Smart Host Microcontroller for Optimal Battery Charging in a Solar-Powered Robotic Vehicle & Cell Phone Charging

[1]K.Shiva Prasanna, 2K. SrinivasReddy
M.Tech Student, Associate Professor & HOD Dept. of ECE
Nagole Institute of Tech & Science Hyderabad, Telangana

Abstract: *This paper focuses on the planning associated construction of an improvement charging system for Li–Po batteries by suggests that of half-track star panels. Thus, the implementation of an entire energy management system applied to a robotic exploration vehicle is advance. The projected system was tested on the robotic platform—an autonomous remote-controlled exploration vehicle specialized in recognition. The interest of this robotic system lies within the style thought, supported a wise microcontroller. On this basis, our proposal makes a twofold vital contribution. On the one hand, it presents the development of a star chase mechanism geared 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.*
Keywords: *Li-po battery, Solar tracker, Robotic tool, Pick and place mechanism, Photovoltaic (PV)*

I.   Introduction

Robot is associate electro-mechanical machine that was guided by associate electronic circuit. It is often autonomous, semi autonomous or remotely controlled. The branch of technology that deals with automaton is named artificial intelligence. The employment of robots in military combat raises moral considerations. Industrial robots sometimes incorporates a articulated arm and finish effectors that's connected to fastened surface. In 2003, NASA's Mars Exploration Rovers can launch towards Mars in search of answers concerning the history of water on Mars. Robotic manipulators employed in producing square measure samples of fastened robots. They can not move their base faraway from the work being done. Mobile bases square measure typical platforms with wheels or tracks connected. Rather than wheels, some robots use legs so as to maneuver concerning. The VANTER robotic exploration vehicle aims to boost varied aspects of the said rovers with scientific and educational functions. To introduce the developed automaton (see Fig. 1), the most options and properties square measure compared, this paper is organized as follows. Successive section presents the mobile robotic system. Its main options square measure represented and its hardware and software system design square measure bestowed. Section III introduces the thought of sensible host microcontroller (SHM) for intelligent power management applied to an enquiry vehicle. The subsequent sections gift the management of the battery-charging system by suggests that of half-track star panels, that are that the main aim of this paper; the planning of its mechanical structure, its electronic devices and also the graphical program (GUI) square measure bestowed. Section IV aims at providing the mandatory parameters for the batteries filler, charging, and discharging rule, and also the PV system filler. Therefore, Section V puts into follow the developed methodology by testing the rover power systems. Finally, the results and findings from the developed work square measure bestowed.

Solar energy is that the best natural resource which may generate electricity. The electrical phenomenon cells employed in calculators and satellites square measure liable for changing daylight directly into electricity. This cell is created from conductive materials like Si. Basically, once light-weight strikes the semiconductor it's absorbed and so permits the negatron energy to flow freely. the most operate of PV cells is it converts the phonons to electrons. Associate atom of sili-con has fourteen electrons, organized in 3 totally different shells. Si has the pure crystalline kind. Once energy is supplemental to pure Si, as within the type of heat for instance, it will cause some electrons to interrupt the bonds and leave their atoms. This method produces electrical phenomenon in contact. 2 separate items of Si were electrically neutral and to scale back losses within the field made within the Si antireflective coating is applied to those surfaces. This solar power may be used for the operate of automaton. Robots employed in military purpose gain energy from star are helpful for complete energy utilization. this may be done by victimisation star chase mechanism.

II.   Mobile Robotic Platform

VANTER—Spanish signifier for autonomous remote-controlled exploration vehicle specialised in recognition—is a robotic exploration vehicle developed at the University of Huelva, Huelva, Spain. The rover was developed to be guided and features a set of 4 wheels coupled to a plane chassis which will rotate severally. The four-wheel-drive (4WD) and also the individual management of every wheel permit differing types of movement; together with Ackerman configuration, the crabbing maneuver or the rotation with inner mechanical phenomenon center. The four wheels in VANTER square measure sustained by suggests that of freelance passive suspension of double metallic element fork to soak up piece of ground vibrations. Every wheel consists of 2 motors, one for rotation and another for driving. On the one hand, forward movement is made by suggests that of dc motors (12 V and sixty mA) that has one hundred twenty r/min with a torsion of eight.87 kg/cm. On the opposite hand, the rotation motor provides a speed of 152 r/min Among others instruments aboard VANTER disposes of a 5-DOF robotic arm, associate Omni Vision MC203 wireless micro camera, associated an analog video receiver with a Pinnacle Dazzle DVC100 video capture card. Its reduced weight, tiny dimensions, and flexibility create VANTER appropriate as a robotic exploration vehicle. The robotic system programming is split into 3 main code levels and its hardware was designed with a gradable management structure supported standard microcontrollers. the highest level program, applied in Lab VIEW language, is dead in an exceedingly remote laptop and offers a GUI to observe and management the complete robotic vehicle. The second code level, programmed in C language, runs autonomously on a master PIC16F876A microcontroller aboard VANTER. Communication with the remote laptop is performed by victimisation a UHF modem for the centralized management of rover functions. The third code level consists of many slave microcontrollers distributed in associate I2C network geared toward the distributed management of the VANTER driving functions (4×PIC16F88), remote manipulation, and power management.

III.   Mechatronic System Design

A typical power management style consists of sensible batteries group action each communication devices and natural philosophy able to management the charge. However, once a cost-effective system is needed, the thought of intelligence ought to be applied to software system style for easy batteries. One amongst the most objectives of this paper is that the implementation of the SHM thought to develop a low-priced power management system aboard a robotic vehicle. The system consists of associate electric circuit interconnecting a PV system, a charger device, a selector system, a batteries monitor system and electric battery system (see Fig. 3). The SHM relies on a PIC16F886 microcontroller that monitors VANTER consumption and choices in an exceedingly fully autonomous means. The SHM has 2 main functions: 1) police investigation environmental light-weight level and dominant the star chase system to get the very best power; and 2) deciphering operation information from batteries and star panels to manage the operating mode of the charger consequently. The value of this system—regardless of the navigation instruments and VANTER software—is US$ 600. The PV system provides power, keeping in mind that voltages and currents generated should adapt to the most and minimum values of the hardware. However, since the environmental natural options can not be foreseen at every instant, the quantitative energy from radiation can not be foreseen either. Thus, one amongst the most proposals of this paper is that the implementation of a star chase mechanism geared toward increasing power levels within the PV panels. in contrast to different rovers that use navigation techniques to guide their panels toward the Sun,VANTER's quality doesn't represent a drawback, since the projected huntsman system appearance for the foremost powerful source of illumination. star huntsman prototypes inbuilt mobile robots have evidenced that orientation of PV systems results in hyperbolic energy potency relative to systems with fastened star panels (20–50% per collector). This gain depends on many construction methods of the star huntsman like the kind of axis movement (either single or dual), kind of sensors on that relies (photoresistors or electrical conduction cells), and also the accuracy rendered by the quantity of device pairs. On the contrary, parasitic load consumption associated to the projected configuration (a mobile solar array, 2 batteries, and electronics) compared to an easy system (a fastened panel, a battery, and electronics) is hyperbolic between one.14% and 21.42%. The consumption increment varies primarily owing to the operation of the star chase system, that relies on servos; therefore, customary dc motors is projected to scale back the consumption up to eight.57%. The inexperienced energy conjointly referred to as the regeneration energy, has gained abundant attention these days. inexperienced energy are often recycled, very similar to solar power, water power, wind power, biomass energy, terrestrial heat, temperature distinction of ocean, sea waves, morning and evening tides, etc . Among these, solar power is that the most powerful resource which will be wont to generate power. up to now the potency of generating power from solar power is comparatively low. Thus, increasing the potency of generating power of solar power is extremely necessary. within the past, star cells are hooked with fastened elevating angles. they are doing not track the sun and so, the potency of power generation is low. For instance, the elevating angle of a cell for the most important volume of illumination in daytime is twenty three.5°in southern Taiwan. Since the fixed-type solar array can't acquire the optimum solar power, the transformation potency of solar power is restricted.

several students have projected totally different ways for chase the sun [3-9]. many various source of illumination sensors, candlepower sensors, intelligent vision techniques, and CCD equipments were applied to reckon the absorbed time of the sun radiation in everyday for measurement the quantity of solar power. up to now the bulk of cell panels worldwide square measure hooked with fastened angles. Thus, it's clear that the strategy of chase the sun could be a technique merit being developed. during this paper, the most goal is to style and implement a star chase system victimisation field programmable gate array (FPGA). The CdS light-weight sensitive resistors square measure used. Feedback signals square measure delivered to the allotted chip through associate A/D device. From the experimental results, the projected chase system is verified a lot of with efficiency in generating energy than the fastened system

The cell consists of the semiconductors of the P-N junctions. It will convert light-weight into electrical energy. thus we will assume that electricity made victimisation daylight shining on the cell are often used like common electricity. The equivalent circuit of the cell is shown in Fig. 1. the present offer I pH represents the electrical current generated from the sun beaming on the cell. Rj is that the non-linear ohmic resistance of the contact. Dj could be a contact diode, Rsh and Rs represent the equivalent lineup with the inside of the materials and connecting resistances asynchronous. Sometimes generally analysis, Rsh is giant, and also the worth of Rs is tiny. thus so as to modify the method of research, one will ignore Rsh and Rs . The image artificial language represents the external load. I and V represent the output current and also the voltage of the cell, severally. From the equivalent circuit, and supported the characteristics of the contact, (1) presents the association between the output current I and also the output voltage V : Where np represents the parallel whole number of the star cell; ns represents the series connected whole number of the star cell; alphabetic character represents the contained electricity in associate electro (1.6×10−19 Columbic); k is that the Ludwig Boltzmann constant (1.38×10−23 J / °K); T is that the temperature of the cell (absolute temperature °K); and A is that the ideal issue of the cell (A = one ~ five). the present Sat I in (1) represents the reversion saturation current of the alternative energy. Further, Sat I are often determined by victimisation the subsequent formula: Where Tr represents the reference temperature of the cell; Irr is that the reversion saturation current at the time once the star cell reaches its temperature Tr ; and EGap is that the energy required for crossing the energy band gap for the semiconductor materials. (the crystalline EGap ≅ one.1eV). From the study we tend to square measure able to recognize that once the temperature is fastened, the stronger the daylight is, and also the higher the open-circuit voltage and short-circuit current square measure. Here we will see the apparent effects of illumination on the short-circuit current, instead of the open-circuit current. thus the cell will offer higher output rate because the daylight becomes stronger, i.e. cell facing the sun.
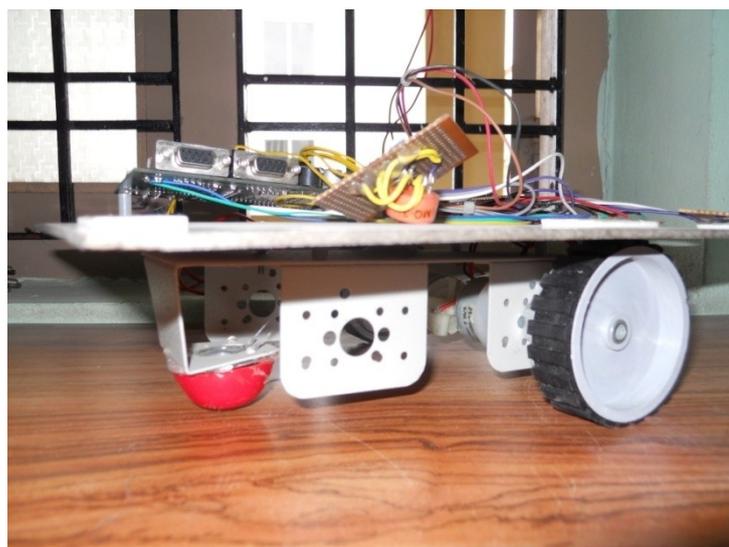

Fig.1. Robot flat form

IV.   Implementation Details

The main focus of the project is alternative energy system will be attending to operate the automaton. We tend to square measure attending to interface choose and place arm with automaton. Thus the functions of robotic vehicle are wont to perform another operation that is to choose and place any objects. For this the ability management can incorporates smart battery that mixes each communication devices and natural philosophy that square measure able to management the charge. To realize this economical system, intelligence are applied to software system style for simple batteries. Therefore our main objective is to implement sensible

microcontroller for low value management system on board a robotic vehicle with pick and place arm. Power management system consists of electrical phenomenon system, a charger device, selector system and battery system.
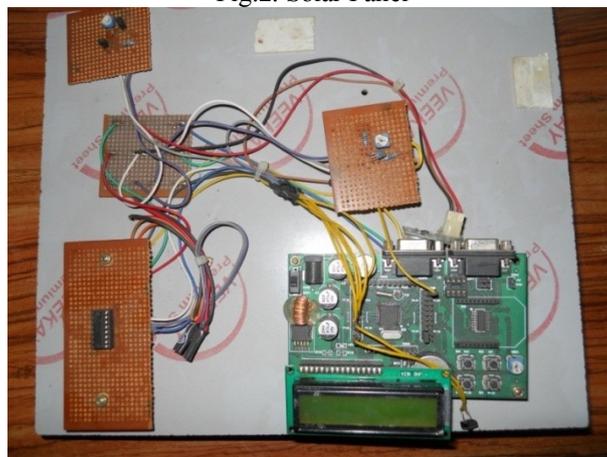

Fig.2. Solar Panel

Fig.3. Microcontroller Base Kit

V. Conclusion

The interest of this robotic system lies within the style thought, supported master and slave primarily based microcontroller. On this basis, our proposal presents the development of a star chase mechanism geared toward increasing the rover's power in spite of its quality. On the opposite hand, it proposes zigbee primarily based wireless communication to manage and move the automaton. The aim is finishing the method of dominant the automaton within the availability of alternative energy.

VI. Future Scope

We square measure implementing a model of the automaton within which it performs just some restricted actions, if we want to implement in real time, with advanced technology and with latest planning we will bring home the bacon the automaton perfectly so as to figure in real time.

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About the authors:

K. Shiva Prasanna Pursuing M.Tech in VLSI and embedded systems at Nagole Institute of Technology and Science, Hyderabad, Telangana, India. She received B.Tech degree in Electronics and Communication Engineering from Annamacharya Institute of Technology and Science (AITH), Hayathnagar, Hyderabad, Telangana, India.

K. SRINIVASA REDDY is Associate Professor of the Electronics and Communication Engineering, Nagole Institute of Technology and Science, Hyderabad .He received his B.Tech degree in Electronics and Communication Engineering from JNT University, Hyderabad, and M.Tech degree in Embedded Systems from JNT University, Hyderabad. He is a member of The International Association of Engineers (IAENG). He has about 6 publications in National and International Journals.