supports both star and tree typical networks, and generic mesh networks. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Zig-Bee is targeted at applications that require a low data rate, long battery life, and secure networking. Zig-Bee has a defined rate of 250 kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range wireless transfer of data at relatively low rates shown in fig[4].

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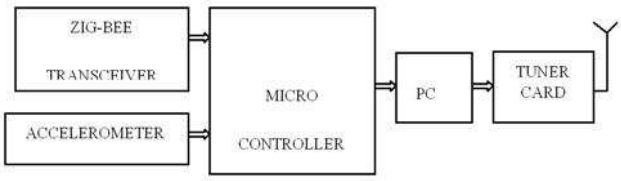

Fig.4. Architecture of System Terminal Unit

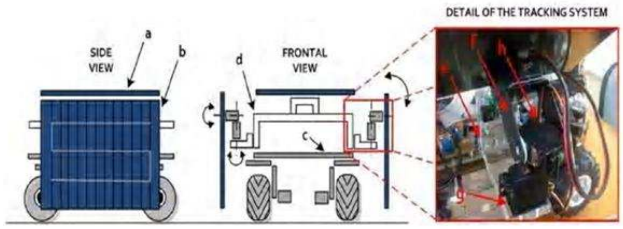

Fig. 5.Mechanical design of the solar tracking system of VANTER: (a) upper solar panel,(b) mobile solar panels,(c) aluminium chassis,(d) methacrylate chassis,(e) methacrylate support,(f)pan and tilt unit,(g)pitch servometer, and(h)yaw servomotor

Fig. 5. shows the mechanical solar tracking system. This comprises(a) a fixed solar panel mounted horizontally on VANTER and (b) two panels with symmetrical movements. The mechanical structure is mounted on (c) an aluminium chassis on which the electronics were mounted. On top of this platform (d) a methacrylate panel with (e) two side supports has been assembled. The solar panels are mounted on (f) pan and tilt units formed by two DYS0213MGs metal gear servos. Each pair of digital servomotors allow soft rotations with an amplitude of180◦ in (g) azimuth and (h) elevation, so that the solar panels can be oriented toward any part of the space.

5. Li-Po BATTERIES SWITCHING OPERATION

The switching system consists of two MAX1538EVKIT selectors with break-before-make operation logic. Their function is connecting electrically the charge and discharge paths between the batteries, the charger module, and the load system see fig(6) 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 and, from there, to the battery selected in each moment. Selector 2 is used to connect the selected battery to the load system.
Therefore, the dynamic connections of the electric circuit are carried out according to the PIC16F877-defined logical operation mode. This is based on the voltage thresholds programmed into the control algorithm. Now, these two pack of Li-Po batteries performs their charging and discharging operation independently. In the first row, selector 1 was programmed to charge battery 1 while selector 2 is preset to discharge battery 2. Charge current obtained from the PV panels is routed to the charger through selector 1 and, from the charger, to the selected battery. Likewise, the discharge current of battery 2 is routed to the load system through selector 2. The main advantage of the dual selector system is that it allows hot swapping of separated power supplies. In addition, in case both batteries were fully discharged, a working mode was programmed in selector 1 to supply the load system directly from the PV panels.

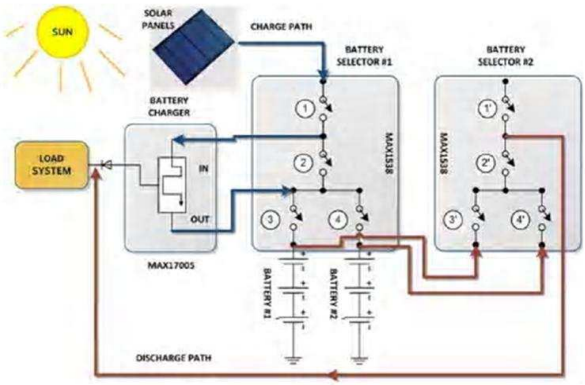

Fig.6.Overall connection diagram for battery selectors

6. CONCLUSION

Solar power systems in autonomous robotic vehicles have been often used for some years. In real example most of the supplied energy is generated by a reduced size photovoltaic (PV) panel. It includes the construction of a robotic vehicle which we designed is to move robot in forward and reverse with right and left turns using dual battery. The robot controlling is done with the help of microcontroller which brings the robot on movement.

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