
SHAURIDUT- The solar car of BITS Vizag

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Abstract

In urban communities of India one of the real medium of transportation is auto rickshaws, which is delivering a colossal measure of air contamination and also nursery gasses like CO₂. Fuel, which is utilized is a non-inexhaustible source and furthermore which costs, one of the front runners within the vicinity of renewable energy resources nowadays is sun strength, a solid source like sun oriented vitality which is accessible in bounty in a nation like India. Received SOLAR ENERGY as the extra sources notwithstanding the regular IC Motors. Utilizing the Photovoltaic panels, controllers, and brushless DC motor setup to change over the light, as an electric vitality which is sustained to the DC engine to acquire mechanical movement. The mechanical movement was exchanged to the wheels through the propeller shaft which prompts cheap and powerful transmission.

The paper represents how the charge produced by a variety of sun-powered boards are gotten and its stream all through a battery pack is to be controlled utilizing a microcontroller based charge controller to guarantee effective putting away of charge in a battery pack. The putaway vitality would be unveiled to a DC engine which would run the auto. The design of an engine controller to control the auto's speed and forward/turn around bearing of movement appears. The mechanical development from scratch of the chassis along with all crucial mechanical frameworks of Shauridut solar car is illustrated.

Keywords:

Solar car, Solar Energy, Photovoltaic panels, Brushless DC motor, CONTROLLER, Batteries,

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1. Introduction

The quests for a steady, safe, easy, environmentally-pleasant gasoline is never-ending. Carbon-based fuels, consisting of fossil fuels are unsustainable and risky to our surroundings. Not anything in the world is free of cost, but what if we could discover a way to put in force unfastened rides? Certainly it'd be remarkable if our motors may want to maintain to run without us having to spend billions on fossil fuels every 12 months and to address natural risks that their combustion goes away in the back of. If we may want to power a solar-powered automobile, that car dream might come true. Sun automobiles would harness electricity from the sun through sun panels. Photovoltaic manufacturing turns into double every two years, increasing by means of a mean of forty eight percentage each year in view that 2002. Due to its innumerable advantages in environmental, financial and social elements PV structures have turned into the sector's fastest developing strength era.

1.1 Pollution

The earth is struggling as a result of the destruction wreaked upon it by means of humanity. whether it is the pesticides debasing the streams, chemicals from factories polluting the seas or the exhaust fumes from automobiles and industries polluting the air, the systematic destruction of our special ecosystems everywhere in the world has led to a dreadful mess. Our major focus is on the transportation enterprise which is the second one biggest source of pollutants and fitness dangers. Thus a huge number of individuals are getting to be casualties of heart and lung issues, sadness, memory misfortune, asthma and even unexpected losses. The CO₂ of the world is ascending at an amazingly disturbing rate. As appeared in Figures 1.1.1 and 1.1.2

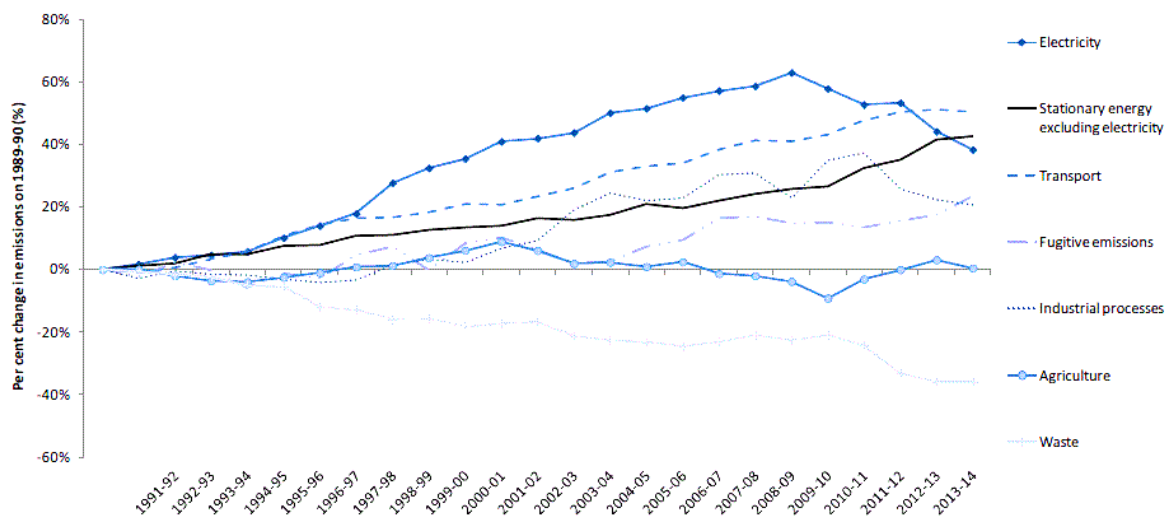


Figure 1.1.1.CO₂ Emission by Various Sectors

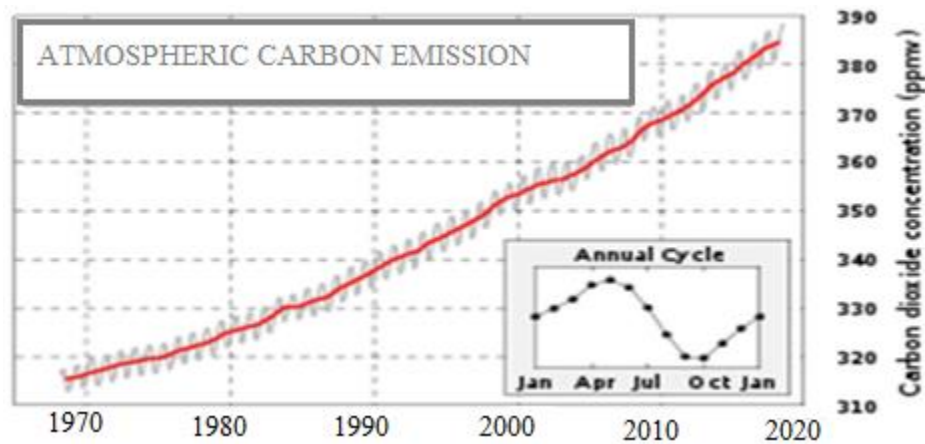


Figure 1.1.2 CO₂ Emission over periodic era

1.2 Fuel Prices

Fuel-based autos aren't just undermining the very air we take in yet, in addition, the cost of running and keeping up them are tremendous and oppressive, and as the petroleum products are progressively being drained, the cost of these restricted terrify assets, the current powers' costs are consistently rising. Unmistakably, people need to wind up noticeably more mindful of the outcomes of their activities and can help secure the earth by utilizing an optional technique for transport, maybe the sunlight based auto, an eco-accommodating, spotless, modest, reduced auto, autonomous of non-renewable energy sources and lethal outflows. This electric vehicle may be a noteworthy advance in diminishing activity blockage, commotion and vehicle emanations out and about.



Figure 1.2.1 Gradual increment in price of petroleum product

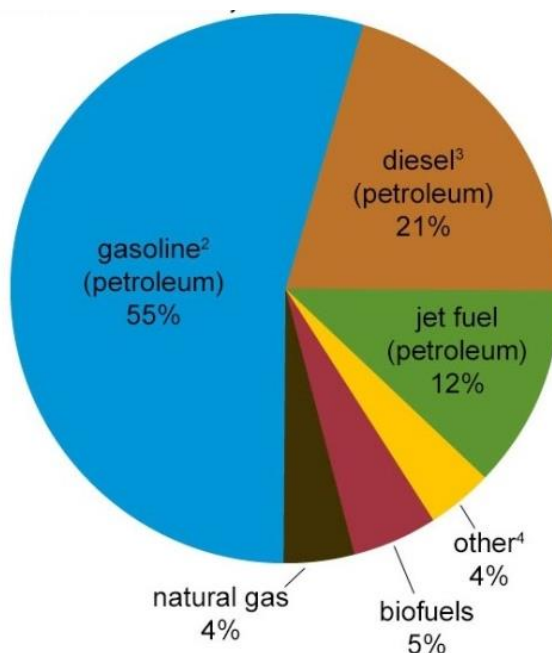


Figure 1.2.2 Consumption of various non renewable sources

The energy and transportation sectors combined emit 60% of overall emissions, We're already seeing development in the transportation: the Environmental safety employer (EPA) and the countryside

motorway visitors protection management (NHTSA) issued GHG emission and gas economy inexperienced powered Eco friendly requirements for cars and mild-obligation vans in 2012 to be able to reduce emissions from 2025 motors in 1/2 compared to present day automobiles. EPA sets country-particular objectives of lowering carbon pollution, and states could have a ten to 15 year window after the clean power Plan is final to plan for and reap these reductions. It's as much as states which techniques will work the best of their kingdom or place. The "building blocks" or alternatives for reaching the target encompass:

1. Make fossil fuel power plants more efficient (increase efficiency at the plant)
2. Use low-emitting power sources more (dispatch cleaner resources more frequently)
3. Use more zero- and low-emitting power sources (expand renewable capacity)
4. Use electricity more efficiently (increase efficiency in our homes and businesses)

Benefits of the Clean Power Plan:

- cut carbon pollution from the power sector by 30 percent from 2005 levels (equivalent to powering over 1/2 the homes or 2/3 of cars and light trucks.)
- cut pollution that leads to soot and smog by over 25 percent in 2030
- prevent:
 - 2,700 to 6,600 premature deaths
 - 140,000 to 150,000 asthma attacks in children
 - 470,000 to 490,000 missed school and work days
- reduce average electricity bills by 8% by 2030

1.3 Main components of hybrid solar car

1. PV panel convert sunlight into electricity, which is stored in batteries. Then its energy will be utilized for hybrid car propulsion.
2. Electric motor has, generally, been employed for driving the hybrid solar car (HSC). However, we can observe that the brushless DC motor (BLDC) is often operated in the (HSC) over the classical DC motor due to long lifetime operation, high speed and also high torque.
3. Electric Generator is self-energy generated in a car during a regeneration brake or stop on a road.
4. Battery bank is an important component for the HSC. It has been generated 24V DC for supplying to the electric motor and also electronic devices in the HSC.
5. Electronic controlling unit (ECU) is an electronics circuit that is used for controlling the energy in the electric motor which can be provides a speed variation.

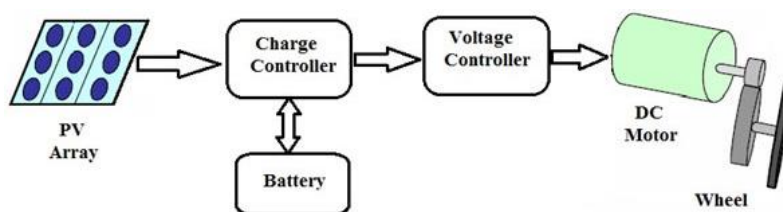


Figure 1.3.1 Fig Block diagram of a solar vehicle

Fabrication Overview

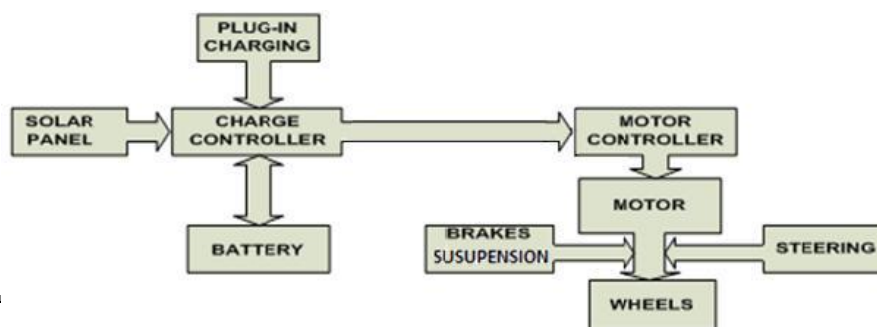


Figure 1.3.2 System architecture of the solar car

1.4 Solar Panel

Sun oriented autos are controlled by the sun's vitality, therefore, sun powered boards are the most vital piece of a sun-based auto since they are exclusively in charge of gathering the sun's vitality. The sun based boards utilized as a part of this undertaking is monocrystalline and adaptable. They can be mounted and fitted over the auto or on the cap easily attributable to their thin semi-adaptable nature

How Solar Panels Work

The sun offers of radiated strength inside the shape of mild photons that's converted into electrical power by means of the sun panels. Solar panels are composed of silicon primarily based semiconductors and when the radiation comes in contact with the silicon atoms, the photons are absorbed and the electrons are separated from the relaxation of the atoms. Those loose electrons are chargeable for sporting and growing an electrical contemporary. The electricity generated is most usually saved in batteries to be used later.

Sorts of solar Panels

Sun panels nowadays have turn out to be more efficient than they were earlier than and are persevering with to be increasingly efficient daily. There are actually unique kinds of solar panels available, specifically, monocrystalline silicon, polycrystalline silicon, and Amorphous Silicon 'skinny film' modules.



Figure1.4.1 (a) Monocrystalline Figure1.4.1 (b) Polycrystalline Figure1.4.1(c) Amorphous Thin Film

Types of Solar Panels

Monocrystalline Silicon

Monocrystalline silicon sun panels have rectangular-fashioned cells and are one of the most green kinds of solar panels. These devices have the most silicon content out of all the unique panel types, which makes them extra pricey to make but conversely takes up quite much less relative space. those solar panels are generally utilized in excessive reliability applications like telecommunications.

Polycrystalline Silicon

Polycrystalline silicon sun panels use less silicon, which makes them rather less green. However, the specific layout, which features strips of silicon wrapped around rectangular conduit wires, lights in them to characteristic more efficiently. Positive circumstantial use of polycrystalline silicon solar panels including when used on rooftops can yield performance as close to as the ones of monocrystalline silicon solar panels

Thin Film Amorphous Modules

Thin film sun panels are one of the cheapest varieties of panels, but also are the least green. The efficiency of amorphous modules to convert sunlight to power is 1/2 of polycrystalline or mono crystalline panels. These are not appropriate for dependable domestic or commercial use. But when the focus is on quantity as opposed to exceptional i.e. where big numbers of sun panels are required to supply a big amount of strength (e.g. in massive array solar farms), because of their cheap mass production value they grow to be essential.

Given that solar automobiles have tons much less power to work with to drive the car as compared to mention energy supplied through inner combustion engines, it is important that this small electricity is as effectively applied as possible. Also the lesser the distance the solar panels take in over the frame of the automobile the better it's miles. Consequently judging from the characteristics of the three

Styles of solar panels as described above it become maximum prudent to go along with the mono crystalline type of sun panels. Thinking about sun panel cost, durability, toughness, guarantee, size and wattage, Very important to notice that every of the panels were semi bendy which allowed the roof of the car (wherein the panels are to be located) to have a extra curved and aerodynamic form as a substitute being flat.

1.5 Batteries

The suns based boards will gather vitality from the sun and change over it into usable electrical vitality, which thus will be put away ahead of the pack corrosive batteries to be provided to the engine when important. The battery to be used is a 12 V unsealed lead-acid re-chargeable battery. Lead-acid batteries, invented in 1859 by French physicist Gaston Planté, are the oldest type of rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, their ability to supply high surge currents means that the cells maintain a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile motors. Due to the internal electro-chemical mechanism of a lead-acid battery, charging is carried out in 3 distinct stages rather than through a continuous fixed voltage/current supply to the battery. Each of these stages is varied in the amount of voltage/current that needs to be supplied to the battery. The charge controller will detect voltage from the battery prior to charging. However, the actual SOC vs. voltage characteristics of a lead-acid battery is unique like a signature. So, the actual charge/discharge characteristic graph pertaining to the lead-acid battery to be used in this project had to be obtained by testing the batteries for at least one charge/discharge cycle. The battery test was carried out by first charged by connecting it in series with a controllable DC power supply and an ammeter, with a voltmeter across to measure the voltage. While charging data of current and voltages were recorded. For the discharging part, the battery was connected in series with a rheostat and ammeter with a voltmeter across to measure the voltage. Again, data of current and voltages were recorded. The arrangements are shown



Figure 1.5.1 Setup of the battery for charging

1.6 Charge Controller

The batteries are associated with a charge controller, which will guarantee the sound existence of the batteries by keeping it from overcharging and over releasing. A microcontroller inside the charge controller is customized to recognize the voltages at the battery terminal as well as the sun-powered board terminals and appropriately figure out what charging current the battery should be provided.

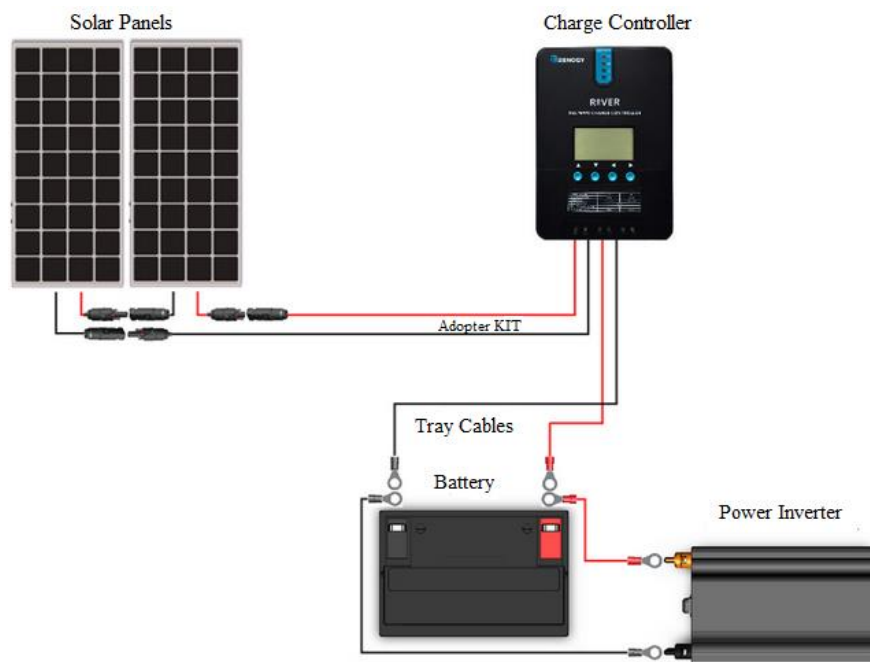


Figure 1.6.1 Circuit diagram of solar charger controller connection

Charge controller

The objective of the charge controller is to act as a battery management system (BMS) where it regulates the charging and discharging of the battery. The task is carried out using a microcontroller chip. Whenever the battery is going to be charged above 100% nation of charge it is said to be overcharged. Each time the battery is discharged beneath 20% it's far stated to be over-discharged. To prolong battery life. The purpose of the rate controller circuit is to cut off the supply from the solar panel while the battery is completely charged to keep away from over charging.

VOLTAGE INPUT TO MICROCONTROLLER: The microcontroller is expected to take decisions based on the terminal voltage of the battery and the solar panel/AC line. As a result, it needs a mechanism to sense the voltage at the battery terminals precisely. After sensing the voltage the internal Analog to Digital converter (ADC) module of the microcontroller then digitizes the analog terminal voltage at its input ports by dividing it into a proportion to increase the resolution of the voltage sensed

Module charging

A basic factor here is that the charge controller will be accessible with an extra info that can be utilized to charge the batteries from an AC control supply (just by connecting to). Accordingly the sun oriented automobile will have this module charging framework for utilizing when there isn't sufficient daylight because of mist, cloud or rain. This arrangement for an outside module framework to charge the batteries from the regular AC control supply will enable the auto to build its general utility.

Steering, Suspension, Brakes, Wheels

These four segments make up the mechanical piece of the solar-powered automobile. Front wheel steering is utilized as it has a tendency to be more steady and safe. The suspension utilized is sufficiently modern to permit the client a steady ride and to shield the auto and boards from sudden stuns and blows. A drum breaking mechanism as in customary autos is utilized to give the security highlights of the auto while voyaging. The wheel choice is reliant upon the moving protection which would decide how far the sun based auto can go with the accessible vitality. Since thicker wheels have a tendency to have higher moving protection, more slender however solid wheels are selected.

1.7 Brushless DC motor (BLDC)

In an ordinary DC motor, there are permanent magnets on the outside and a spinning armature on the inside. The permanent magnets are stationary, so they're called the stator. The armature rotates, known as the rotor. The armature includes an electromagnet. When you run electricity into this electromagnet, it creates a magnetic area inside the armature that attracts and repels the magnets in the stator. So the armature spins through 180 degrees. To maintain it spinning, you have to alternate the poles of the electromagnet. The brushes deal with this change in polarity. They make contact with two spinning electrodes connected to the armature and flip the magnetic polarity of the electromagnet as it spins. In a brushless DC motor (BLDC), you placed the permanent magnets on the rotor and also you flow the electromagnets to the stator. Then you definitely use a computer (connected to excessive-power transistors) to price up the electromagnets because the shaft turns. In other words, it determines the cars speed and forward/reverse direction of motion of the wheels

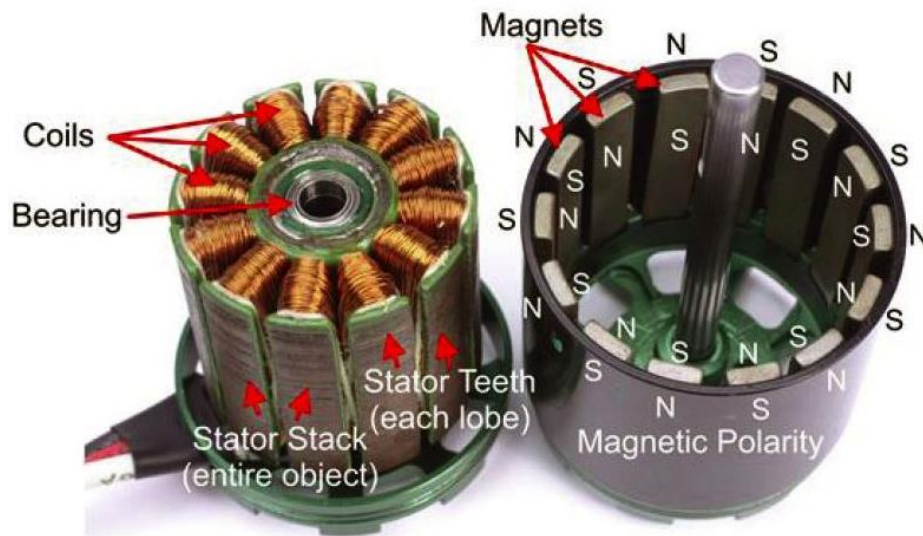


Figure1.7.1 Crosssectional view of BLDC

- Motor efficiency, η_M
- Battery discharging efficiency, η_{BDC}
- Battery charging efficiency, η_{BC}
- Charge controller efficiency, η_{CC}
- Total battery voltage, V_B
- Total Motor Output Energy, E_{MO}**

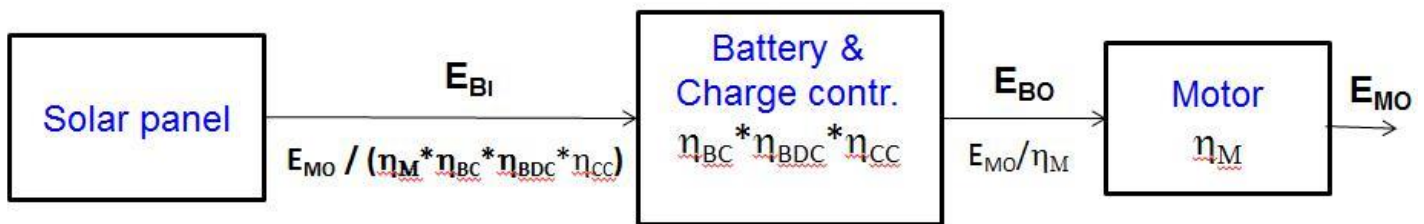


Figure1.7.2 System diagram solar panel, battery and motor.

Assumptions of efficiency battery capacity calculations.

Therefore accounting for all internal losses in the motor, battery and charge controller, it can be estimated that,

Battery output energy required, $E_{BO} = E_{MO} / (\eta_M)$

Battery input energy required, $E_{BI} = E_{MO} / (\eta_M * \eta_{BC} * \eta_{BDC} * \eta_{CC})$

Battery capacity, $C_B = E_{BI} / (DoD * V_B)$

Formulas required to calculate PANEL WATTAGE

1) the total energy required from the output of solar panels $E_{PO} = E_{BT}$

2) The minimum required panel wattage is,

$$P_w = E_{PO} / 6h \quad P_w = E_{PO} / 6h$$

To account for the acceleration of the car the actual value chosen for the panel.

1.8 Working Mechanism:

The erection of solar panel on the roof of the car is responsible for receiving the sun energy and then a series of conversion process takes place to give the power to the motor to run the car. In that conversion process first and foremost is the heat energy of the sun is converted into electrical energy under some phenomenon, later on that electrical energy is being used to charge the batteries.

The electrically charged battery then give the power to motor and hence electrical energy gets converted into mechanical energy.

1.9 Technical specification of the components:

Scrap maruti Omni car has been used to develop this solar car in which a differential of 42" has been mounted along with the rear wheel. A set of three solar panel of 250 watt and 24 volt each have been used. A BLDC (Brush Less Direct Current) motor of 800 watt and 48 volt has been mated with this differential. This BLDC motor consist of 5 hall sensor which is controlled by the controller what we have used. This controller operates at a voltage of 48v and it needs 48 amps. In order to give power to the motor, 4 battery of 12 volt and 35AH each have been connected in series manner.

Apart from differential, motor and controller here one solar charger controller has also been install in order to supply the constant power to the motor. Because of fluctuation in suns intensity during day time there may be a prone chance of damage of the motor, so keeping safety of motor into the consideration, we need to install this solar charger controller which operates at a current of 10 amps. & 48 volt.



Figure 1.9.1 (a) Fabricated Solar Car Figure 1.9.1 (b) Shauridut at BITS Vizagworkshop

1.10 Conclusion

Taking everything into account, the round ride trip can be visualized in the following manner –

- With battery completely charged begin the trip and arrive to the destination. The battery is in the meantime being released by the engine and charge by the sun powered introduction while driving. The battery should now be at max 40% exhausted.
- The car is now left subjected to solar exposure for about 6 hours while the user commits to his/her business. This will bring the batteries back to full charge.

- The return trip is made with batteries still having sufficient charge to overcome the distance.
- It is to be noted that the battery charge will only be depleted when the motor is driving the car. Thus during the time when the car is halted at traffic (unlike an internal combustion engine which will waste fuel) the batteries of the car will actually get charged by the solar exposure thus increasing the cars mileage. This is just the beginning of a new technology and it is guaranteed that future developments will make solar cars the predominant mode of transportation over vehicles with internal combustion engines.

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