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Optimal Battery Charging using Smart Host Microcontroller using Solar Powered Rover

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Abstract: The objective of this project is to design and construction of an optimal battery charging system for the battery by using solar panel tracking. The main focus lies in the design of the rover on the smart host microcontroller. To meet the requirements, the proposed system has been made with the two significant contributions. One-way, the construction of solar tracking mechanism has been designed to increase the rover power consumption of its mobility. On the other way, an alternative design of power system performance based on a pack of two batteries. The aim of this project is to complete the process of charging the one battery while the other battery provides the energy required for the rover.

Keywords: Solar Powered Rover, Optimal Battery Charging, Smart Host Microcontroller, Photo Voltaics.

I. INTRODUCTION

Solar power is the conversion of sunlight into electricity. Photovoltaics are used for the conversion of sunlight into electricity either directly or indirectly with concentrated solar power (CSP), which normally concentrates the sun's energy to boil water which is then used to generate power. Photovoltaic's were initially used to power small and medium sized applications, that are powered by a single solar cell to off grid homes powered by a photovoltaic array.

II. ROBOTIC VANTER

In a speech coding system, initially the input speech signal which is analog in nature is digitized using a filter, sampler and analog to digital converter (A/D) circuits. The filter used is an anti aliasing filter which is a low pass filter used before a sampler to remove all signal frequencies that are above the nyquist frequency. The filtering is done to avoid the problem of aliasing. If the speech signal sampling frequency is less than twice the bandwidth of a sampled speech signal the problem of aliasing occurs. The best solution to aliasing is to make the sampling frequency greater by 2.5 times the bandwidth of the analog speech signal. According to nyquist theorem the sampling frequency must be at least twice the bandwidth of the continuous-time signal in order to avoid aliasing. A value of 8 KHz is commonly selected as the standard sampling frequency for the telephone speech signals, since the telephone speech signal frequency range is between 300 to 3400 Hz.
Later the sampler converts the analog speech signal into a discrete form and will be given as an input to A/D converter whose output is a digitized speech signal. Most speech coding systems were designed to support telecommunication applications, by limiting the frequency contents between 300 and 3400 Hz. To convert the analog speech signal to digital format, to maintain the perceptual quality and to make the digital speech signal indistinguishable from the input it is necessary to sample the speech signal with more than 8 bits per sample. The block diagram of a speech coding system is shown in Figure 1.1 Throughout the thesis the parameters considered for the digital speech signal are sampling frequency of 8 KHz and 8 bits per sample. Hence the input speech signal taken will have a bit-rate equal to 64 Kbps.

A. ROBOTIC VANER

The Robotic vanter is designed for the optimal battery charging by using solar panel tracking system. And the robotic vanter is worked as a solar panel tracking system by using the microcontroller with the help of LDR's, and it worked as obstacle detection by using another microcontroller with the help of IR sensor, and it is used for the optimal battery charging system by using the battery charging circuit.

The below diagram shows the block diagram of the robotic vanter, and it consists of two microcontrollers, one act as a master microcontroller, and another microcontroller act as a slave microcontroller. Master microcontroller is connected with the light sensor and tracking system and the slave microcontroller connect with the driving function and IR sensor. The battery charging circuit is connected with the battery level indicator circuit and the two batteries are connected with the charging circuit. Solar panel is connected with the battery charging circuit

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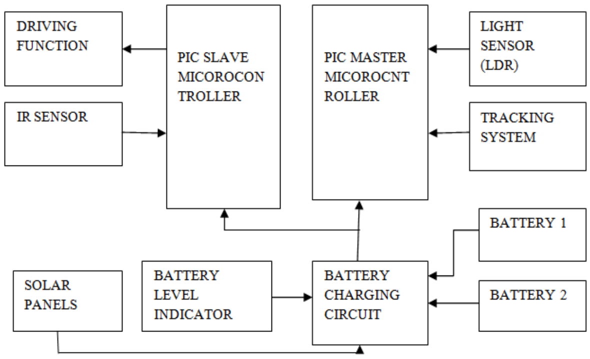

Fig1: Speech coding system.

B. DESIGN OF PROJECT

Master microcontroller is interface with the light sensor and tracking system. In the light sensor LDR's are used as a sensor. LDR is connected in series with the resistor and the voltage is given at the one end of LDR and the other end of the resistor is connected to the ground. The voltage across the resistor is taken as the output. And this output is connecting to the microcontroller as input. Based on the input values the solar panels are rotated in the tracking system. By tracking the solar panels to track the position of the sun and move the panel in accordance with the direction of the sun, so that the panels are always perpendicular to the solar energy radiated by the sun. This will tend to maximize the amount of power absorbed by the solar panel. It has been estimated that the use of a tracking system, over a fixed system, can increase the power output by 30% to 60%.

Slave microcontroller is interface with the driving function and the IR sensor. In the IR sensor it consists of transmitter and the receiver. The transmitter is used to transmit the signal infrared radiation signal when it detect any obstacle the in infrared radiation signal is reflected back and then the receiver receive the reflected signal and then the IR sensor gives the output signal and it is connected to the microcontroller input. The slave microcontroller is connected to the driving function it consists of two motor driving IC's and each motor driver IC interface with the two motors. The motor driver IC consists of four outputs and four input, output connect to the two ends of the DC motor and input pins are connect to the microcontroller. Four motors are connect to the motor driver IC's and these motors are base of the robot the motor moves in the forward direction. When robot detect any obstacles IR sensor detect the obstacle and send the pulse to the microcontroller and output of the microcontroller changes then the robot moves back ward direction and turns in right side direction. From the battery charging circuit is connect to the two microcontrollers and the battery driving IC. Battery level indicator is connected to the voltage level of the battery. Here two batteries are connected to the battery charging circuit.

C. SCHEMATIC DIAGRAM FOR INTERFACING CIRCUIT

The above schematic circuit diagram shows the interfacing of the DC motors and the IR sensor and the LDR's to the microcontroller. LDR act as a light sensor it connected to the analog pins of the microcontroller. Output of the LDR is non linear so the input of the analog pin values are changes depend on the intensity of light falls on the LDR sensor.

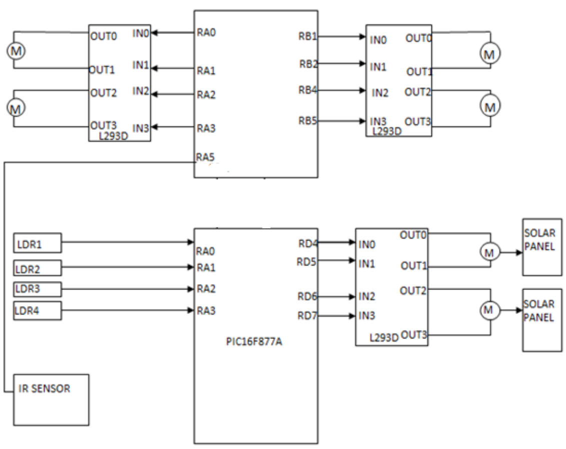

Fig 2: Schematic Diagram of the Robotic Vanter.

Based on the analog input values the DC motor is rotated in clock wise and antilock wise direction and solar panel is interface with the DC motor. Based on the analog values the solar panel rotate in the tracking system and it captures the maximum sun light. DC motor connect to the motor driver IC and it is connect to the output port of the microcontroller. IR sensor is connected to the slave microcontroller and two motor driver IC's are connected to the microcontroller. Four motors are connected to the two motor driver IC's. when IR sensor detect any obstacles it give the output to the microcontroller. When it receive the signal, then the output of the microcontroller changes and then the motors rotate in anti clock wise direction for some time and one side of motors are rotate in clock wise and other side of motors rotate in anti clock wise direction then the robot rotates towards right side or left side direction.

As shown in the above diagram motor driving IC consists of IN0, IN1, IN2, IN3 are the input pins of the motor driver IC. Out0, out1, out2, out3 are the output pins of the motor driver IC. RB0, RB1, RB2, RB3 are the output pins of the microcontroller. The input pins of the motor driver IC are logic pins when the input pin IN0 is logic 1 an IN1 is logic 0 then the Motor A rotates in clock wise direction. When IN0 is logic 0 and IN1 is logic 1 then the Motor A rotates in anti clock wise direction. When the both inputs IN0 and IN1 are logic 0 or logic 1 then the motor can't rotate any direction then the motor in stop stage. In this way Motor driver IC works and rotates the motor in clock wise and anti clock wise directions.

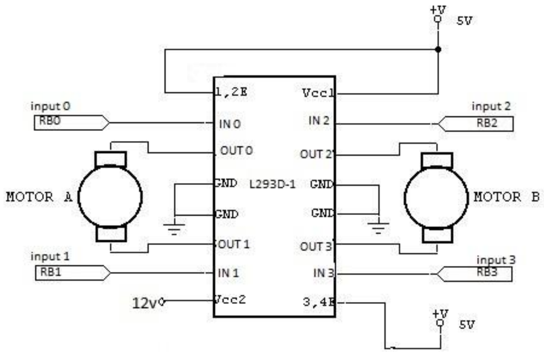

Fig 3: Motor Driving IC Interfacing Circuit

D. FLOW CHART

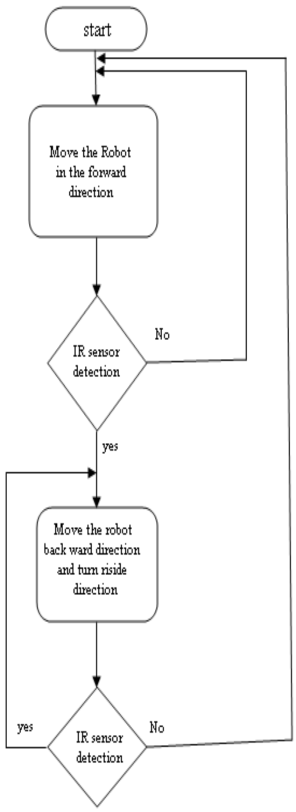

Fig 4: Flow Chart for the Obstacle Detection.

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The flowchart is drawn for the two microcontrollers. One is master microcontroller and another one is slave microcontroller. Slave microcontroller is used for the obstacle detection. And the master microcontroller is used for the solar panel tracking system. In the slave microcontroller when I start the microcontroller the robot moves in the forward direction and it checks the IR sensor value when IR sensor detect the obstacle it gives the output to the microcontroller then the output of the microcontroller changes then the robot moves back ward direction and turns right side direction.

The master microcontroller is used for the solar panels tracking system. When we start ht master microcontroller then it reads the LDR output values. When it detect the LDR values if the LDR1 is detected first it moves in the clock wise direction. And when it reaches to 180 degrees then it checks the LDR output values. When the values are zero it comes to normal position. If LDR4 is detected the solar panels are rotate in anti clock wise direction. When it reaches to the 180 degrees then it checks the LDR output values when the values are zero then the solar panels comes to normal position.

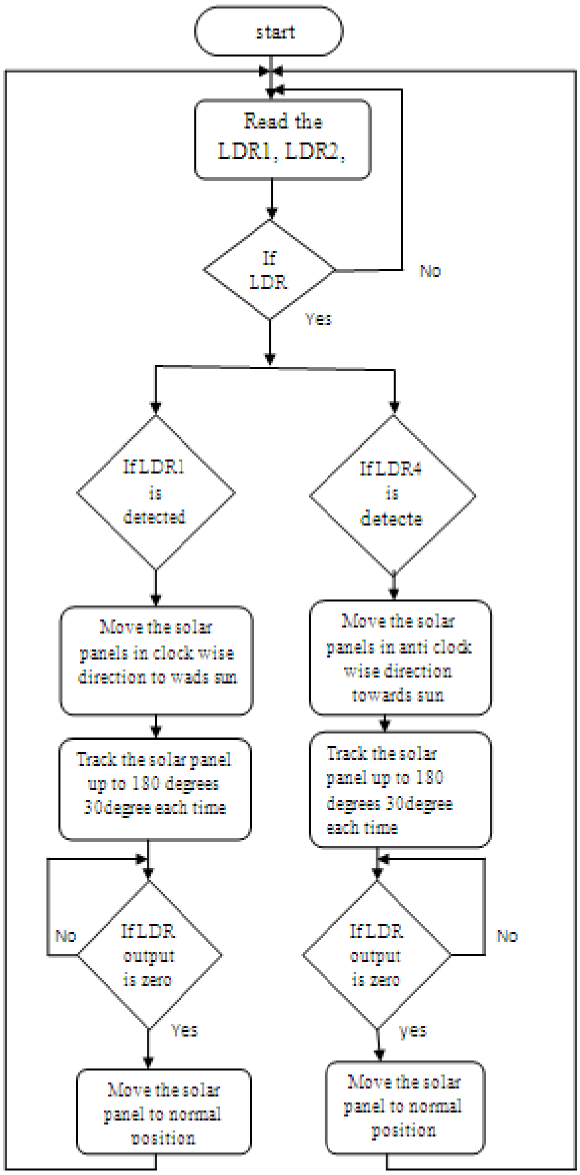

Fig 5: Flow Chart for the Solar Panel Tracking.

E. IR SENSOR

A passive infrared sensor (IR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in IR-based motion detectors. Infrared (IR) is invisible radiant energy, electromagnetic radiation with longer wavelength than those of visible light, extending from the nominal red edge of

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the visible spectrum at 700 nanometers. Most of the thermal radiation emitted by objects near room temperature is infrared.
Infrared radiation and it is discovered in 1800 by astronomers. Sir William Herschel, who discovered a type of invisible radiation in the spectrum lower in energy than red light by means of its effect upon a thermometer. Slightly more than half of the total energy from the sun it is eventually found to arrive on earth in the form of infrared. The balance between absorbed and emitted infrared radiation has a critical effect on earth's climate.
Infrared radiation is used in industrial, scientific, and medical applications. Night vision devices using active near infrared illumination allow people or animals to the observed without the observer being detected. Infrared astronomy uses sensor equipped telescopes to penetrate dusty regions of space, such as molecular clouds detect objects such as planets, and to view highly red shifted objects from the early days of the universe. Infrared thermal imagining cameras are used to detect heat loss in insulated systems to observe charging blood flow in the skin, and to detect overheating of electrical apparatus.
The IR object detection sensor module is quiet easy to make. The sensor circuit as shown in below figure 6 is a low cost and low range infrared object detection module, that can easily make at home using IR transmitter and receiver led's. The use of photodiode and IR LED's to make a simple circuit. IR led looks like a regular LED that are usually seen in television remote controls. And the LED is added to glow as an indicator when something is detected, and it can be replaced with a buzzer also. The main concept is simple, the IR LED keeps transmitting IR infrared rays up to some range (There is a potentiometer also used in the design with the help of which can alter the range). When some object comes in the (IR) infrared range, the IR waves hits the object and comes back at some angel, the photo diode next to IR led detects the IR infrared rays which got reflected from the object and hence works as a proximity sensor.

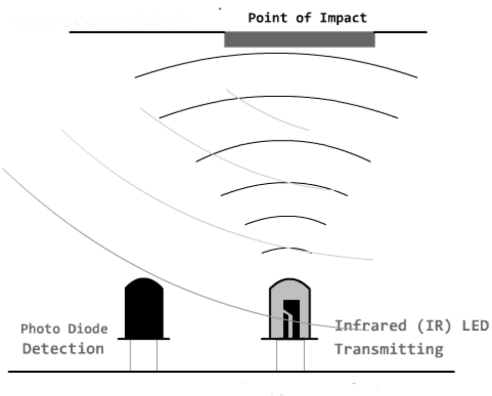

Fig 7: Infrared IR object detection sensor.

As shown in the figure 7, it can easily make on a breadboard. Now in this circuit the LED would glow as an example. Notice that there are three pins in the schematic in which two pins are used to provide power to the infrared sensor and the middle pin is un used, and it can be used for other operation. The middle pin goes high (Logic 1) if the photodiode in this object detection module detects an object, and hence can be interfaced with other devices. It can be used to run some DC motors and make a simple robot. The middle pin of the IR sensor circuit can be interfaced with microcontroller easily and it can detect the obstacle and give the data to the microcontroller then the output of the microcontroller changes.

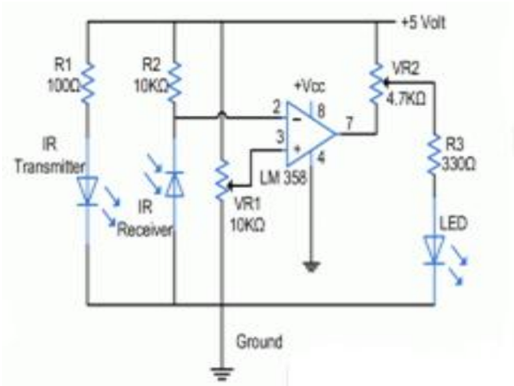

Fig 6: Infrared Sensor Module Schematic.

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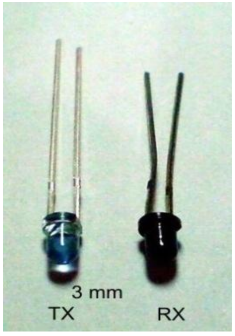

Fig 8: Transmitter and Receiver of the IR Sensor.

2.6 BATTERY LEVEL INDICATOR

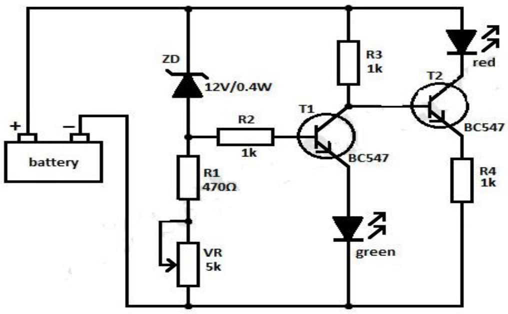

Fig 9: Battery Level Indicator Circuit.

This circuit is simple battery level indicator circuit. Which be simple complicated can see that the circuit has will LED keep for display arrive at 3steps. The work of the circuit be this circuit is fiexed come to give atemple volt usual that above 11V-14V. which will the level volt normal, if level voltage a little 11V more make LED1 red stick bright. When the battery charging if full then it indicates the green LED, when the charging of the battery is increased then the intensity of the green LED is increased. And when the voltage of the battery is decreased then the intensity of the green light is decreased gradually, when the charging of the battery is very lo then it indicates only red LED.

2.7 Battery Charging Circuit

Battery charging circuit consists of relay, transistor, and the resistor and the diode. Battery charging circuit is connected to the two batteries. Relay is used as a switch for the charging circuit.

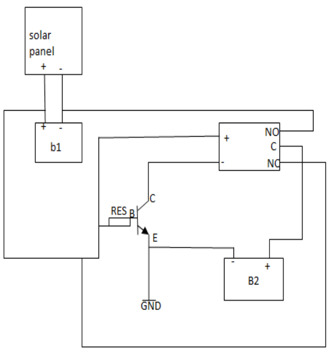

Fig 10: Battery Charging Circuit.

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit to an electrical circuit which works at very high voltage. For example a relay can make a 5V DC battery circuit to which a 23V AC mains circuit. The small sensor circuit can drive, say, a fan or an electric bulb.

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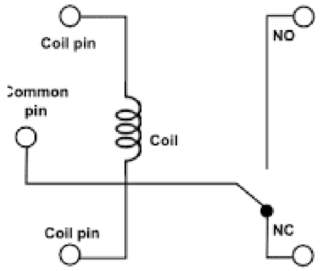
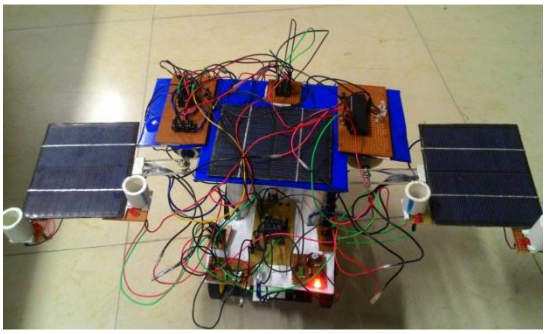


Fig 11: Relay Circuit

III CONCLUSION

The project is successfully designed to gain maximum energy from the sun with the help of solar panels using LDR's. The efficiency increases and power output from the panel also increased. Although automatic solar tracking system (ASTS) is a prototype towards a real system, but still its software and hardware can be used to drive a solar panel tracking rover. Values of the light sensors and battery values are transmitted using the different wireless communication. Transmitted values are studied in the system PC. Then it will be worked as a satellite rover for the data transmission.

IV. RESULTS



The above figure shows the solar panel tracking rover which is used to capture the maximum energy from the sun light. The captured energy from the solar panel is given to the battery charging circuit, and the charging circuit charges the one battery and the second battery give the energy for the solar panel tracking system and to move the rover in the forward direction. When the second battery discharges the battery switching circuit switches to charge the second battery, then the first battery give the energy to the solar panel tracking system and to move the rover in forward direction. The current voltage characteristics and the power characteristics of a photovoltaic are as shown below. The ideal MPP is reached when the product of current and voltage is maximum.

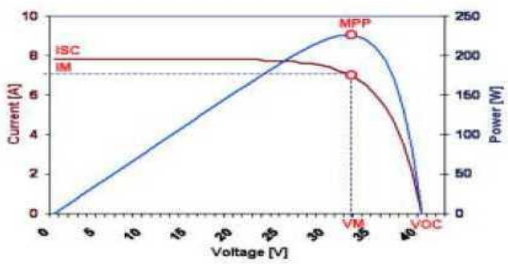


Fig 12: voltage-current characteristics of photo voltaic

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