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Solar Powered Car (Automobiles)

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ABSTRACT

In present fast developing world our existing fuels are not sufficient, so in our automobile industry also we need change to present new renewable and Eco-friendly energy, that is solar power, so we are developing solar car that can carry baby easily, t can prove that prototype can be produced real tme car achievements, which collects energy by solar panel and charge battery, the battery stores the energy that will used to rotating wheels, solar panel battery and motors are in such a way that all are reached that power at good efficiency, so it prove present emerging sources of energy solar which comes free of cost can be adapted to automobiles industries. The real reason to switch to solar energy is to stop global warming.

Keywords : Fuels, Soar Power, Gear Motor, Battery

I. INTRODUCTION

Fuel efficiency is a form of thermal efficiency, meaning the efficiency of a process that converts chemical potential energy contained in a carrier fuel into kinetic energy or work. Overall fuel efficiency may vary per device, which in turn may vary per application fuel efficiency, especially fossil fuel power plants or industries dealing with combustion, such as ammonia production during the Haber process.

In the context of transport, fuel economy is the energy efficiency of a particular vehicle, given as a ratio of distance traveled per unit of fuel consumed. Fuel economy is expressed in miles per gallon (mpg) in the USA and usually also in the UK (imperial gallon); there is sometimes confusion as the imperial gallon is 20% larger than the US gallon so that mpg values are not directly comparable. In countries using the metric system fuel economy is stated in kilometers per liter (km/L) in the Netherlands, Denmark and in several Latin American or Asian countries such as India, Japan, South Korea, or as the reciprocal ratio, "fuel consumption" in liters per 100 kilometers (L/100 km) in much of Europe, Canada, New Zealand and Australia. Litres per mil are used in Norway and Sweden.

Fuel consumption is a more accurate measure of a vehicle's performance because it is a linear relationship while fuel economy leads to distortions in efficiency improvements.

Weight-specific efficiency (efficiency per unit weight) may be stated for freight, and passenger-specific efficiency (vehicle efficiency per passenger).

II. METHODS AND MATERIAL

A. Solar Energy

Solar energy is radiant light and heat from the Sun harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic's, solar thermal energy, solar architecture and artificial photosynthesis.

It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on the way they capture and distribute solar energy or convert it into solar power. Active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy.

Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

The large magnitude of solar energy available makes it a highly appealing source of electricity. The United Nations Development Programme in its 2000 World Energy Assessment found that the annual potential of solar energy was 1,575–49,837 exajoules (EJ). This is several times larger than the total world energy consumption, which was 559.8 EJ in 2012.

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating global warming, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared.

B. Solar Panel

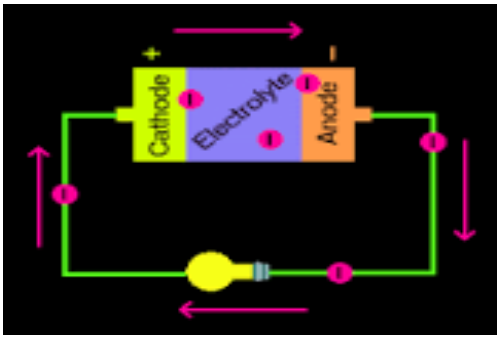
Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.

A photovoltaic (in short PV) module is a packaged, connected assembly of typically 6×10 solar cells. Solar Photovoltaic panels constitute the solar array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions, and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few solar panels available that are exceeding 19% efficiency. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring.

The price of solar power, together with batteries for storage, has continued to fall so that in many countries it is cheaper than ordinary fossil fuel electricity from the grid.

C. Batteries

Batteries have three parts, an anode (-), a cathode (+), and the electrolyte. The cathode and anode (the positive and negative sides at either end of a traditional battery) are hooked up to an electrical circuit. The chemical reactions in the battery.



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Here we took Lead acid type battery:

A paste of what's referred to as "active material" is then bonded to the plates; sponge lead for the negative plates, and lead dioxide for the positive. This active material is where the chemical reaction with the sulfuric acid takes place when an electrical load is placed across the battery terminals.

The storage battery or secondary battery is such battery where electrical energy can be stored as chemical energy and this chemical energy is then converted to electrical energy as when required. The conversion of electrical energy into chemical energy by applying external electrical source is known as charging of battery . Whereas conversion of chemical energy into electrical energy for supplying the external load is known as discharging of secondary battery . During charging of battery ,

current is passed through it which causes some chemical changes inside the battery . This chemical changes absorb energy during their formation.

When the battery is connected to the external load, the chemical changes take place in reverse direction, during which the absorbed energy is released as electrical energy and supplied to the load. Now we will try to understand principle working of lead acid battery and for that we will first discuss about lead acid battery which is very commonly used as storage battery or secondary battery.

Materials used for Lead Acid Storage Battery Cells

The main active materials required to construct a lead-acid battery are

1. Lead peroxide (PbO_2).
2. Sponge lead (Pb) and
3. Dilute sulfuric acid (H_2SO_4).

Lead Peroxide (PbO_2)

The positive plate is made of lead peroxide. This is dark brown, hard and brittle substance.

Sponge Lead (Pb)

The negative plate is made of pure lead in soft sponge condition.

Dilute Sulfuric Acid (H_2SO_4)

Dilute sulfuric acid used for lead acid battery has ration of water : acid = 3:1.

The **lead acid storage battery** is formed by dipping lead peroxide plate and sponge lead plate in dilute sulfuric acid. A load is connected externally between these plates. In diluted sulfuric acid the molecules of the acid split into positive hydrogen ions (H^+) and negative sulfate ions (SO_4^{--}). The hydrogen ions when reach at PbO_2 plate, they receive electrons from it and become hydrogen atom which again attack PbO_2 and form PbO and H_2O (water). This PbO reacts with H_2 SO_4 and forms $PbSO_4$ and H_2O (water).

$$PbO_2 + 2H \rightarrow PbO + H_2O$$

$$\frac{PbO + H_2SO_4 \rightarrow PbSO_4 + H_2O}{PbO_2 + H_2SO_4 + 2H \rightarrow PbSO_4 + 2H_2O}$$

SO_4^{--} ons are moving freely in the solution so some of them will reach to pure Pb plate where they give their extra electrons and become radical SO_4. As the radical SO_4 cannot exist alone it will attack Pb and will form $PbSO_4$. As H^+ ions take electrons from PbO_2 plate and SO_4^{--} ions give electrons to Pb plate, there would be an inequality of electrons between these two plates. Hence there would be a flow of current through the external load between these plates for balancing this inequality of electrons. This process is called discharging of lead acid battery . The lead sulfate ($PbSO_4$) is whitish in color. During discharging.

1. Both of the plates are covered with $PbSO_4$.
2. Specific gravity of sulfuric acid solution falls due to formation of water during reaction at PbO_2 plate.
3. As a result, the rate of reaction falls which implies the potential difference between the plates decreases during discharging process.

Now we will disconnect the load and connect $PbSO_4$ covered PbO_2 plate with positive terminal of an external DC source and PbO_2 covered Pb plate with negative terminal of that DC source. During discharging, the density of sulfuric acid falls but there still sulfuric acid exists in the solution. This sulfuric acid also remains as H^+ and SO_4^{--} ions in the solution. Hydrogen ions (cation) being positively charged, move to the electrode (cathode) connected with negative terminal of the DC source. Here each H^+ ion takes one electron from that and becomes hydrogen atom. These hydrogen atoms then attack $PbSO_4$ and form lead and sulfuric acid. $PbSO_4 + 2H \rightarrow H_2SO_4 + Pb$ SO_4^{--} ions (anions) move towards the electrode (anode) connected with positive terminal of DC source where they will give up their extra electrons and become radical SO_4. This radical SO_4 cannot exist alone hence reacts with $PbSO_4$ of anode and forms lead peroxide (PbO_2) and sulfuric acid (H_2SO_4). $PbSO_4 + 2H_2 + SO_4 \rightarrow PbO_2 + 2H_2SO_4$ Hence by charging the lead acid storage battery cell.

1. Lead sulfate anode gets converted into lead peroxide.
2. Lead sulfate of cathode is converted to pure lead.
3. Terminal; potential of the cell increases.
4. Specific gravity of sulfuric acid increases

D. Mechanical Design

The engineering design process is a formulation of a plan or scheme to assist an engineer in creating a product. The engineering design is defined as: an componenet, or process to meet desired needs. It is a decision making process (often interativve) in which the basic sciences, mathematics, and engineering science are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the desing processs are the establishment of objectives and criteria, synthesis, analysis, construction, testing and evaluation.

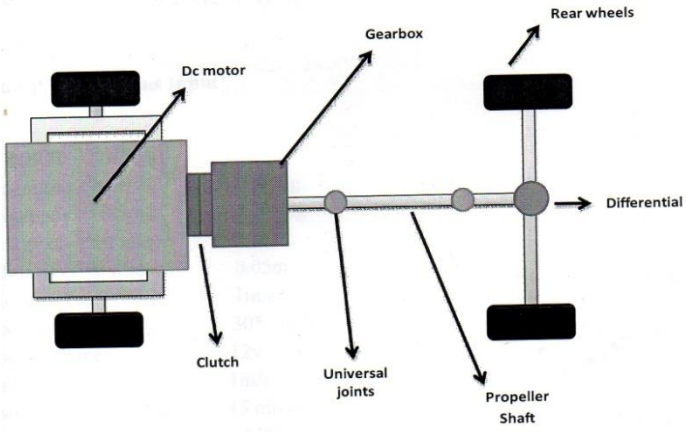
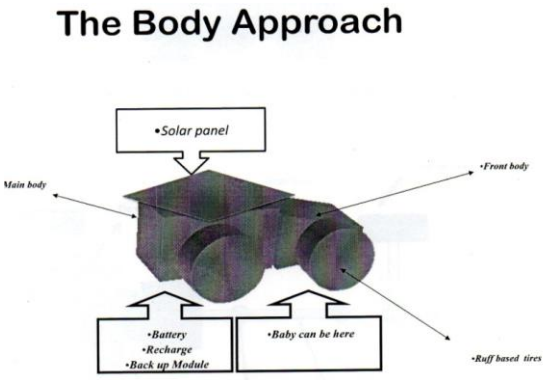


fig. 3 Transmission System of Solar Car



Load estimation

1. **Pre Mechanics of body**
   - Force **F=ma**
     - Measured in Newton's

Work **w=f*d**

- Measured in joules

Power **P=w/t**

- Measured in watts
- To design car mechanical body for motor and battery selection it is mandatory to go for pre-calculation

Mechanical weight of the car

Parameter	Weight (kg)
Body weight	4
Battery	1
Panel	2
Baby	12
Total	**20 kg**

Mechanical calculations input

Name	Value
Total mass of car	2.040kg
Weight of car	20.00kg
Number of drive motors	2 motors
Radius of rive wheel	0.05m
Velocity of car:	1m/s
Supply voltage	12V
Desired acceleration	1m/s
Desired operating time	15minutes
Total efficiency [%]	65%

Balance the forces

$mg_x=mgsin(\Theta)$

Fx=ma x sin (Θ) →20*0=00

$Mg_y=mg*cos(\Theta)$

Fy=ma y cos (Θ) → 20*1=20

T=f*R

Torque value represents

Note now that all forces (F) are along the x and y axes. We balance the forces in the X-direction;

$\sum F_x=M*a=M*g_x+f$

Inserting the equation for torque above, and the equation for Mg_x, we obtain:

M*a=M*g*sin (Θ)+T/R

Rearranging the equation to isolate T:

T=(a+ g*sin (Θ))*M*R

This torque value represents the total torque required to accelerate the robot up an incline:

T=(a+ g*sin (Θ))*M*R

T=(1+9.8* sin (Θ)+M*R {M=30 R=0.05}

T=1*20*0.08=1.6
T=1.6
With friction it is 1.3
T=1.6*1.3
T=2.8

2. High torque DC Geared Motor

Features
60RPM 12V DC motors with Metal Gearbox and Metal Gears
18000 RPM base motor
6mm Diameter shaft with M3 threaded hole
Gearbox diameter 37mm
Motor diameter 28.5mm
Length 63mm without shaft
Shaft length 15mm
180gm weight
38kg-cm torque
No load current = 800mA
Load current = upto 7.5 A (Maximum)

E. Electrical Design

Design Approach

Electrical design approach of the car starts figuring out of parts required and power requirement, the components rating are inter depend so that we can made.

Battery calculations

Total power (P) (a+ g*sin (Θ))*M*R

- Total torque required to accelerate the robot (T) value must be devided by the total number(N) of drive wheels to obtain the torque needed for each drive motor.

$$T = \frac{100}{e}\frac{(a + g * \sin(\theta)) * M * R}{N}$$

$$T = \frac{t}{n} = \frac{2.8}{1} = 2.8$$

- The final point to consider is the efficiency (e) in the motor, gearing and wheel (slip).

$$T = \frac{(a + g * \sin(\theta)) * M * R}{N}$$

$T = \frac{100}{e}$ *T=2.8*100/65=4.3

- This increases the torque required and compensates for inefficiencies.
- Total power (P) per motor can be calculated using the following relations:
  ω =20
  P=T*ω
  P=4.3*60=258
- The two equations above ar used to produce the following relation:

P=T*ω P=I*V

$$I = \frac{T * \omega}{V}$$

$$I = \frac{P}{V} = \frac{258}{12} = 21.5A$$

Finally, the capacity (c) of battery pack required can be estimated using the equation:
robot work for hour
=current*time =21.5* 1=21.5
Total battery capacity= 1*c= 21.5
BATTERY MUST BE 20Ah

Selected battery

- **12V 5Ah rechargeable Lead-acid battery**

Voltage	12V
Capacity	5Ah
Cycle used	14.4 – 15.0v
Standby use	13.6 – 13.8
Initial current	<1.50A

Solar Panel

- Solar panels use light energy (photons) from the sun to generate electricity through the photovoltaic effect.
- Electrical characteristics include nominal power ($P_{max,}$ measured in W), open circuit voltage (V_{OC}), short circuit current ($I_{sc,}$ measured in Amperes), maximum power voltage (V_{MPP}), maximum power current (I_{MPP}), peak power, $W_{p,}$ and module efficiency (%).

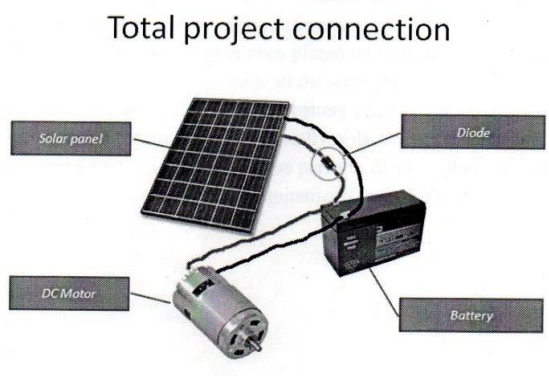
Selected panel specifications:

P_{max}	7w
V_{oc}	18 v
I_{sc}	350amp
V_{MPP}	15V
W_p	8.5w
H	25%

The solar panel is selected in such a way that the voltage of the solar panel is quiet more are equal to battery charging voltage (cycles used) than battery than it can charge the battery.

Total project connection

Making use of solar energy, in modest techniques can certainly help create a difference in our life. Solar car battery charger is an excellent example. How often have you ever attempted to begin your automobile, simply to learn that the battery is dead then there is simply no ignition? Everyone hates that idea, though with a solar car battery charger, the remedy is proper at hand. Making use of the unrestricted energy from the sun, you possibly can make certain the battery is obviously topped off and prepared to go.

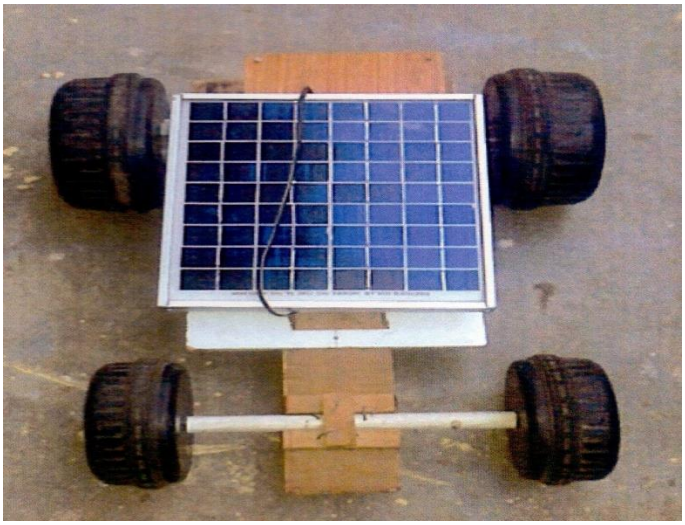


Solar can battery charger is quite practical device and doesn't demand mains power, hence supplying the largest advantages. They are definitely quickly set up and also easy to take everywhere. Solar car battery chargers support to extending the life of photovoltaic batteries. This is quite possible through charging the battery without submitting this to wear and tear which can be as a result of driving. Solar car battery charger is surely an uncomplicated, maintenance-free solution to keep the car battery recharged and prepared to use once you want it. Unless you often make use of your automobile, the battery slowly and gradually discharges so much that your motor is not going to start. Solar battery chargers are not only found about supporting folks charge the batteries however it is also about supporting the declining earth. If you utilize the solar battery charger, you decrease the trace of carbon at home in several methods. Solar l= chargers are a fantastic addition to your tragedy readiness kit. Photo voltaic battery chargers are readily available for a variety of goods and are available in numerous current capabilities at the same time, making it simpler for you to change a number gadgets. Photovoltaic chargers certainly are a prime example, providing you the opportunity to charge the battery is without having to pay for added power or having to worry on the subject of air pollution. Solar chargers over 5 watts demand a solar controller to modify the result, preventing over charging. Solar chargers basically have to have natural light to start out charging your batteries and has to be positioned in a place where in it can gather maximum sunlight. You can spend a whole lot of funds charging up all your products, with solar battery chargers, you not just decrease the energy expenses however they enable customers huge freedom in where they are able to make use of their portable electronic devices. The solar car battery charger is actually really simple to use. It attaches in to your cars cigarette lighter outlet or even straight iinto your battery. The chargers solar panels may well be connected to your windshield by way of suction cups or even placed on your dashboard. And that's all you have to do. The solar car battery charger does all the work for you without having anymore intervention. Fortunately, purchasing a solar car battery charger is not really that costly plus they are constructed to last for some time. Generally, solar energy systems are constructed to supply power for a very long time as long as you perform correct upkeep as well as check with a solar energy expert to evaluate your requirements from the start. Go for the one that it's your need.

III. RESULTS AND DISCUSSION

We successfully tested the solar car load capabilities, out test run is taken on-road and off-rod, both sides it given good results, the test run is carried away by small pay load to max

of it load capacity, we had a smooth run in overall test.



At applied load of 30kgs for 100 meters distance it achieved time period of 15seconds.

IV. CONCLUSION

In our fast developing world this is only way to reduce gasoline fuels and make Eco-friendly world, in the coming decades, transportation in the world is expected to change radically in response to environmental constraints, fluctuating oil availability and economic factors. The transportation systems that emerge iin the 21st century will be defined largely by the choices, skills and imaginations of today youth. As scientists and engineers, they will develop new vehicle and fuel technologies. As citizens, they will make decisions balancing mobility, environmental and economic needs.

V. ACKNOWLEDGMENT

We successfully completed project of "SOLAR POWERED CAR" under the guidance's of S.Aejaz Ahmed, Lecturer in Automobile Engineering and Dr. Ramakrishna Reddy, Head of the Department Electrical and Electronics Engineering, Government polytechnic College, Ananthapuramu, Andhra Pradesh, India.

VI. REFERENCES

[1]. Automobile engineering Vol.1 & Vol.2 by Kirpal singh he Leading Edge, Tamai, Goro, Robert Bentley, Inc., 1999, p. 137
[2]. Lynch, J., Power from sunlight: photovoltaics
[3]. Study of electronic compnenets by J.A. Smith (2nd edition)
[4]. Practical Photovoltaics by "Richard Komp Ph.D.,"
[5]. Battery science: Make widgets That Work, by Doug Stillinger
[6]. Electronic circit analysis and design by Donald .Neumann, Mc Grawhill ook company, USA Texas instrument, Data book volume B