Modification of a Normal Radio Controlled (RC) Car to a Solar (RC) Car

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Abstract - The objective of this project is to modify a normal radio controlled (RC) car to a solar radio controlled (RC) car. In this study, the purchased RC car was disassembled and LEDs were placed on the tires, it was given a new body made of stair board designed for the accommodation of the solar panel, solar charge controller and the battery pack. A solar charge controller was also constructed based on the design of the YP-LD solar charge controller but in mine the LEDs present in the original circuit was replaced with 3-pin connects which were connected to the LEDs placed in the tires of the car, the size was also altered when the PCB layout was designed. The normal batteries of the RC car were replaced with 3 9V, 250mA rechargeable batteries. The original case of the solar panel was also changed for the purpose of weight reduction. Upon the completion of the solar charge controller, the solar panel and the solar charge controller were tested, and were found to meet the requirements. Finally, the solar panel, solar charge controller and batteries were all properly connected.

Index Terms - Radio controlled car, LEDs, Solar Panel, Solar charge controller

1 INTRODUCTION

THE major difference between a normal RC car and a Solar RC car is in the power source. In this work, an electrically powered RC car and convert/modify it, into a solar RC car. To accomplish this we add a solar power source (comprising of a solar panel, solar charge controller, and rechargeable batteries). The major objective of this project is to assemble a solar charge controller specific to the RC car and modifying the RC car to meet the require results.

Table 1: Required specifications of solar power source

Output Voltage	8.5-12V(as required by the RC car controller chip)
Output Current	700-840mA(as required by the RC car controller chip)

These requirements were also consider in the choosing of the solar panel and batteries. All this together makes up the solar power source.

Radio controlled cars are simply self-powered model cars which can be controlled wirelessly due to the transmitted and receiver in their respected circuits. They are of two main types namely: toy grade RC car and hobby grade RC cars (which has different sub-types namely: electric models, nitro-powered models and gasoline-powered models) [1].

2 BASIC OVERVIEW OF DEVELOPMENT OF SOLAR RADIO CONTROLLED (RC) CAR

The requirements of solar charge controllers vary according to the device and solar panel in use ranging from solar charge controllers used in solar farms to solar charge controllers used in solar recharger lambs. Solar charge controllers generally work as a medium between the battery(s) and the solar panel, doing just as the name implies controlling the charging of the battery so as not to overcharge it and so cases also sending electricity to the device requiring it, or sometimes both[1]. In this case it is required to charge the batteries and then also send electricity to the RC car according to these requirements.

Electrically powered models use mechanical and/or electronic speed control units to adjust the amount of power delivered to the electric motors. The power delivered to the electric motors is proportional to the amount of throttle (a mechanism used to manage the flow of electricity) called for by the transmitter - the more you pull the trigger, the faster it goes. The basic parts of a RC car are the:

Transmitter: It is a component located in the circuit of the radio controller which is attached to an antenna that sends pulses which provide instructions for the car, the pattern of the signal has two major segments the synchronization segment and the pulse segment, the synchronization

Receiver: It is a component located in the circuit of the car which is attached to an antenna that, its job is to continuously search for radio waves, when it receives one it sends it to the circuit board which then interprets it and sends a charge from the power source to the appropriate motor.

Motor(s): It responsible for turning wheels and steering the vehicle.

Power source: It provides the electric current required to power the car.

segment is to alert the car that it is about to get new instructions and the pulse segment tells the car what to do and the car is programed to translate and perform the received instructions.

The power source (Solar charge controller) and the output device (Radio controlled car) come together to form a solar RC car. A solar RC car is a RC car powered by solar cells either directly or using a hybrid power supply system where it uses the solar cells when it is producing electricity and uses the battery when the solar cells are not (NOTE: the batteries will be charged by the solar cells) or one completely dependent on the battery output with the battery charging when the solar panel generate power [2],[3], as such is the case in this work.

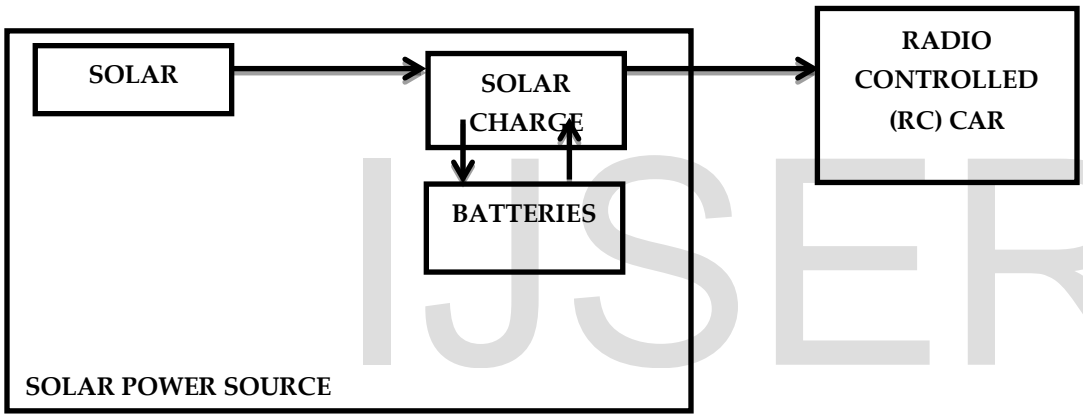

Figure 1: Block diagram of the solar (RC) car

3 DESIGNS AND IMPLEMENTATION

This work involves the development of a solar charge controlled and the modification of a normal RC car.

3.1 DEVELOPMENT OF SOLAR CHARGE CONTROLLER

Table 2: Specifications of YL-CD solar charge controller

Output voltage	12V and 5V
Output Current	2A

The model circuit for this work was designed by YL-CD on 15/04/2011 of model number 64H1009A, this circuit board was obtained from a solar battery charger kit with which the solar panel used was obtained. The solar charge controller had the following specifications:

The YL-CD solar charge controller circuit was drawn out and modified to meet the requirements of this work

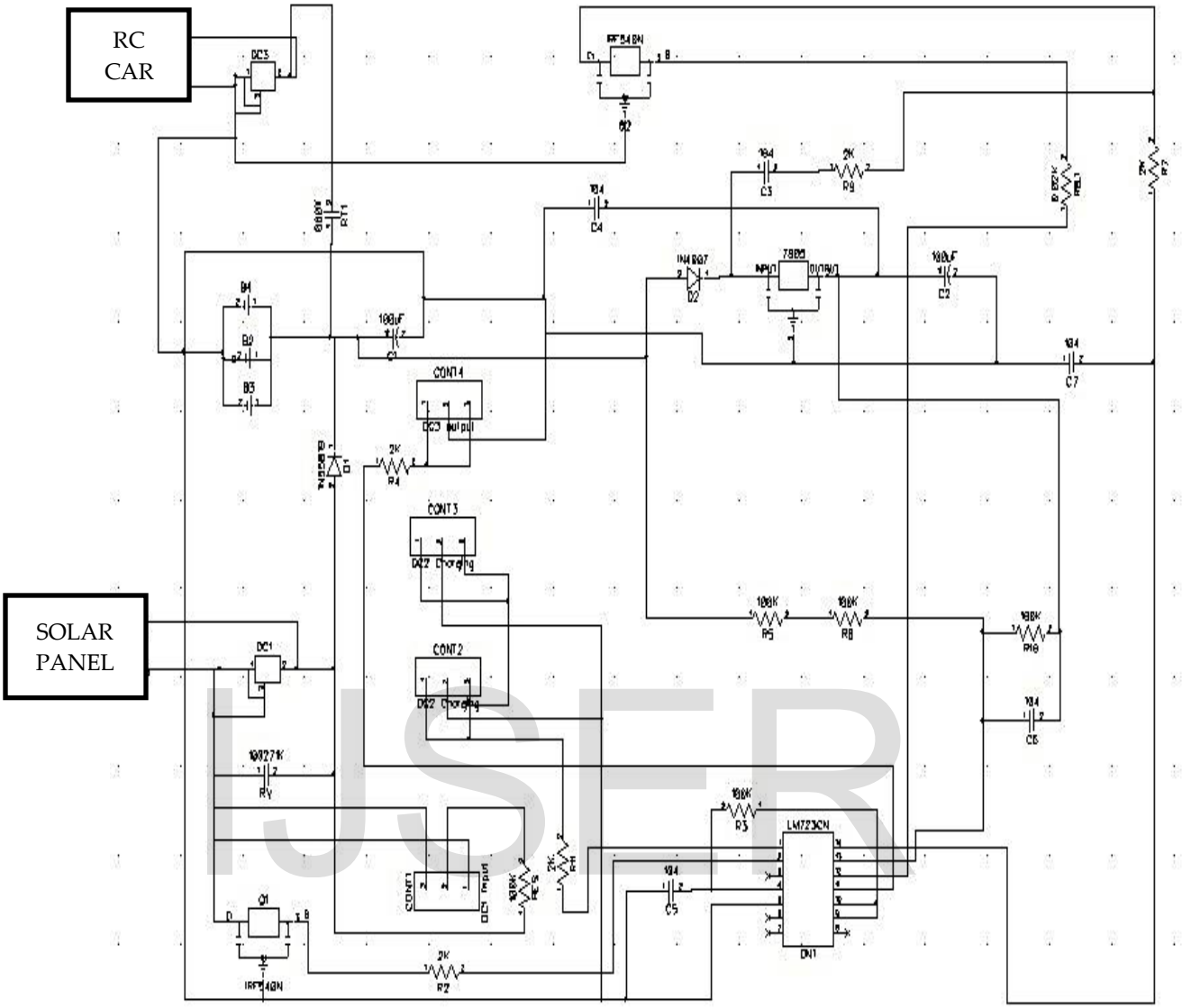

Figure 2: Solar Charge controller circuit in use

The above circuit solar charge was designed using the following components:

RESISTORS

Table 3: List of resistor values

LABELS	VALUES
R1,R3,R5,R6,R10	100K
R2,R4,R7,R8,R11	2K
R9	2Ω

CAPACITORS

Table 4: List of capacitor values

LABELS	VALUES
C1,C2	100µF
C3,C4,C5,C6,C7	104,100V

THERMISTORS

Table 5: List of thermistor values

LABELS	VALUES
RT1	06X
RV	100271K

LM723CN Integrated circuit (IC)

According to the [TEXAS INSTRUCMENT datasheet on LM723/LM723C voltage regulator from www.ti.com snvs765b - MAY 2004 revised in NOVEMBER 2004], It is a voltage regulator designed primarily for series regulator applications. By itself, it supplies up to 150mA; but with the help of transistors it can supply higher values of current.

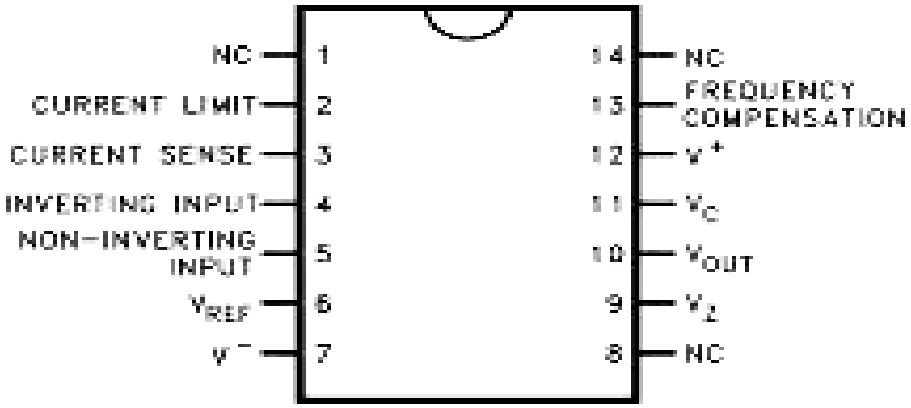

Figure 3: Top view of LM723CN (IC)

BATTERY PACK

The battery pack consists of three 9V, 250mA batteries connected in series which gives a 9V 750mA battery pack.

Figure 4: Picture of Battery and Battery pack

DIODES

Table 6: List of diodes used

LABEL	VALUES
D1	IN5819
D2	IN4007

POWER (MOSFET) Metal oxide semiconductor field effect transistor magnetic or switching electronic signals

Table 7: List of power MOSFET used

LABEL	VALUES
Q1,Q2	IRF540

VOLTAGE REGULATOR

Table 8: List of power MOSFET used

LABEL	VALUES
U2	7805 (5V voltage regulator)

4 WORKING PRINCIPLE OF THE SOLAR CHARGE CONTROLLER

The solar charge controller works in such a way that it receives power directly from the solar panel at DC1, then the received voltage is stepped down to charge the batteries, then send the voltage and current equivalent of the battery to DC3 (output). DC3 (output) is completely dependent on the battery, as the battery charges or not (when the solar panel is under a shade or at night) the it send out power through the solar charge controller to DC3(output), this way the DC3 receives the appropriate power that is required[2].

The principle of the circuit operation relies fundamentally on this IC (LM723CN), and is used as a linear regulator in this circuit. The operation of the circuit goes thus; when a voltage of about 19-21 volts is fed to the solar charge controller, which is fed to Q1 (Power MOSFET IRF540) which then send power the LM723CN IC, this is received at pin 2 (current unit pin) of LM723CN, while it also goes to the pin 4 (inverting input) of LM723CN which is connected to pin 9 and 10 (Vout and Vz respectively) of LM723CN, the voltage from DC1 (solar panel) also goes through U2 (voltage regulator 7805) to pin 14 (NC pin) of LM723CN, pin 13 (frequency compensation pin) of LM723CN send a signal to the input of the voltage regulator 7805. Q2 is sends a signal to pin 14 (NC) of LM723CN which is sent to pin 12 of LM723CN (the positive pin). Power is sent to DC2 (Battery pack) through D1 (IN5819) to DC2. Power is sent DC2 to DC3, while DC3 is also connect to ground and the voltage at DC3 equals that at DC2. CONT1 is connected to LEDs, and is fed by the solar panel and the when the LEDs are on it indicate that the Solar panel is supplying current to the circuit. CONT2 and CONT3 are connected to LEDs, and are fed by pin 5 of LM723CN and when the LEDs are on indicates that the battery is charging. CONT4 is connected to LEDs, and is fed by pin 11 and DC2, when the LEDs are on it indicated that DC3 is receiving power.

The solar charge controller was first done on a breadboardthe a PCB circuit for the solar charge controller was also designed; this was done on Diptrace (a PCB design circuit.

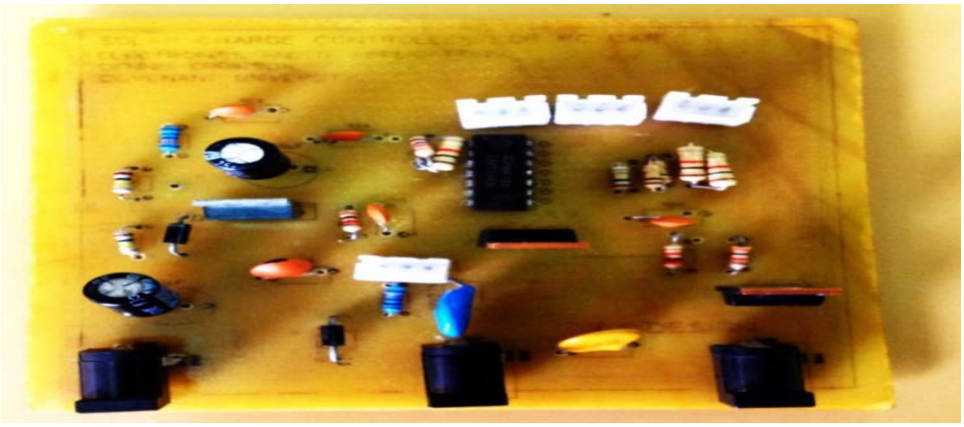

Figure 4: Completed PCB for Solar RC car

5 MODIFYING THE RADIO CONTROLLEDCAR

To accomplish this aspect of the work one will need a Radio controlled car; in this work a Traloie model 667D Hammer RC car was used. Other needed materials are hard paper (white, black and blue), Paper glue, Plywood, Nails, Body filler, Black spray paint, Super glue, QM all-purpose glue, Styrofoam and Light transparent plastic.Then follow these steps:

1. Remove the original body of the RC car, keeping only the bottom part and controller circuit of the original RC car, let's call this BPC (i.e. bottom part and circuit).
2. Construct a new body for the RC car.
3. Internal structure of this body is made of wood and then sprayed with body filler and black paint (this gives it the appearance of metal) let's call this IWS (i.e. internal wooden structure).
4. Mounted the IWS on the BPC, with nails, super glue and QM all-purpose glue.
5. Crave out the interior of the car from Styrofoam and glue it to the BPC.
6. Crave out the different part and sides of the car using hard paper for body and the light transparent plastic for the wind screens then glue it to the BPC.
7. And that's the redone RC car.
8. Mount the solar panel on the redone RC car
9. Make the appropriate connects to the Solar charge controller
10. Then close up the car and that's all.

Figure 5: Complete Solar RC car

6 RESULTS AND DISCUSSION

The solar panel, developed solar charge controller and solar RC car were tested and the output voltages were acquired as:

Table 9: Specifications of solar panel

QUANTITY	VALUE
Solar panel output voltage (max)	19V
Solar panel output Current	0.29A
Solar charge controller Input Voltage	19V
Solar charge controller Input Current	0.29A
Solar charge controller Output Voltage at DC2(Port charging the battery pack)	14.41V
Output Voltage at DC3(Port supplying the car)	9.78V
Output Current at DC3(Port supplying the car)	0.72A

Table 10: Specifications of solar charge controller

QUANTITY	VALUE
Input Voltage	19V
Input Current	0.29A
Output Voltage at DC2(Port charging the battery pack)	14.41V
Output Voltage at DC3(Port supplying the car)	9.78V
Output Current at DC3(Port supplying the car)	0.72A

FUTURE WORK/APPLICATION

The concept and mechanism of the solar RC car can also be used in the conversion of an electric car to a solar car. In this case an inverter should be used in place of the solar charge controller and a liquid- cooled high voltage lithium-ion battery system is recommended, with motors of at least 3 horsepower or 2238 watts, depending on the desired speed and weight of the car.

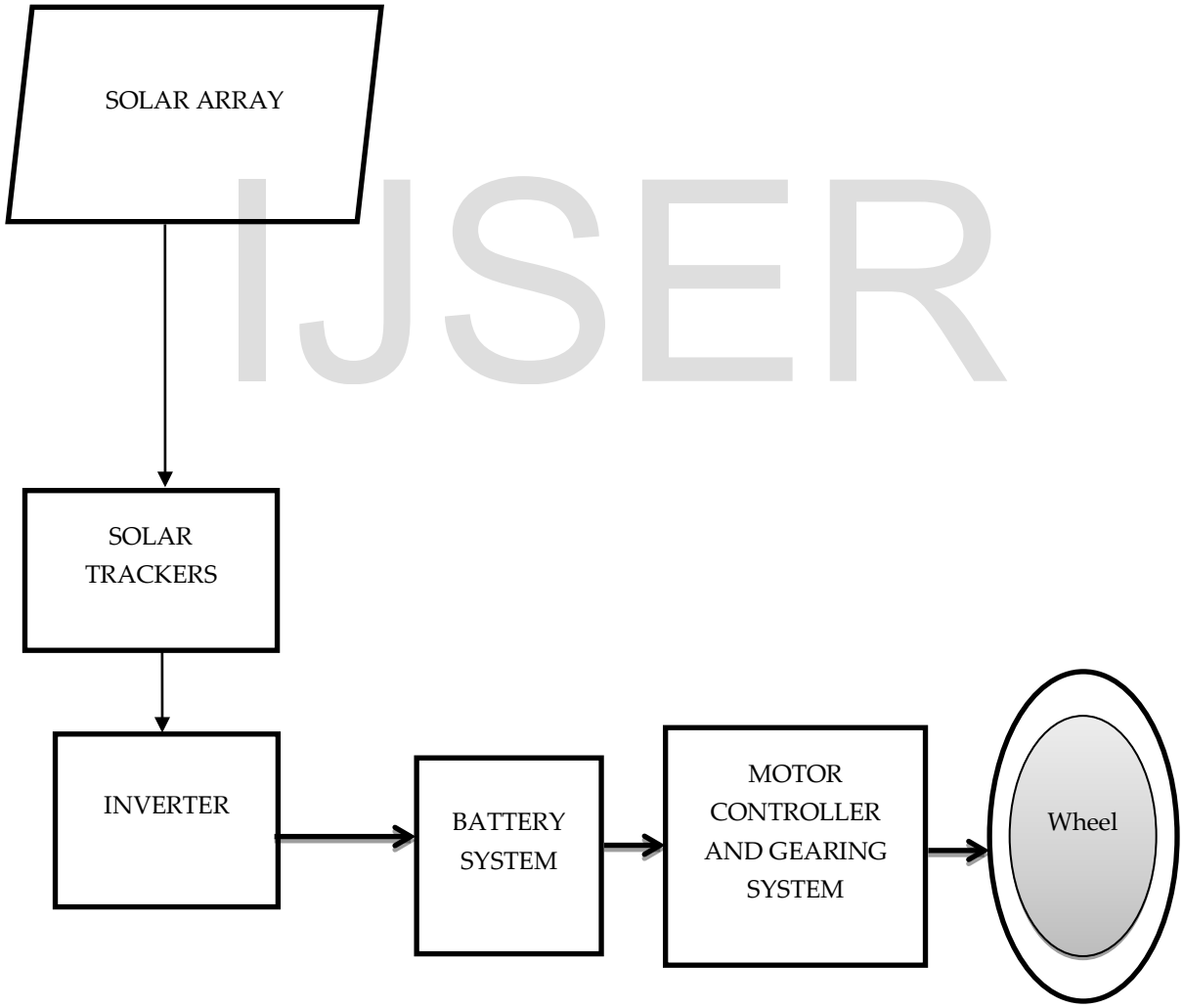

Figure 6: Block diagram of a solar car.

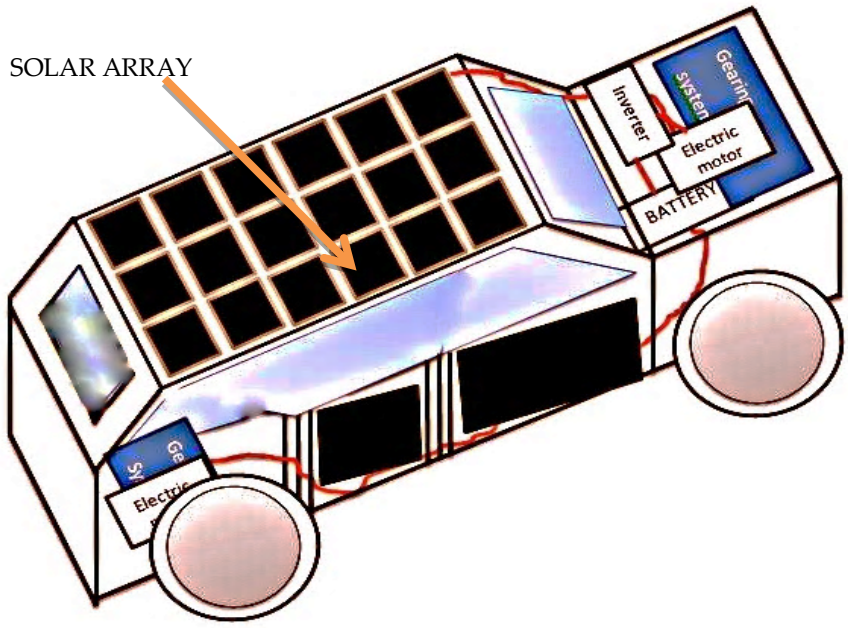

Figure 7: Basic schematics for a solar car

7 CONCLUSIONS

The project gives an understanding of solar energy; solar panels, RC cars and solar charge controller circuitry thereby bring an understanding of the ideology behind the mechanics and construction of solar vehicles.

8 REFERENCES

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