Hybrid Power Remote Control Solar Car with Automatic Speed Control System

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Abstract- In present age, role of renewable energy is enormously increasing in the world. With advancing modern technology, vehicles are driven by using those energies, especially solar energy. In development countries, many kinds of automotive, such as car, train and ship and even aircraft are being in active and passive way. The active way means direct solar power supplying to vehicles and the passive way is from solar energy stored batteries. Many studies have surveyed the last decade of hybrid light vehicle and solar car development. This project is inverted to study performance of solar powered vehicle. In this project, the basic concepts of Hybrid power supply system, Ultrasonic Transducer, Remote control system, motors and motor control systems and C programming language for Arduino board are displayed. The major goal is to give security and more economically uninterruptable power for vehicles. This reduces all types of pollution and fuel economy.

Index Terms- Hybrid power supply, Ultrasonic Transducer, Radio Frequency Control, Arduino UNO.

I. INTRODUCTION

Solar car is a solar vehicles used for land transport. Solar car usually runs on only power from the sun, although some models will supplement that power using a battery, or solar panels to recharge batteries or run auxiliary systems for a car that mainly uses battery power. Solar cars depend on a solar array that uses photovoltaic cells to convert sunlight into electrically. The design of a solar vehicle is severely limited by the amount of energy input into the car. It will not work during rainy and cloudy days. Hybrid car is a vehicle that uses two or more distinct power sources to move car. Hybrid electric vehicle combine a solar energy and electric energy. But instead of using a solar panel for energy, electric car get their energy from batteries. When the batteries run out, they must be recharged by plugging or solar panel the car into the electric power outlet. This project is a remote control solar car supplied power from hybrid power source, battery and solar panel, modifying car to automatically avoid collision by using Ultrasonic Transducer. In solar car, there are many portions such as Hybrid Power Supply System, Arduino UNO board and its programming language, Remote Control System, Motors and Motor Driving Circuit, and Automatic Speed Control System by Ultrasonic Transducer.

II. HYBRID POWER SUPPLY SYSTEM

Hybrid power supply system contains solar panel, dc to dc converter, battery and comparator.

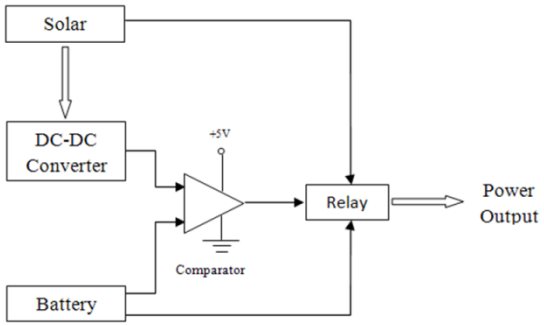

Figure 1 Block Diagram of Hybrid Power Supply

A.Solar Panel

Solar panels are devices that convert light into electricity. They are called "solar" panels because most of the time, the most powerful source of light available is the Sun, called Sol by astronomers. Some scientists call them *photovoltaics* which mean, basically, "light-electricity." A solar panel is a collection of solar *cells*. Lots of small solar cells spread over a large area can work together to provide enough power to be useful. The more light that hits a cell, the more electricity it produces.

Table 1 Specifications of 10W Solar Panel

Related power	10W
V_{oc}	20.6V
V_{op}	17.3V
Short circuit current (I_{sc})	0.69A
Working current (I_{op})	0.58A
Temperature range	-40℃to +80℃
Guarantee of power	90% within 10 years 80% within 25 years

B.Battery (Lipo)

Lithium-polymer batteries offer a variety of significant advantages over NiCd, NiMH and Li-Ion batteries for use in R/C electric devices. It is very important to have a good understanding of the operating characteristics of LiPo batteries - especially how to charge and care for them safely. Always read the specifications printed on the battery's label and this instruction sheet in their entirety prior to use.

Specifications of 2650mAh-11.1V-25C-3S-XT60 Battery (LiPo)

Capacity	: 2650mAh
Cells	:3S
Volts	: 11.1V
Continuous discharge rate	: 25C
Max discharge rate	: 50C
Max charging rate	: 5C
Apply	: for Aircraft , Helicopter
With connector	: XT60

C.DC/DC converter

DC to DC converters are important in portable electronic devices such as cellular phones and laptop computers, which are supplied with power from batteries primarily. Such electronic devices often contain several sub-circuits, each with its own voltage level requirement different from that supplied by the battery or an external supply (sometimes higher or lower than the supply voltage). Additionally, the battery voltage declines as its stored energy is drained. Switched DC to DC converters offer a method to increase voltage from a partially lowered battery voltage thereby saving space instead of using multiple batteries to accomplish the same thing. Most DC to DC converters also regulate the output voltage. Some exceptions include high-efficiency LED power sources, which are a kind of DC to DC converter that regulates the current through the LEDs, and simple charge pumps which double or triple the output voltage. DC to DC converters developed to maximize the energy harvest for photovoltaic systems and for wind turbines are called power optimizers.

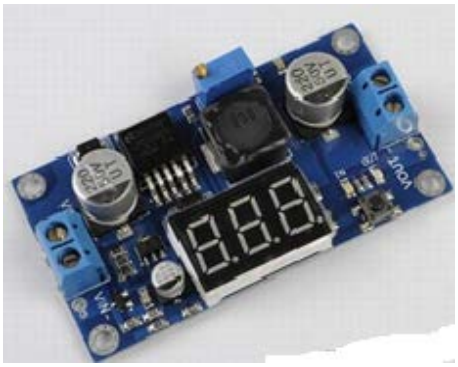

Figure 2 DC-DC Converter Circuit Board

D. Comparator IC (LM358)

LM358 consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltage. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. Application areas include transducer amplifier, DC gain blocks and all the conventional OP amp circuits which now can be easily implemented in single power supply systems.

Figure 3 LM358 IC

E.LM2596 3.0 A, Step-Down Switching Regulator

The LM2596 regulator is monolithic integrated circuit ideally suited for easy and convenient design of a step−down switching regulator (buck converter). It is capable of driving a 3.0A load with excellent line and load regulation. This device is available in adjustable output version and it is internally compensated to minimize the number of external components to simplify the power supply design. Since LM2596 converter is a switch−mode power supply, its efficiency is significantly higher in comparison with popular three−terminal linear regulators, especially with higher input voltages. The LM2596 operates at a switching frequency of 150 kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Available in a standard 5−lead TO−220 package with several different lead bend options, and D2PAK surface mount package. The other features include a guaranteed 4% tolerance on output voltage within specified input voltages and output load conditions, and 15% on the oscillator frequency. External shutdown is included, featuring 80A (typical) standby current. Self-protection features include switch cycle−by−cycle current limit for the output switch, as well as thermal shutdown for complete protection under fault conditions.

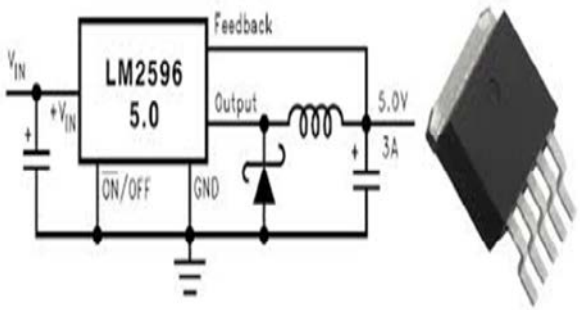

Figure 4 LM2596 Configuration

III. ULTRASONIC TRANSDUCER

The human ear can hear sound frequency around 20HZ ~ 20KHZ, and ultrasonic is the sound wave beyond the human ability of 20KHz. Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar which evaluates attributes of target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensor generates high frequency sound waves and evaluates the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. This technology is used for measuring the distance.

A.Selected Ultrasonic Module HC - SR04

This HC-SR04 Ultrasonic Ranging Sensor is a non-contact distance measurement module with stable performance and high ranging accuracy with the inexpensive price.

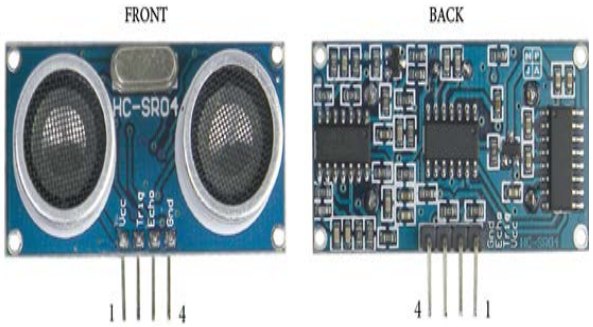

Figure 5 Front and Back View of HC-SR04 Ultrasonic Module

IV. RADIO FREQUEBCY REMOTE CONTROL

A.Radio Control

Infrared remotes can operate TVs and videos only over quite short distances. The infrared LED is quite small and low-powered and the receiver on the TV or video is small too. This is why you generally have to point the remote directly at the appliance you are trying to control. Some remotes are more tolerant and it is sometimes possible to bounce the infrared beam off a wall, mirror, or picture and still change channel. Infrared remotes are no good for controlling things over distances greater than a few meters (feet); the infrared energy is too easily soaked up and dissipated along its journey. To control things over greater distances, you need to use a different kind of system called radio control. You operate radio-controlled cars, trucks, boats, airplanes and robots using a handheld radio transmitter box that sends signals from an antenna on whatever you are interested in controlling. Radio signals can travel much further than infrared ones without interference, especially if the transmitters and antennas are large and powerful.

B.Multi-channel Radio Control

The multi-channel radio control is used to transmit more complex and useful signals to a piece of remote equipment. For example, to make a radio-controlled car speed up, slow down, or steer from make side. Instead of just sending a basic on/off signal, it transmits a series of code analog or digital pulses that are decoded by the transmitter and use to produce specific actions. For example, turning a steering wheel on a radio control transmitter will send a series of pulses that make an electric motor rotate by a corresponding amount to steer a radio-controlled car one way or other. Motors that work this way are known as servo motors. Unlike normal electric motors, which rotate an arbitrary number of times according to how long they receive an electric current, servo motors are much more controllable and have built-in electronic feedback mechanisms (based on potentiometers similar to variable resistors), which enable you to make them rotate by reasonably precise amounts.

C.Selected RF Control (Four Channel Radio Control (FS-T4B))

Figure 6 Channel Radio Control (FS-T4B)

The 4 channel radio control system is used to transmit more complex and useful signals to a piece of remote equipment. This system contains four channels for control. This radio control system can control radio-controlled cars, boats, and helicopters by using a transmitter box from an antenna to a receiver.

V. ELECTRIC MOTORS AND MOTOR CONTROLS

A.Arduino Smart Car Robot Plastic Tire Wheel with DC Gear Motor

This type of gearmotor is produced, intended for small cars, and other robot applications. The gearmotor is a type of right angle shaft gearmotor.

Specifications

Operating Voltage	:	3V ~ 12V
Maximum Torque	:	800 g.cm
No Load Speed	:	170 rpm
Load Current	:	70mA(250mA Max)
Reduction ratio	:	1:48

B.L298N Dual H-Bridge Based Motor Driver Circuit Board

This driver module is made using L298N, a high current, high voltage dual H-Bridge driver. It is designed to accept standard TTL voltage levels and to up to two drive inductive loads such as DC Motors, Stepper Motors, Relays and Solenoids. This Dual H-Bridge driver is capable of driving voltages up to 46V and continuous current up to 2A in each channels.

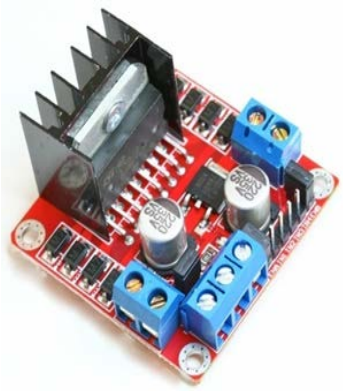

Figure 7 L298N Motor Driver Module

VI. DEIGN AND OPERATION

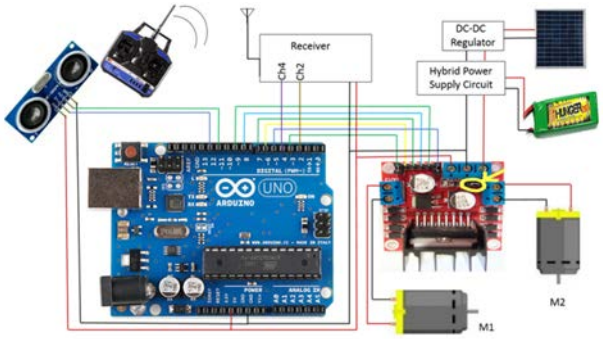

Figure 8 The whole circuit diagram of solar car

The whole car assembly is supplied from hybrid power source, battery and solar panel (nearly 12V). The DC-DC regulator is inserted in the output side of solar panel to adjust output voltage or current. The current passed through the hybrid power supply circuit is provided to motor driving circuit, which drive two sets of motor. The 5 V from motor driving circuit is supplied to Arduino to operate its functions. Then, receiver and Ultrasonic transducer are also supplied via Arduino. Transmitter is supplied by external cells.

Channel 2 of transmitter is used to control car forward and backward mode. If joy stick of channel 2 is upward, the car moves forward and if the joy stick is downward, it moves backward.

The command signal from transmitter is received on the receiver. The received signal is sent to pin 2 of Arduino, which determines signal polarity to move car forward or backward through motor driving circuit. Then, the polarity of signal is delivered to IN1 and IN2 of motor driving circuit from Arduino pin 6 and 7 to control M1, and IN3 and IN4 are from pin 8 and 9 to control M2 respectively. Depending on polarity of command signal (0 or 1), the car moves forward and backward.

Channel 4 of transmitter is used to control car turn left and right mode. If joy stick of channel 4 is put to the left, the left set of motor stops and the right set continue moving. By this way, the car turns to the left. If joy stick is put to the right, the right set of motor stops and the left set continue moving. Then, the car turns to the right.

The turn left or right function has to be operated together with car forward or backward mode. The command signal from transmitter is received on the receiver. The received signal is sent to pin 4 of Arduino. The read signal from pin 4 diminishes the signal read signal of pin 2 and then produces determined signal to ENA for M1 or ENB for M2. Depending on the determined signal to M1 or M2, the car turns left or right.

Ultrasonic transducer is used to measure distance before car. The trigger pin of Ultrasonic transducer is connected to the pin 12 of Arduino and echo pin is to pin 11. When trigger pin is HIGH, acoustic signal is transmitted until trigger pin is LOW. The returned signal from an object is received by the echo pin when it is HIGH. When distance between car and disturbance is greater than 30 cm, the command functions from transmitter can control all modes of the car. But, when distance is 30 cm or lower, the forward command cannot operate and only backward command will operate. When the car is moving and disturbance unexpectedly appears, the car will stop automatically.

VII. CONCLUSION

In this project, selected solar panel cannot fully supply enough power to the whole car assembly. External batteries have to be applied to other components of car like reference voltage source to comparator and a supply source to Arduino board. This is also due to the necessary different voltage. Charging can be made externally or by solar panel. If it is by solar panel, supply to circuit component from it must be cut off. As strength of the project, the car is able to avoid collision because ultrasonic transducer used in car can sense any disturbance instantly during distance of 30 cm, and command the car to stop via Arduino board. One more thing is that hybrid power source can be applied to the car, which is sometimes called uninterrupted power supply, and the car is capable to carry all boards even with its low power (10 W). When solar energy become popular to use in automotive, including car, train and ship, with more advancing technique, we can create better environment due to reduction of carbon dioxide which comes out from diesel or petrol engine vehicles. The environment becomes clean. Energy saving and cost recovery would be attractive to people to use solar vehicles than any other ones.

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