Course Project Report

CS 101

Self Charging Bot

Team ID:136

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1. Introduction:

Today, robots are being used in many fields. They work with great accuracy and can be controlled as per human desires. But, being a machine, these bots need to be charged frequently or need a constant power source. So to overcome this inconvenience we decided to build a bot that would charge itself while simultaneously doing the work it is designed for.

We decided to utilize the energy that is available on earth free of cost and in abundant quantity, solar energy. Solar energy is relatively easy to harness as compared to other non-conventional sources of energy.

So, with this project we have come up with a bot that can charge itself with solar power.

2. Aim Of The Project:

The aim of this project is to build a bot that would charge itself with solar power with maximum efficiency at some predefined points. These predefined points would lie on a white line. Bot by using its white line sensors would follow the white line in order to reach these predefined points

User will enter the time for which the bot will remain stationary at each point. During this period of time, bot will align its solar panel at an angle such that it receives maximum intensity from the sun. Once it has aligned the solar panel, it will initiate the process for charging itself.

3. Requirements:

A) Software Requirements:

1. Atmel Studio 6
2. Avr bootloader
3. Avr USB program driver

B) Hardware requirements:

1. Firebird V ATMEGA2560
2. Solar Panel
3. Servo Motor
4. Clamps
5. Resistors
6. Wires
7. Rechargeable batteries (1.2V each)

4. Implementation:

1) Reaching the predefined points:

The predefined points are basically nodes created by us on the white line. The bot using its white line sensor follows the white line until it encounters a node. It has been programmed in such a way that if it reads the reading from all the three sensors to be nearly equal, it recognizes that point as a node. The bot will stop at the node and wait there for the time duration that user has set

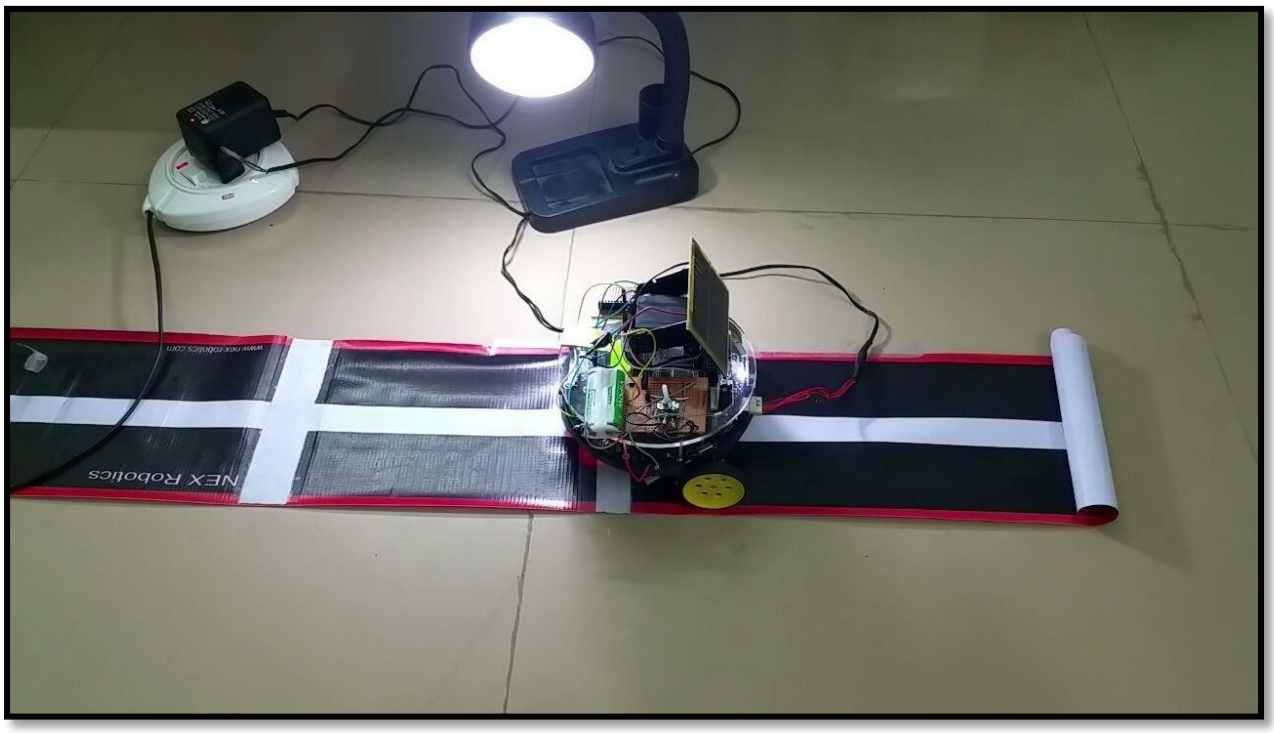

Fig 1.Bot after stopping at a node.

2) <u>Aligning the solar panel:</u>

Once the bot has reached the node, it will start aligning the solar panel at a direction of maximum light intensity. The voltage output from solar panel is directly proportional to the light intensity. To identify the desired direction, the bot will align its panel at angle of 45 degrees with vertical. After this the bot will rotate itself 360 degrees, 5 degrees at once. In this way the bot would have 72 readings of light intensity. It would detect the maximum reading from the data and again align itself in the plane of maximum intensity.

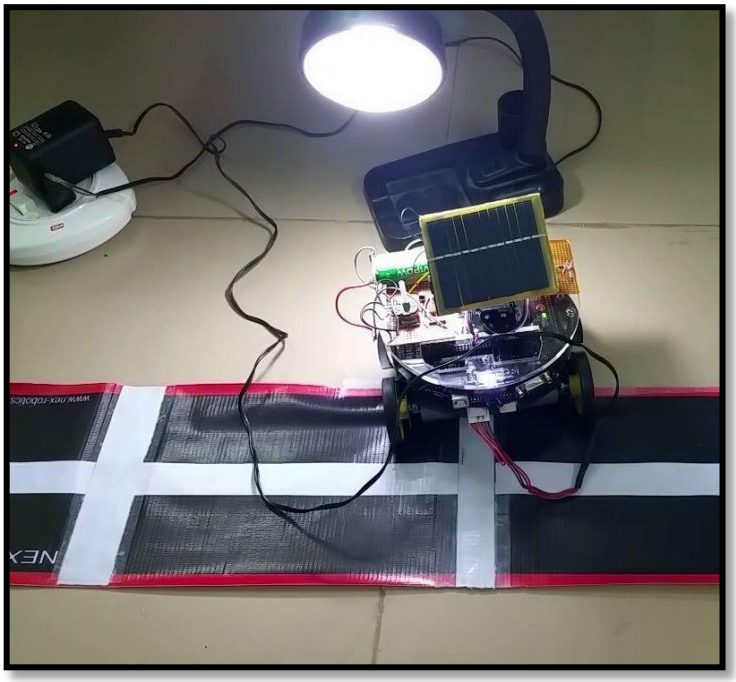

Fig.2 Bot while identifying the plane plane of maximum intensity

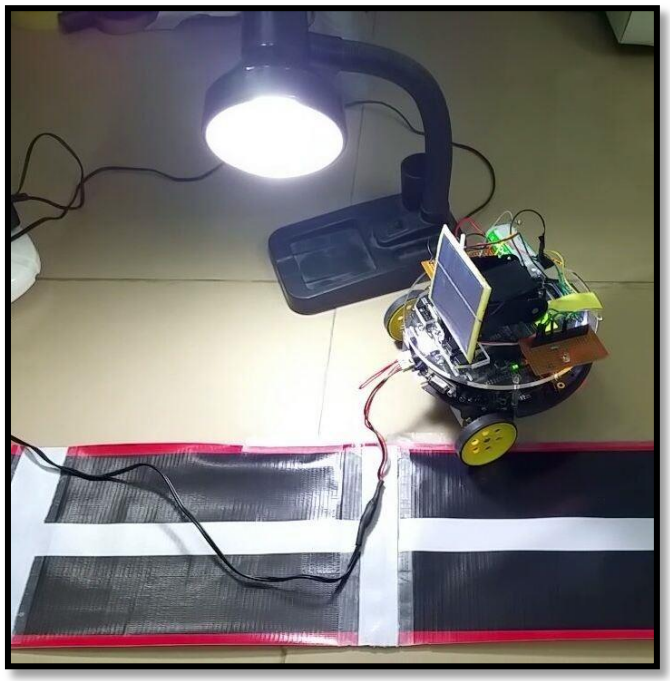

Fig 3.Bot aligned in the plane of maximum light intensity

Once it has aligned itself in the proper plane, it will start rotating the solar panel in that plane with the help of servo motor mounted on it. Again the servo motor would rotate 180 degrees, degree at once. In this way, the bot would once again collect 180 readings of light intensity in the surroundings. After the motor has completed its rotation, the bot would find the angle at which maximum reading was achieved and realign the panel at that angle. In this way, the direction of maximum light intensity was found.

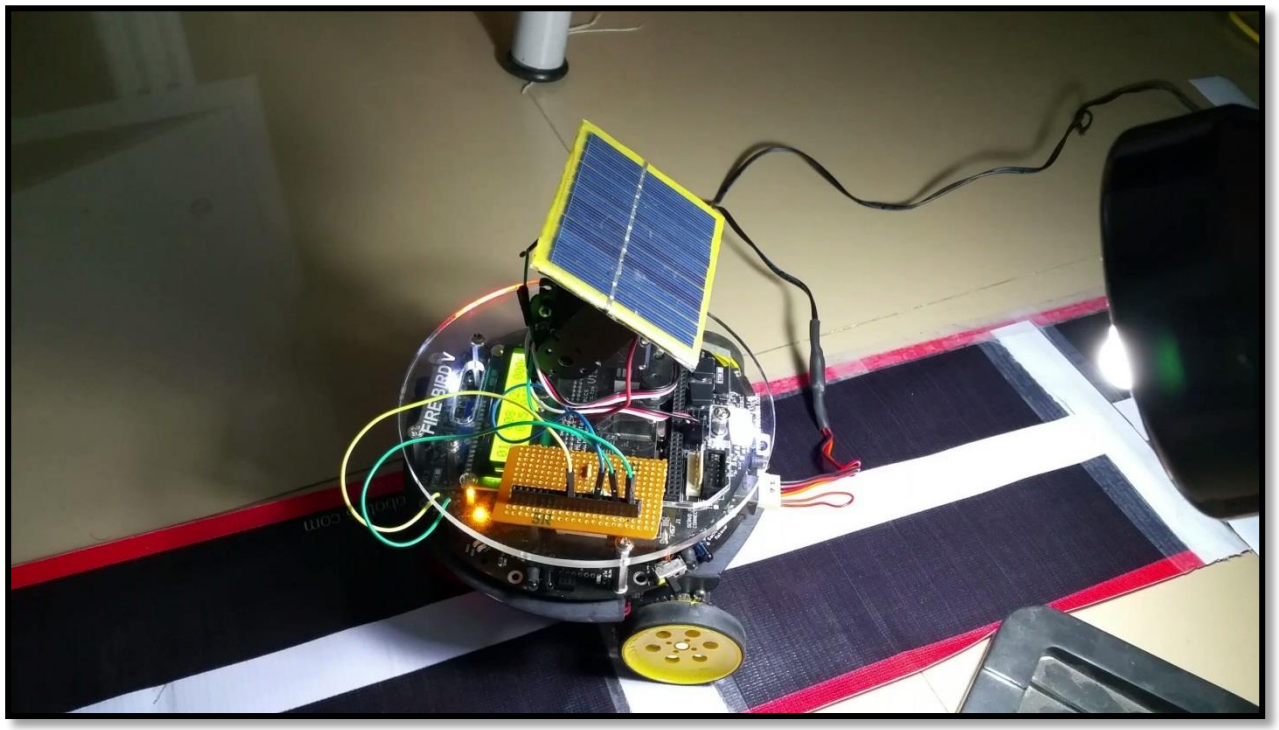

Fig 4. Bot with solar panel aligned in the direction of maximum light intensity

3) Charging process:

It was planned to charge the bot with solar panel. But the battery voltage of the bot is 12V whereas the maximum voltage that we received from the solar panel was 9V. Clearly, it was impossible to charge the battery with such low amount of voltage. So to demonstrate the charging process, we decided to charge to rechargeable batteries.

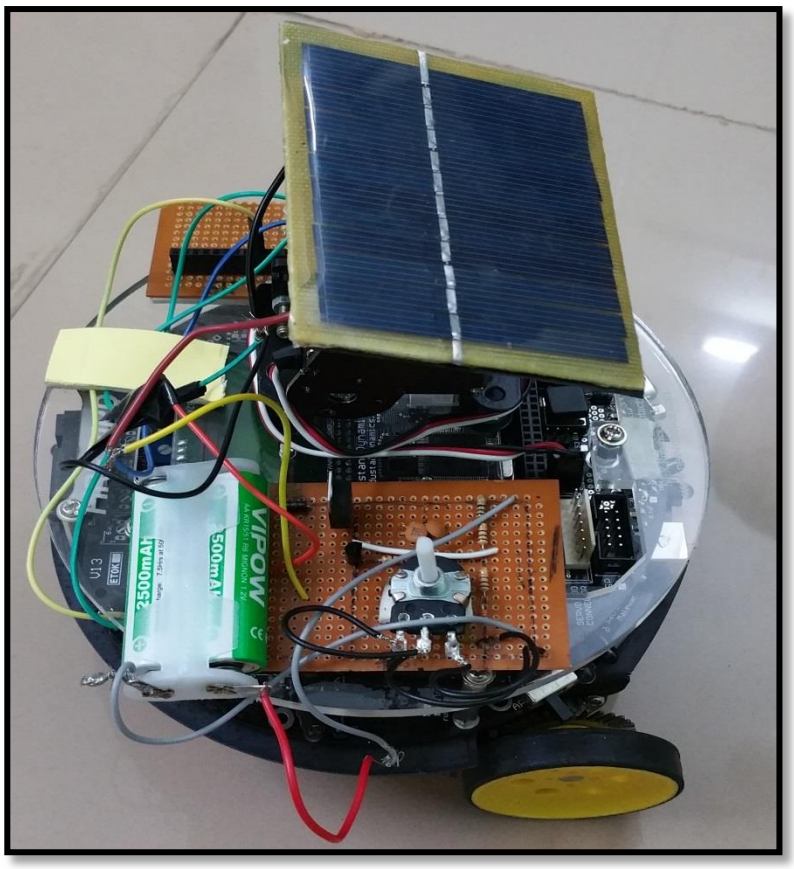

Fig.5 Picture showing the circuit for charging of external batteries with solar power

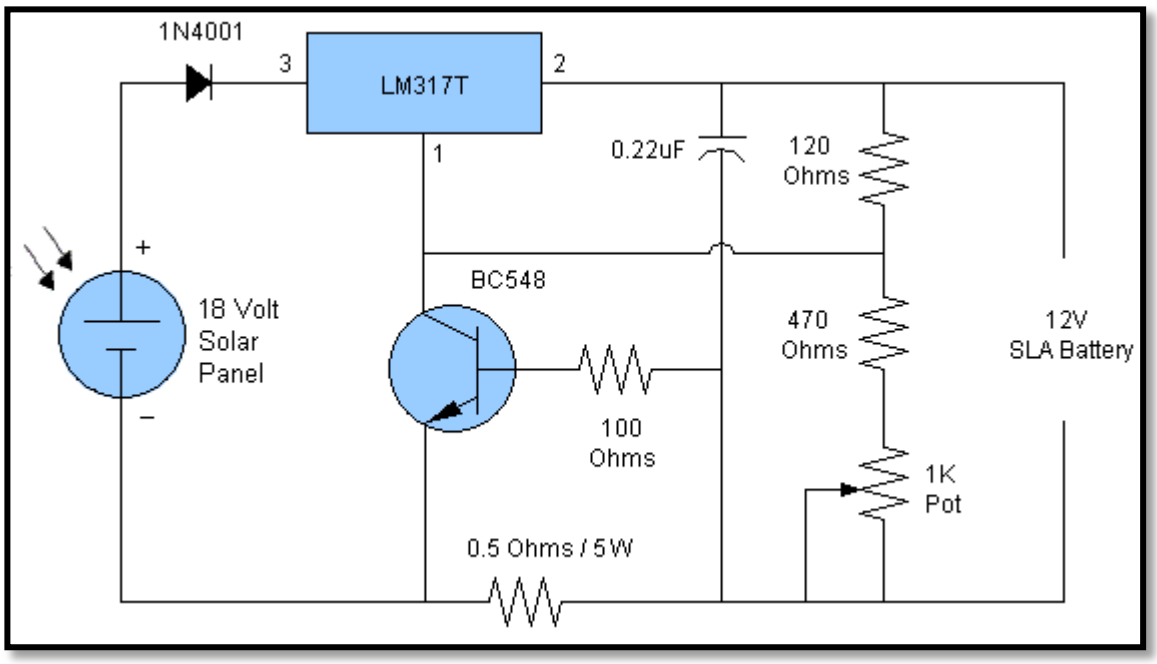

Fig.6 Representative circuit diagram

4) <u>Realigning of bot:</u>

Once the bot has finished the time duration at one point, it will realign itself so as to get back on white line. After that it will go to next node.

5. Testing and data acquisition:

1) Identification of node:

   A node is two white lines crossing each other. The bot identifies a node by the value of three white line sensors. The three white line sensor's ADC converted value is stored in center_white_line, right_white_line, left_white_line. The bot identifies the node if the difference between each of two is less than 10.

Fig.7 LCD display with reading from white line sensors as 015,008,019. Battery voltage of 12 V, Panel voltage of 1.11V(multiplied by 100).

2) The bot rotates itself finding the plane with maximum voltage. Then solar panel is rotated with the help of servo motors to find the angle in the direction of maximum light intensity. The voltage given out from the panel at 2p.m in direct sunlight is around 4-6V with maximum voltage reaching 9V.The voltage is constantly read and displayed on the LCD.

Fig 8. Voltage as measured at 10.22 a.m

3) The voltage and current as measured from the battery charger circuit came out to be 4.8V and 10mA respectively when the output from solar panel was 7V. This was enough to charge to Ni-

Mh batteries of 1.2V each with a bit long time of 10hours. To reduce the time period, panel with better efficiency and output voltage should be used. Also more current can be produced by compromising with excess voltage.

6. System Discussion:

A) Achievements:

1) First we thought of finding the maximum intensity position in only one degree of freedom. But we were able to achieve two degrees of freedom using bot's rotation. Thus, the solar panel can map full hemisphere.
2) The bot recognized and stopped at the node for user defined duration of time.
3) The panel was aligned in the direction of maximum light intensity in short interval of 3.3mins.
4) Two rechargeable batteries could be charged.
5) The bot covered all the points in given time interval.

B) Problems faced:

1) Initially, it was decided that bot would rotate the panel 180 degrees in each plane. But it would have taken a lot of time.
   The bot would take 61.9ms to rotate by 5 degrees with stabilization time of 400ms. The total time consumed by the bot amounted to 33.25secs. Moreover with panel rotating in each plane, total time taken was 79.2mins. So total time taken by bot was 80.80 minutes which was too large.
   Solution: We decided to align the panel at 45 degrees and then rotate the bot 360 degrees to identify proper plane first. Then the panel was rotated by 180 degrees only in the identified plane. In this way we could effectively reduce the time for identification of direction of maximum light intensity to 3.3 minutes.

2) As mentioned in the SRS, it was decided to use LDR's to identify the direction of maximum light intensity. But later we realized that rather than using LDR's, it was far more convenient to directly measure the voltage of solar panel in order to identify the direction. It wouldn't have been possible to identify the maximum position for two degrees of freedom using LDR accurately.

7. Future Scope:

1) The bot can be used in urban agriculture where the bot would charge itself while simultaneously doing its agricultural work.
2) The bot can be used in missions like Mars Rover,etc.
3) The bot can be used to charge small devices like mobile phones where it would itself go to place of sunlight charge the phone and bring it back.

8. References:

1) www.electronicshub.org
2) www.e-yantra.org
3) http://www.electroschematics.com/6888/solar-battery-charger-circuit/