Design &Fabrication Of Solar Powered Bike

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Abstract: **The main objective of the project is to design &fabrication of a SOLAR BIKE body which includes design of chassis, steering mechanism and the upper body to place the solar panels by using CAD &PRO-E Software's.**

We are going to design the whole body, chassis, steering mechanism, braking system, suspension system, charging system by using the above 2 software's and going to suggest the best suitable one for the manufacturing.

Using this methodology, engineers can define the frame of a new car body respecting the company standards. The principal benefit is the reduction of the design development time as the modification process is optimized. There will be a huge reduction in the weight of the body comparing to other which will lead to decrease in production cost as well as increase in its efficiency.

I. INTRODUCTION

Energy is one of the most vital needs for human survival on earth. We are dependent on one form of energy or the Other for fulfilling our needs. One such form of energy is the energy from FOSSIL FUELS. We use energy from these sources for generating electricity, running automobiles etc. But the main disadvantages of these FOSSIL FUELS are that they are not environmental friendly and they are exhaustible. To deal with these problems of FOSSIL FUELS, we need to look at the NON-CONVENTIONAL SOURCES of energy. With regard to this idea we have designed an Electrical vehicle that runs on solar energy. The vehicle designed is a two wheel drive and can be used for shuttle and short distances. As these vehicles form the future of the automotive industry, we need to concentrate on improving their design and making them cost effective. This vehicle is an initiative in this direction.

The above diagram gives an overview of the working of solar vehicle. Sun is the main source of energy for the vehicle. Energy from Sun is captured by the solar panels and is converted to electrical energy. The electrical energy thus formed is being fed to the batteries that get charged and is used to run 24 V DC high torques DC series motor. The shaft of the motor is connected to the rear wheel of the vehicle through chain sprocket. The batteries are initially fully charged and thereafter they are charged by panels. This helps in completing the charging-discharging cycle of the batteries, which is very important for proper working of batteries.

DESCRIPTION OF PROJECT

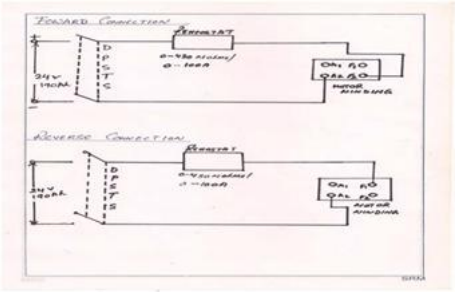
The renewable energy is vital for today's world as in near future the non renewable sources that we are using are going to get exhausted. The solar vehicle is a step in saving these non renewable sources of energy. The basic principle of solar bike is to use energy that is stored in a battery during and after charging it from a solar panel. The charged batteries are used to drive the motor which serves here as an engine and moves the vehicle in reverse or forward direction. The electrical tapping rheostat is provided so as to control the motor speed. This avoids excess flow of current when the vehicle is supposed to be stopped suddenly as it is in normal bike with regards to fuel. This idea, in future, may help protect our fuels from getting extinguished.

All recent electric vehicles present drive on AC power supplied motor. The setup requires an inverter set connected to battery through which DC power is converted to AC power. During this conversion many losses take place and hence the net output is very less and lasts for shorter duration of time. Although this is cheaper the setup and maintenance required is much more in AC drive than DC drive. The vehicle designed is controlled by ELECTRICAL means and not by ELECTRONIC means

BASIC CIRCUIT DIAGRAM

The fig 2 shown below represents the connections of the motor for forward and backward motion. The connections are made from battery to motor via switch, controller unit and the solar panel. As stated before, the motor used in this vehicle is24 V dc series motor. There are four terminals on motor, namely A1, A2, F1, F2, as A1, A2 are the armature terminals and they are internally shorted. All the connections are made keeping the DPDT switch at the centre. The either connections on DPDT switch are made for forward direction motion of motor and the next side of DPDT switch is made for reverse direction of motor. The motor will work as the switch is kept in either of the directions as per requirements. The A2 is directly taken from battery to the positive side of DPDT switch and F2 is taken via controller unit to the negative terminal of

switch. For the DPDT the centre terminals are given the upper side as positive from battery and the lower as the negative from battery. The controller unit used here is a high resistance setup box which can with stand up to the current of 60amps. Now the A1, A2 are he internally shorted terminals of the motor. Thus either of the one is the main and another one is the dummy. In case of our motor the A1 terminal is dummy and A2 is the main terminal. Thus all connections are made keeping A2 as the main terminal. In the switch the A2 and F1 are the terminals that are responsible for the reverse motion of motor. All the connections are directly to switch, A2 is given to positive and given to the negative of switch.



COMPONENTS USED

Various types of electrical components were used for making the solar powered vehicle. A list of these components used with their range and the specific quantities that were required for making the solar vehicle is given in the following table. Apart from the above listed components the main component that is responsible for speed control of the motor is the speed control switch. It is defined as follows:-

SPEED CONTROL SWITCH

The speed control of the DC motor is the essential part of the vehicle. For controlling speed of the motor, a switch was designed with 8 tapping, giving different values of resistance at each tapping, hence limiting the current that flows in the motor. The switch uses pure Nichrome wire for resistances. It uses a 8 tapping DC switch. The front view of the switch is as

The switch has been provided with two terminals; one for the motor connections and the other for the battery connections. The arrangement of the switch is more or less like a rheostat. The different tapping act as resistance points. With each increase in the tapping value the value of resistance decrease, thus at the last tapping the motor will run at the highest speed as the limiting resistance will be minimum whereas the high torque condition of the motor will arise when the minimum tapping will be used, since the limiting resistance will be maximum. The picture showing the view of the tapings is shown below in fig. It can be easily concluded that two coils are connected in a series to give one taping hence increasing the resistance.

The value of resistance at each taping is given in the table below. This resistance value is used for controlling the 1 hp motor.

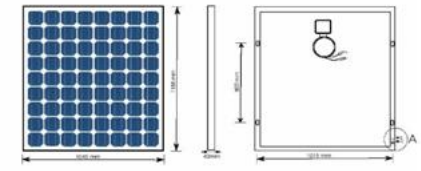
SOLAR PANEL DETAILS

Solar bikes have been developed in the last twenty years and are powered by energy from the sun. Although they are not a practical or economic form of transportation at present, in the future they may play a part in reducing our reliance on burning fossil fuels such as petrol and diesel.

A solar powered bike is shown above. These are expensive to produce and usually seat only one or two people. The main cost is due to the large number of expensive and delicate photovoltaic solar panels that are needed to power the vehicle. Also, many of the solar powered bikes used in races today are composed of expensive, lightweight materials such as titanium composites. These materials are normally used to manufacture fighter jets. Carbon fiber and fiber glass are also used for much of the bodywork. Most of the bikes used in races are hand made by specialist teams and to theexpense

One of the more realistic ways in which that solar powered bikes could become practical is to charge up their batteries when they are parked, during the day. Imagine driving the short distance to work and plugging the bike into a set of photovoltaic solar panels. Whilst you are working the batteries charge up ready for use for the journey home. The same procedure could be carried out when the bike is parked at home. A combination of solar power and wind power may prove to be a method of charging the batteries of ‘electric cars’.

SOLAR MODULE- 140 Wp



II. WORKING OF THE VEHICLE

The solar module mounted on the tank of bike is used to charge the batteries via charge controller. A 140 WP solar module is used with output ranging from 24V to 25V at STC. The batteries are initially fully charged and then they are connected to solar module for charging. This helps to keep the battery charged always. This is also done as the efficiency of solar module is only 15%.Thus under this condition the battery gets fully charged again within 3hrs-3.5hrs. Thus to keep the full sine wave of charging this time lap is made. The maximum solar radiations are obtained between morning10am to evening 3:30pm. Hence the panel is so mounted that maximum output may be obtained. As the supply is given through DPDT switch the motor takes a high starting current to propel the wheel to move in forward direction. On start the load on motor is nearly 250kg including the weight of person driving it. The motor after start acquires the maximum speed of 20kmph to 30kmph. The batteries get charged always from the solar panel and so it provides the continuous run for the vehicle. Motor must be started on top most gear so as to get maximum torque and speed to lift the full load. The speed may be varied later according to the driver's requirements. As the speed varies the load current also varies. So the speed variation must be low to keep battery alive for maximum duration of time. For stopping the motor, the speed control switch should be brought to minimum gear and then switch should be open; thereafter the mechanical brakes should be applied. The mechanical brakes can be applied instantly during emergency but this should be avoided as this could damage the motor and also produce unnecessary back emf. The average battery back-up is around four hours. The batteries are continuously charged by the solar panel but to increase their rate of charging three dynamos each of 24 V can be connected to the wheels of the vehicle. As the vehicle moves these dynamos will generate EMF and will charge the batteries. Hence the chagrining and discharging cycle of the batteries will be complete.

III. FABRICATION AND ASSEMBLY

CHASSIS

We will see how easily I converted a normal bike so it would move both as a regular bicycle, and motor assisted too!

My goal from the beginning was not to remove the characteristics of a normal bicycle:

The cyclist must pedal, otherwise ...go to buy a motorcycle! The electric bicycle will be able to assist the cyclist making longer journeys.

The second objective was to make the electric bike light and beautiful. I think I got this too!

The conversion to electric was very easy: I bought a ready conversion kit which includes everything you need:

1. The front wheel which in the centre has a 250W built-in motor that drives the wheel with electricity.
2. The controller which controls the speed of the motor etc. I placed him in a small bag under the seat.
3. The handles on the steering wheel (the right one functions like the "accelerator" in motorbikes to regulate the speed).
4. The brake handles that replaces the ones that are already on the bike: When you push the brake, the motor stops.

As shown in the photographs, to the conversion is easy:

1. Unscrew the front wheel and replace it with the new wheel that has the built-in motor.
2. Unscrew the brake handles and replace with the new ones.
3. Find a convenient spot to place the small size controller.
4. We connect all the cables (the motor, the brakes and the throttle) to the controller according to their colour. Finally, we connect the two wires of the controller, positive and negative (red and black, respectively), over their respective poles of the batteries which I placed in a small box behind the bicycle rack.

The batteries are 3 X 13AH sealed lead acid, 12V. They can be recharged with the charger from an electrical socket as well as with solar energy from solar panels.

They can ensure autonomy for approximately 40 kilometres in normal ways with a few inclines and with the cyclist to help a bit with the pedal, especially in the start I could use smaller and lighter batteries (e.g. 7AH) with half the size and weight.

WORKING

(a) WORKING OF BIKE

The feeling is amazing! While continuing to cycle, you are not getting tired, there is no sweat and you feel clean and refreshed no matter how many Km you have cycled.

It is not a motobike, it remains a bicycle. Just where you used to cycle 5 km before now you do 15 without problem, so you are working out more. It's like you have an invisible professional racing cyclist who is pedalling with you! In the hills especially this is very important.

Moreover, you feel more active. It accelerates much faster after stops; it develops higher speeds on the road (up to 32 kilometres per hour with light pedal) so you can adjust to the requirements of traffic. Everybody is looking at you amazed!

Finally, you have a tool if necessary, to move somewhere where there is no other way (e.g. inaccessible roads, lack of fuel, etc.).

The technical characteristics and the cost to convert to an electric bicycle

The motor is 36V - 250W and needs no maintenance (it has permanent magnets). The 250W is the average power that a professional cyclist produces during a race.

The batteries are 3X12V connected in series in order to give the 36V that the motor needs. The capacity should be at least 7AH so we could have autonomy of about 15-20 km a day.

I put 13AH, but they have more weight and volume. If you put 7AH, the bike's extra weight is about 12 Kg, so you do not feel it as you move. If it was the most expensive NIMH batteries, the weight would be around just 5 Kg. Under normal use they would last probably around 2 years.

The final cost, when I made it (2008), was around 350 Euros for the conversion kit. The batteries cost about 15 Euros (7 AH) to 30 Euros (13AH) each.

Charging with solar energy

I have connected 3 small solar panels of 20 Watt/p in series and I am allowing it to charge every morning.

I can also remove the box with the batteries and take it with me to charge, in the house from a plug.

To fully recharge the batteries of 7AH, 2.5 -3 hours are sufficient with a charger or in the morning (5-6 hours) in the sun. This will happen only if they were completely empty. If our ride was for example only 7-8 kilometres, then it is going to take half the time to fully recharge again.

(b) DC Motors - Advantages and Hazards of running DC Motors

DC Motor converts electric energy into mechanical energy. A DC Motor uses direct current - in other words, the direction of current flows in one direction.

A DC Motor usually consists of: An armature core, an air gap, poles, and a yoke which form the magnetic circuit; an armature winding, a field winding, brushes and a commutator which form the electric circuit; and a frame, end bells, bearings, brush supports and a shaft which provide the mechanical support.

Advantages of DC Motors.

Speed variation is accomplished by changing either the armature voltage or field voltage, or a combination of both. For example, a motor with a

base speed of 1750 RPM and armature voltage of 500 VDC will run at 875 RPM with a 50% reduction in armature voltage (to 250 VDC).

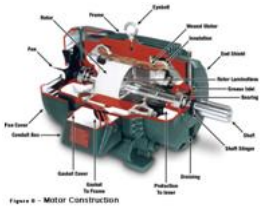
ARMATURE VOLTAGE CONTROL - For this type of speed control the armature voltage is varied while maintaining constant shunt field excitation. Output torque of a DC motor is proportional to the product of the main pole flux, armature current, and a machine constant that is a function of armature windings. Therefore, with armature voltage speed control and constant shunt field excitation, the torque is dependent upon the armature current only. In other words, at rated armature current the torque is constant.
A DC motor, operated with armature voltage control and fixed field excitation, will develop rated torque at rated armature current independent of the speed.

SHUNT FIELD CONTROL - With speed control by field weakening, the voltage applied to the shunt field is adjusted by a variable resistance rheostat in series with the shunt field

Types of DC Motors.

There are four kinds of DC motors commonly used in industrial applications: shunt, series, compound wound or stabilized shunt, and permanent magnet. When selecting a DC motor for a given application, two factors must be taken into consideration: 1) The allowed variation in speed for a given change in load. 2) The allowed variation in torque for a given change in load.

PERMANENT MAGNET MOTORS - Permanent magnet motors are generally used where response time is a factor. Their speed characteristic is similar to the shunt wound motor. They are built with a conventional type of armature, but have permanent magnets in the field section rather than windings. Permanent magnet motors are considered less expensive to operate, as they require no field supply.

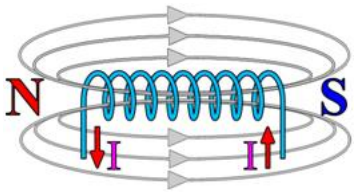


Hazardous Conditions for DC Motors.

The exposed un-insulated components of DC motors (commutator, brush rigging, bolted connections) are vulnerable to early electrical failure when enclosure is inadequate, regardless of insulation system. A great many contaminants, wet or dry, are excellent conductors such as carbon, metal dust, and acid salts. Anything wet similarly conducts current quite well even at low voltages across distances of several inches. Normal oily vapors present in most atmospheres gradually deposit on all surfaces.

(c) The Ampere's rule (the right-hand screw rule)

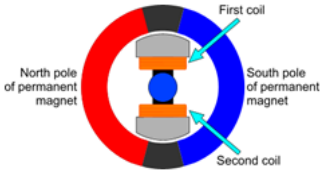
It is Frenchman Andre-Marie Ampere (1775–1836), a mathematician and physicist, who discovered what happens to a wire winded in a coil when current flows within. The current will generate a magnetic field around the coil, as shown in the following drawing:



as the orientation of the North pole. This is called "the right-hand screw rule".

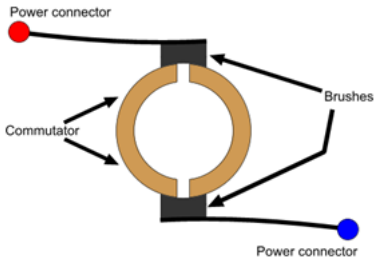
The basic DC motor has actually two windings and two permanent magnets. The coils are powered from the commutator and the brushes. We will see these two later on. For now, you only need to know that during a full cycle of the rotor, the current that

runs through each winding change direction once. Thus, each electromagnet will change its magnetic polarity. Moreover, the windings of the two magnets are winded in reversed direction. Thus, when one electromagnet is North, the other is South and vice versa. Look at the following drawing of the basic DC motor:



The following animation indicates how the two electromagnets changes magnetic polarity during a full rotation:

This kind of DC motor is called "Brushed DC motor". Why? Because it uses brushes... The brushes are the way that the motor provides the coils with power, and the geometrical characteristics and position of the brushes (and the commutator of course) will be responsible for changing the magnetic field of the two electromagnets according to the position of the rotor. So, how this is done?



The commutator is fixed on the shaft of the motor. Each semi-ring has one pole of each coil. Giving thus power to both half-rings, is like giving power to the coils. But while the shaft of the motor rotates, the commutator rotates as well. This causes the poles of the power supply provided to the coils to change. The following two animations indicates this procedure. The left one shows the brushes and the commutator from above, while the right one shows how the electric and magnetic polarity is changed.

(d) Batteries

Batteries (electrochemical cells) produce electricity by spontaneous chemical reactions. If you understand how batteries work, you understand a key part of chemistry and biochemistry. That is because batteries work by oxidation/reduction (redox) reactions, involving the transfer of electrons. All biochemical energy reactions, such as photosynthesis, chemosynthesis, respiration, phosphorilation, etc., depend on redox chemistry.

Electrons moving along a conductor is what we call electricity, or electric current. It can be used to generate magnetic fields (as in a motor) or heat things up (as in a light bulb), to drive other chemical reactions (e.g. electrolysis or electroplating), or for many other purposes. (What are electrons, anyway?)

The lead-acid battery was invented in 1859 by Gaston Plante, and the dry cell between 1867 and 1877 by George Leclanché, both of France. The alkaline cell was invented in 1914 by Thomas Edison. Dozens of other types of batteries have been developed since then. They all work by oxidation/reduction chemistry. Here are some pictures of cells of yesteryear.

An electrochemical cell has three main parts: two electrodes and an electrolyte. The electrodes are the dissimilar metals mentioned above. There is an electrolyte that allows ions to move between them. Outside the cell they can be connected by a circuit through which electrons will flow.

A lemon can be used to make a simple cell. The cell has a zinc strip, a copper strip, and the acidic juice of the lemon as the electrolyte. It generates about one volt, but only a very small amount of current. (The voltage of a battery is determined by the materials used as electrodes and electrolyte.)

"Oxidation" and "reduction" reactions make a battery work. Oxidation/reduction reactions are electron-transfer reactions. For a battery to work, both an oxidation and a reduction must happen. One generates electrons at one electrode, and the other uses them up at the other electrode. Each of these is called a "half reaction". If the electrodes are connected outside the cell by a circuit, electrons flow and the full reaction is completed. Oxidation is when electrons are transferred from a substance to oxygen or some other compound. Oxidation doesn't have to involve oxygen, and can be thought of as "de-electronation."

Since electrons are negatively charged particles you can see how this might be related to electricity.

Remember that electrons moving along a conductor is electric current. The electrode where oxidation (loss of electrons) takes place is called the anode. On a commercial battery it is marked as the "-" side.

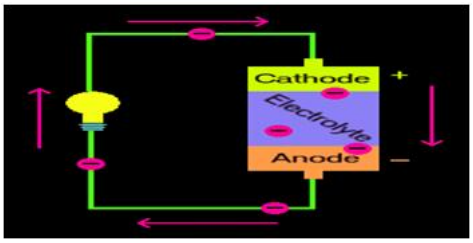
Reduction is when a chemical reactant accepts electrons. It ends up with more electrons than it started with. Reduction could be called "electronation."

Summary of Battery Terms

Anode	Cathode
Oxidation	Reduction
De-electronation	Electonation
Gives up electrons	Accepts additional electrons
- (minus) side	+ (plus) side

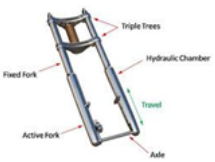
The substance that loses electrons is the "reducing agent" or "reductant", while the substance that gains electrons is the "oxidizing agent" or "oxidant". Anions are negative ions moving toward the anode. Cations are positive ions that move toward the cathode.

Summary Illustration



(e) SUSPENSION SYSTEM

Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two.[1]Suspension systems serve a dual purpose — contributing to the vehicle's roadholding/handling and braking for good active safety and driving pleasure, and keeping vehicle occupants comfortable and a ride quality reasonably well isolated from road noise, bumps, and vibrations,etc luggage from damage and wear. The design of front and rear suspension of a car may be different.



Front Suspension

The most common form of front suspension for a modern motorcycle is the telescopic fork. Other fork designs are girder forks, suspended on sprung parallel links (not common since the 1940s) and bottom leading link designs, not common since the 1960s.

Some manufacturers (e.g. Greeves) used a version of the swinging arm for front suspension on their motocross designs. A single-sided version of the idea is also used in motor scooters such as the Vespa.

The Hub-center steering as developed by Ascanio Rodorigo, on a concept associated to Massimo Tamburini is a complex front swingarm alternative system that entails suspension and steering, as seen in projects such as Bimota Tesi and Vyrus motorcycles.

Rear suspension

Early rear suspensions

While front suspensions were almost universally adopted before World War I, several manufacturers did not use rear suspension on their bikes until after World War II. However, motorcycles with rear suspension were offered to the public before World War I. Notable among these are the 1913 Indian Single with a swingarm suspended from a leaf springand the 1913 Pope with wheels supported on a pair of plungers which were each suspended by a coil spring.

Plunger suspension

Several motorcycles before and immediately after World War II used **plunger suspension** in which the vertical movement of the rear axle was controlled by plungers suspended by springs

(f) Damping Adjustment

Some telescopic forks have external adjustments for damping. The adjuster controls a bleed valve to bypass the cartridge. When closed, all oil must travel through the cartridge, when opened it allows some of the oil to bypass the cartridge, reducing damping.

Fork oil

Since forks act as hydraulic dampers, changing the weight of the fork oil will alter the damping rate.

Cartridge forks

Cartridge forks use internal cartridges with a valving system. The valve will have a number of shims of varying thicknesses that cover the orifices in the valve to control the damping of the fork on high and low speed bumps.

Some of the leaf springs lift with little force allow fluid to flow through the orifice. Other springs require greater force to lift and allow flow. This gives the fork *digressive* damping, allowing it to be stiff over small bumps, but get relatively softer over larger bumps.

Gas-charged cartridge forks

In 2007 the gas-charged bolt-in cartridge set for modern sportbike forks became available. This kit is legal for supersport styled classes of racing, which regulations do not allow a complete fork replacement, and force competitors to use the stock fork casings.

Twin shock absorbers

Twinshock refers to motorcycles that have two shock absorbers. Generally, this term is used to denote a particular era of motorcycles, and is most frequently used when describing off-road motorcycles.

During the late 1970s and 1980s, motorcycle rear suspension design and performance underwent tremendous advances. The primary goal and result of these advances were increased rear wheel travel, as measured in the how far the rear wheel could move up and down. With the exception of Bentley and Draper system (New Imperial and Brough machines) and the HRD (later Vincent) system both developed and patented in the 1920s it is only since the 1980s that monoshock motorcycles have been the norm, the term "twinshock" is now used to categorize vintage motorcycles.

Mono-shock

On a motorcycle with a mono-shock rear suspension, a single shock absorber connects the rear swingarm to the motorcycle's frame. Typically this lone shock absorber is in front of the rear wheel, and uses a linkageto connect to the swing arm. Such linkages are frequently designed to give a rising rate of damping for the rear.[12] Mono-shocks are said to eliminate torque to the swingarm and provide more consistent handling and braking[*citation needed*]. Honda refers to its mono-shock designs as *Pro-link* suspensions,

IV. RESULT

As we have designed the solar powered bike to get a better output result out of solar power. The efficiency was high and we have got an god result out of it. Solar panes were giving the best charge power to charge the batteries very fastely by using triple changing. The bike was driven with a top speed of 50 kmph. Hence we have successfully give our best to get a better result of solar power bike.

DISCUSSION

The solar vehicles are the future of the automobile industry. They are highly feasible and can be manufactured with ease. The main advantages of a solar vehicle are that they are pollution less and are very economical. Since they cause no pollution they are very eco-friendly and are the only an sewer to the increasing pollution levels from automobiles in the present scenario. By harvesting the renewable sources of energy like the solar energy we are helping in preserving the non-renewable sources of energy. The other main advantages f the solar vehicle are that they require less maintenance as compared to the conventional automotives and are very user-friendly.

V. CONCLUSION

The solar vehicle solves many problems related to the environment and is the best pollution free method. We need to make use of them so that we can reduce our dependence on fossil fuels. Solar vehicles do have some disadvantages like small speed range, initial cost is high. Also, the rate of conversion of energy is not satisfactory (only 17%). But These disadvantages can be easily overcome by conducting further research in this area; like the

problem of solar cells can be solved by using the ultra efficient solar cells that give a bout 30-35% efficiency. As this field of automobiles will be explored the problems will get solved. The solar automobiles have a huge prospective market and we should start using them in our day to day life. We have already completed making a solar vehicle prototype as our project and the vehicle is running successfully on solar power

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