Solar Vehicles: An Environment Friendly Art

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***ABSTRACT:** In today's climate, renewable energy is important because non - renewable supplies will be exhausted in the immediate future. The solar vehicle is an effort to reduce the use of non - renewable energy resources. A solar car's basic idea is to utilize the energy stored in a system both before and since it has become powered by a solar panel. The engine, which serves as a generator and elevates the car forward or backward, is driven by the charged batteries. A mechanical tapping direct current is given to track the motor rpm. This prevents an excessive rush of current as the engine is expected to come to a sudden halt, like it is in regular vehicles. This concept will, in the future, aid in the preservation of our fossil fuels. Both current electric vehicles use a motor that is powered by AC electricity. The setup necessitates the use of an inverter system that is attached to the battery and converts DC power to AC power. Many losses occur during this conversion, resulting in a net performance that is very low and lasts for a very short period. Although it is less expensive, AC drives require much more configuration and maintenance than DC drives. The automobile is powered via electrical rather than electronic means. This paper provides an overview for solar vehicles that provides a basic eco-friendly technological approach of development. In future, many more similar approached may be overviewed in order to provide an eco-friendly way of development.*

***KEYWORDS:** Battery, Electric, Energy, Power, Solar Panel.*

INTRODUCTION

One of the most basic requirements for human life on this planet is energy. We are reliant on one kind of energy or another to meet our needs. Fossil fuel energy is an example of this kind of energy. We use energy from these sources to generate electricity, power vehicles, and so on. However, the key drawbacks of these fossil fuels are that they are unfriendly to the atmosphere and that they are finite. Non-conventional energy options must be considered in order to solve the problems of fossil fuels. We developed an electric automobile that runs on solar power in response to this idea. The three-wheeled vehicle is ideal for shuttles and short distance travel. Since these automobiles are the potential of the automobile manufacturing, we must distillate on refining their project and make them more cost effective. This automobile is a positive move forward. A solar car, also referred to as solar autonomous motor, is an electrical vehicle that uses solar energy to fuel it fully or partially. Solar panels' photo voltaic (PV) cells change the sun's power into energy[1]. The word "solar vehicle" typically refers to a vehicle that uses solar energy to fuel all or part of its propulsion. Solar energy can also be used to fuel communications, control systems, and other auxiliary functions. Solar vehicles are currently marketed as experimental vehicles and engineering exercises, mostly subsidized by government departments, rather than as everyday mobility systems. Indirectly solar-charged cars, on the other hand, are popular, and solar boats are commercially viable.

Roadways are an important aspect of transportation networks and they serve as a backbone for people and goods migration. Since roadways have such a large effect on a community's economic growth and prosperity, cutting-edge research has focused on how to prepare, build, and build roadways to minimize environmental effects, increase reliability, and enhance transportation flow quality. Given the increasing need for decreased driver fatigue, non-driver mobility, increased protection, and in-vehicle news and entertainment, further work into the design of novel highways that can accommodate potential vehicles is required (e.g., electric or self-driving carriages). Electric automobiles are seen as a main factor in the long-term growth of this transportation scheme. They are, on comparison, abundant more energy well-organized than cars fueled by vestige fuels. Enhanced usage of electrical vehicles can consequence in lower carbon productions and further air pollution containing nitrogen oxides and particulates (PM), reducing air quality problems and protecting the climate. Increased usage of these automobiles, however, institutional barriers electricity production to custody their battery, so the avoided emissions of carbon dioxide will be moderately offset by increased releases produced by the extra energy production[1].

Furthermore, in order to drive a suitable distance, such upcoming automobiles would need a huge rechargeable battery as just an energy storage unit. Lithium, cells the most usually rummage-sale cell in today's electronic automobiles (EVs), have a power thickness of just ninety to hundred Wh/kg, compared to gasoline (approximately twelve thousand Wh/kg). As a result, lithium ion battery powered EVs will only travel about 300 miles before needing to be recharged. Aside from the poor energy capacity, modern battery systems have the disadvantages of a long accusing time, a huge size and burden, a small lifespan, and a high price. Alternative charging solutions based on clean energy sources and roadways must be built to address these obstacles. EV accusing positions are currently divided into three categories: Level 1, Level 2, and Level 3 charging stations. Level 1 charging stations use a regular socket and a 120 VAC adapter to get 3-5 miles per hour. Level 2 EV alleging positions are used in both housing and retail settings. They practice a 240 V (for housing) or 208 V (for marketable) outlet to charge at the rate of 10 to 20 miles per hour. Level 3 accusing points, also recognized as DC reckless chargers, load an electrical vehicle's batteries to 80% power in 20-30 mins using a 208 Volt (for marketable) adapter or a 480 Volt three Phase AC supply. As an option to static charging points, wireless power transmission (WPT) loading and photovoltaic (solar) automobiles have been introduced.

Magnetic resonance was used to generate a field in around ground recharging coil & a copper coil inserted in an automobile, allowing for EVs use the wireless power transmission (WPT). In accordance to an MIT study team in 2007, 60 volts of control can be moved over a 2 meter space using the joined mass spectrometry theory. Many scholars surveyed up on this ground breaking work on the WPT process, proposing new circuitry and doing system level examination with better controller. Despite the admiration and complexity of WPT equipment for EV accusing, its comparatively high charge and restricted electric power range (maximum of 3 ft) remains significant obstacles. Solar energy, which can be captured via the sun & converted into power by insertion solar plates on a automobile's rooftop, is another option for charging devices wirelessly while relying exclusively on batteries. However, this method of charging system is only possible when electricity is present (for example, during the day); during the night, the car batteries can also be charged using grid power. Furthermore, due to a range of technical and production tasks in existing PV cell machinery, including the technological tradeoff among energy and resource conversion efficiency, electricity EVs are motionless not developed enough two to be obtainable to customers[2].

Due to the various renewable sources accessible, there are multiple applications for removing pollutants from highways: mechanical (mechanical), optical (light), and thermal (heat) (deformation or friction). Solar paving, which is a procedure of roadway that produces electricity by capturing solar energy with photovoltaic panels and is mounted in numerous roadway technologies, is one form of energy extraction. Functional nanomaterial's (such as piezoelectric or thermoelectric) have previously been explored for their ability to produce electricity from motorized force or frictional warmth. The theory behind this nanoparticles energy extraction is that the nanoparticles may be embedded into the roadway concrete or vehicle tire, causing electrical or chemical reactivity in the nano - materials as a function of vehicle tire filling, resulted in electrical current separation. About the fact that this nano-generator unit provides poor voltage and electricity, it has the potential to improve energy harvesting technologies by designing and building the machine and rendering it easier to combine with other corresponding voltage. The Goodyear BH-03 tire, for example, produces electricity via: (1) utilizing thermo-electric substances to produce electricity from of the difference among both the warmer and cold regions of the elastic, and (2) utilizing a thermoelectric generator to produce energy from the load on the tires.

1. *History of Solar Vehicles:*

For the first point in the late 1970s, solar panels and electric vehicles were merged. Hans Tholstrup arranged a 1,865 mile (3,000 km) run through the Australian outback in 1987 to raise awareness and scientific interest in solar-powered transportation. For the World Solar Competition, participants were invited from industry research societies and academic institutions all over the world (WSC). General Motors (GM) took the case by a large majority with their Sunraycer engine, which reached speeds from over 40 mph. As a result of their victory in 1990, GM teamed up with the US Department of Energy (DOE) to keep the GM Sunrays. The North American Solar Challenge began in 2005 and is now held every 2 months along various paths. The rally, which took place in 2005 and spanned 3960 kilometers from Austin, Texas, to Calgary, Alberta, Canada, set a new record for the longest solar vehicle race. After being initially regulated and funded by General Motors, the manufacturing of solar automobiles has evolved into its own distinct manufacturing operation. Because of the unique nature of the solar environment and activities, these developments remain an untapped resource. Electric car technology has advanced significantly, and it can now be applied to a larger range of automobiles to provide more efficient and cleaner options to gasoline engine automobiles[3].

DISCUSSION

1. *Basic Functional Diagram:*

The diagram above, (Figure 1) depicts the activity of a solar vehicle. The vehicle's primary source of electricity is the sun. Solar panels absorb the sun's energy and transform it to electrical power. The generated electrical power is fed into the batteries, which are then powered and used in order to power a 24 V Direct Current high torque DC sequence motor. The motor's shaft is devoted to the automobile's back wheel by a chain notch. The power batteries are completely charged at first, and then they are charged by solar panels. This aids in the completion of the battery's charging and discharging cycle, which is critical for appropriate battery operation.

Figure 2 depicts the motor's both forward reverse motion relationships. A switch, large motorized, and solar panel attaches the batteries to a motor. The motor in this automobile is a 24 V dc series system, as previously stated. There are four ports on the engine: A1, A2, F1, F2, and A1, A2 are indeed the internal short circuit armature terminals. All of the links are centered on the DPDT (Double Pole, Double Throw) switch. The vehicle's forward motion is driven by one of the DPDT turns, while the backward direction is regulated by the other. If the key is set in either direction, the engine will operate in either path. F2 is attached to the switch's output end through the main controller, while A2 is actually connected from either the battery to the brighter note of the DPDT switch. The upper side of the DPDT's center terminals is associated to the positive lateral of the powered operated, while the lower side is associated to the negative side of the battery. The controller unit in this case is a high confrontation configuration box that can handle up to 60 amps of present. The motor's internally shorted terminals are now A1, A2. As a result, one is the dominant and the other is the dummy. The A1 terminal on our motor is a dummy, while A2 is the actual terminal. As a result, all associates are made with A2 as the primary terminal. The terminals A2 and F1 in the switch are accountable for the motor's reverse gesture. Both connections are made directly to the turn, with A2 connected to the positive and F1 to the negative shown in Figure 2.

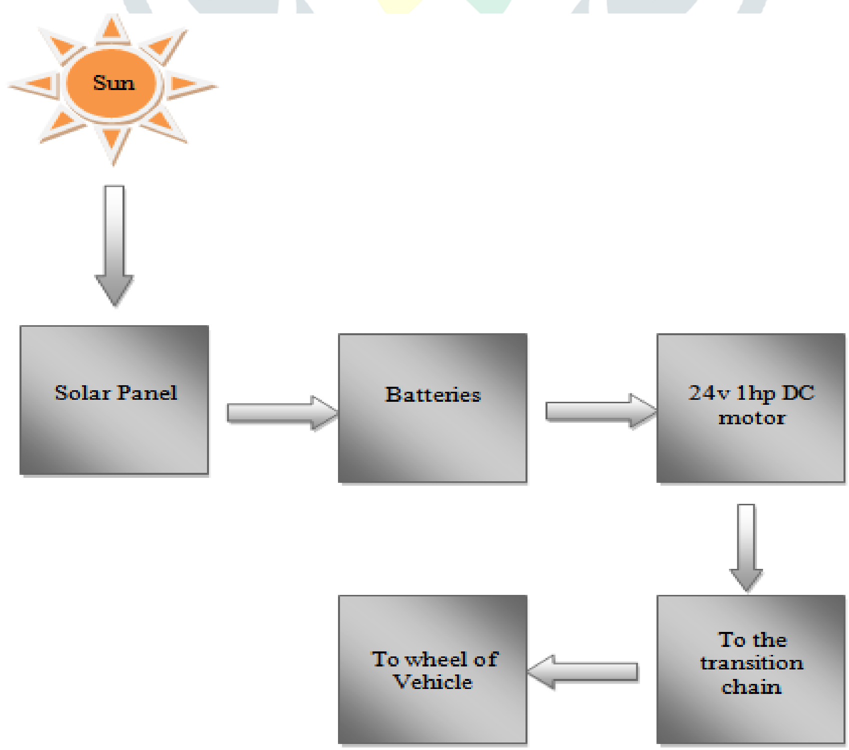

Figure 1: Block Diagram Representation of Basic Structure of a Solar Vehicle.

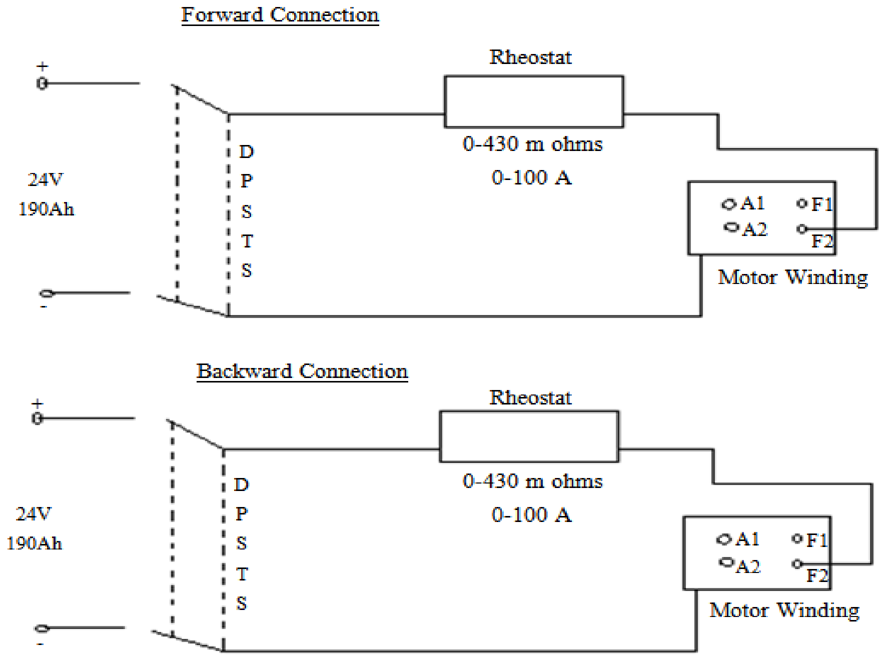

Figure 2 : Diagram Representing Circuit Diagram of working of a Solar Vehicle

2. *Components Used:*

The solar-powered vehicle was designed with a variety of electrical components. The following table contains a list of these elements, along with their ranges and the precise amounts needed to construct the solar vehicle. In Table 1 shown the various components used in solar vehicle.

Table 1: List of various components used in a Solar Vehicle

Components Used	Range	Quantity
Batteries (heavy inverter batteries)	24V 190Ah	2*12V
Solar Module	140Wp(Watt Peak)	1
Connecting Cables	Motor Connection: 25Sq.m m high voltage cables. Solar module to charge controller Unit: 1sq.mm Charge controller to battery Unit: 2Sq.mm	10 meters 1 meter 1meter
Motor	High torque DC motor 1Hp=746W	1

Apart from the components mentioned above, the key feature responsible for motor speed control is the speed control switch. This is how it's defined: The DC motor's speed control is a critical component of the engine. A switch with eight taps is designed to control the vehicle's speed by supplying different measured value for each tap, thus restricting the current flowing through the motor. Pure Nichrome wire is used to make the device's resistances. An eight-tap DC change is used[1]. Figure 3 shown the front view of the speed control unit.[4]

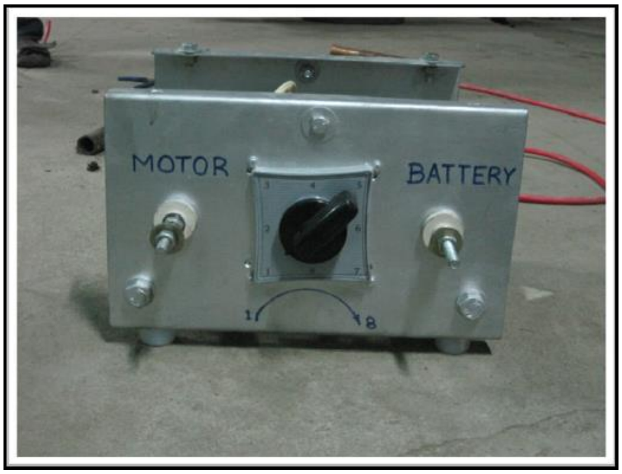

Figure 3: The front view of the speed control unit[1]**.**

There are two terminals on the switch: one for motorized associates and the additional for powered networks. The button is set up in a way that resembles a rheostat. The various tapings serve as resistance points. Since the limiting resistance decreases with each spike in tapping value, the motor will operate at its peak speed at the last tapping because the limiting resistance will be the lowest, while the motor will run at its greatest torque when the least tapping is used because the warning confrontation will be the highest. In Figure 4, you can see a picture of the view of the tapings. It is simple to deduce that dual coils are joined in sequence to form one tapering, thus increasing resistance[4]. Figure 4 shown the upper vision if Speed regulator switch portraying the recording connections

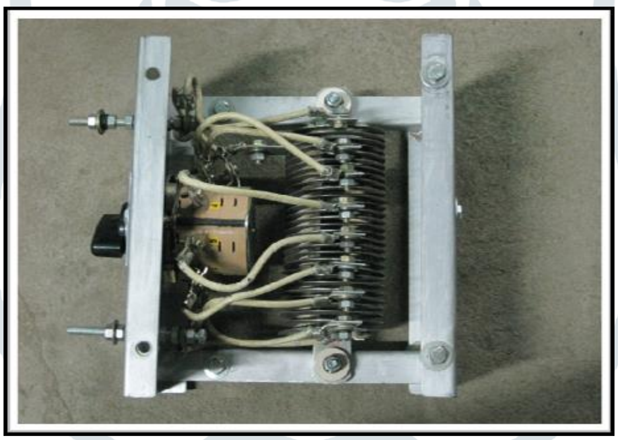

Figure 4: The upper view if speed regulator switch portraying the recording connections[1]**.**

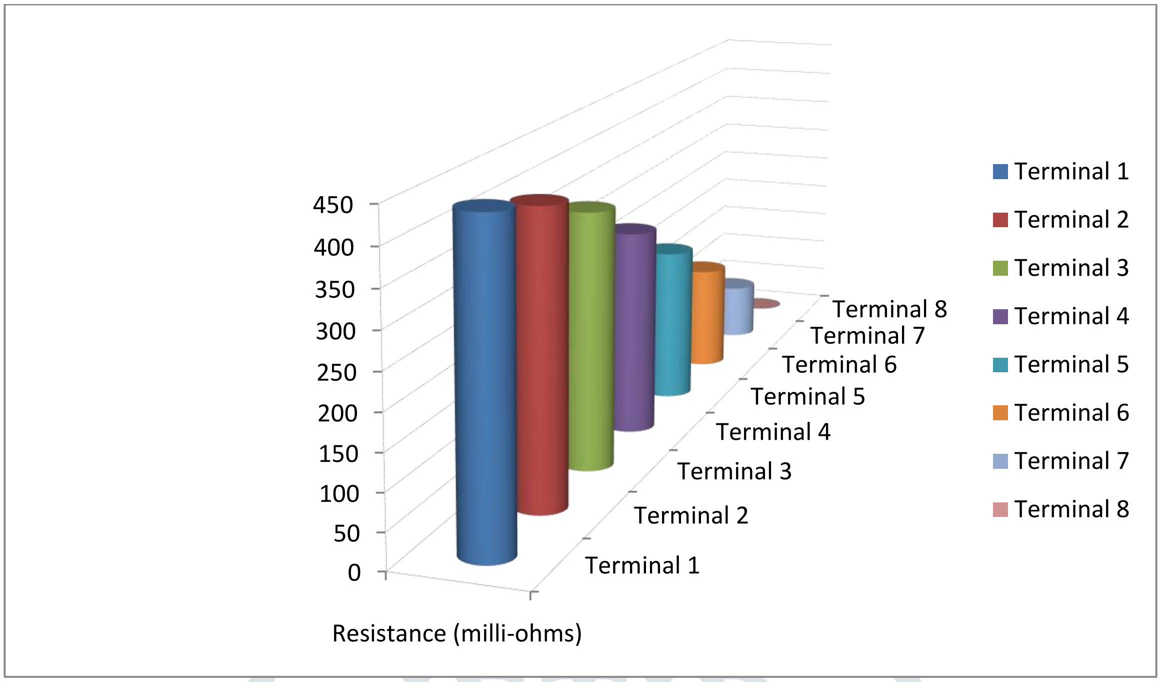

Figure 5: Graphical Representation of Values of Resistance at Various Taping of Switch

2.1.Solar Plate Details - 140Wp:

The solar cell in the solar automobile produces 140 watts per square meter of electricity. When constructing a solar car, the mounting of the solar panel is the most critical consideration. To maximize its efficiency, the panel must be mounted in such a fashion that it consumes as much sunlight as possible. From 6 a.m. to 11.30 a.m., we mounted the solar cell in the SOUTH-East position for the car setup. The panel's direction is then altered in a direction to SOUTH-WEST. We utilized the conventional buildings mounting method for both the solar plate. On the vehicle's windshield, a sheet of fiberglass measuring 6 feet by 4 feet was used. A multi-crystalline solar panel is used in the automobile. The multi crystal-like cell is chosen as it is further effectual than the mono crystalline panel and has a faster rate of energy transfer. A total of 36 cells have been used in this vehicle's PV module. The above casing of the solar component is enclosed with thick film to protect the solar cell from cracking. Figure 5 shown graphical representation of values of resistance at various taping of switch

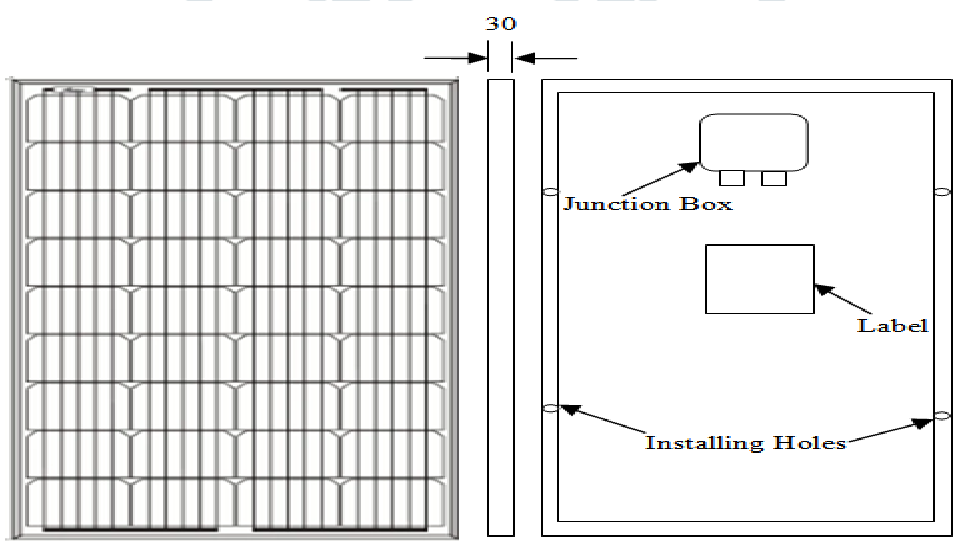

Figure 6: The diagrammatic depiction of the plate and the plate networks[1]**.**

3. Working:

Here's a detailed outline of our solar-powered sedan, following a rundown of the vehicles that are currently in operation. It's a two-seater truck with four wheels. We used a belt pulley system in this engine. Solar panels are used to collect solar energy, which is then used to charge the batteries. The batteries power the vehicle's engine, which turns the wheels. The vehicle we built for our experiment uses a belt crane mechanism, which connects the shaft of the motorized to the belt pulley assembly. The solar panels, which produce a total output of 400W, provide electricity to the sequences, which is then used to charge the batteries. The batteries we're using are lead acid batteries with a 48Volt rating and a 12V rating each. The motor is rated at 48 volts and is powered by four 12 volt batteries. In our scheme, we used a judgment belt with tusks that fit into a jagged crane. They ensure no slippage, operate at a steady pace, and are frequently used to pass direct gesture for indexing or scheduling purposes when properly tensioned. They are sometimes used instead of manacles or gears because they produce less sound and do not need lubrication. Timing belts are among the most effective and require the least amount of friction of any belt. We focused on the cost-effectiveness of the system so that it could be used for travel short spaces without using electricity from outer sources while remaining pollution-free.Figure 6 shown the diagrammatic demonstration of the plate and the plate connections.

3.1.Working of the Vehicle:

The charge controller is used to charge the batteries through the solar module mounted on the top of the vehicle. At STC, a 140 WP solar panel with a performance ranging from 24V to 25V is used. The power batteries are completely charged before being attached to the solar module to be charged. This aids in keeping the battery powered at all times. This is also achieved because the solar module's performance is just 15%. As a result, the battery can be completely charged again in 3 to 3.5 hours in this situation. This time lap is made in order to maintain the maximum sine wave of load. The optimum solar energy is received between 10 a.m. and 3:30 p.m. As a result, the screen is installed in such a way that optimum performance can be achieved. Since the power is supplied by a DPDT button, the motor needs a large starting present to drive the wheel frontward. The load on the motor at start-up is about 250kg, which includes the weight of the person driving it. After starting, the motor reaches a top speed of 20 to 30 kilometers per hour.

The sequence batteries are constantly powered by the solar plate, allowing the car to operate continuously. For optimum speed and torque to raise the entire load, the motor must be started in the highest gear. Later, depending on the needs of the driver, the speed may be adjusted. The load current changes as the speed changes. As a result, the speed difference must be minimal in order to keep the battery alive for as long as possible. The engine should be stopped by lowering the speed control lever to the lowest gear and then opening the switch; the mechanical footbrakes should then be applied. In an emergency, the motorized brakes may be applied immediately, but this can be escaped as it can disrupt the motor and cause needless back EMF. The total period of a battery backup is four hours. The solar panel charges the batteries continuously, but three 24 V dynamos can be attached to the vehicle's wheels to speed up the charging process. These dynamos can produce EMF and charge the batteries as the vehicle drives. As a result, the battery's charging and discharging period will be completed[3].

3.2.Advantages of the Solar Automobile:

Solar cars are the car industry's future. They are extremely viable and simple to produce. The main benefits of a solar automobile are that they emit less contamination and are actual cost effective. They are very eco-friendly because they do not pollute the environment, and they are the only solution to the current situation's rising levels of emissions caused by cars. By harvesting renewable energy sources such as solar energy, we are assisting in the preservation of non-renewable energy sources. The solar vehicle also has the advantage of requiring less maintenance than traditional automobiles and being very user friendly.

CONCLUSION

The solar vehicle addresses many environmental issues and is the most pollution-free approach available. We must take advantage of them in order to reduce our reliance on vestige fuels. Solar automobiles do have certain drawbacks, such as a limited speed range and a high initial cost. Furthermore, the rate of energy conversion is insufficient (only 17 percent). However, by doing additional research in this field, these drawbacks can be easily overcome; for example, the issue of solar lockups can be addressed by using extreme efficient solar lockups that have thirty five percent efficiency. Problems can be overcome when this area of vehicles is investigated further. Solar cars have a massive business potential, and we can start using them in our daily lives. As part of our mission, we have already completed a solar vehicle concept, which is currently working on solar power. The solar vehicle addresses many environmental issues and is the most pollution-free approach available. We must take advantage of them in order to reduce our reliance on fossil fuels. Solar vehicles do have some drawbacks, such as a limited speed range and a high initial cost. Furthermore, the rate of energy conversion is insufficient (only 17 percent). However, by doing additional research in this field, these drawbacks can be easily overcome; for example, the issue of solar cells can be addressed by using ultra efficient solar cells that have a 30-35 percent efficiency. Problems can be overcome when this area of vehicles is investigated further. Solar cars have a massive business potential, and we can start using them in our daily lives. Rather than being powered by electronics, the engine is powered by electricity. This paper gives a description of solar vehicles, as well as a simple eco-friendly technical growth strategy. Many more such approaches could be examined in the future in order to have an environmentally sustainable way of production.

REFERENCES

[1] A. Chaturvedi, K. Kushwaha, P. Kashyap, and J. P. Navani, “Solar Powered Vehicle 1,” vol. 3, no. 2, pp. 270–273, 2015.

[2] F. A. Tiano, G. Rizzo, G. De Feo, and S. Landolfi, “Converting a Conventional Car into a Hybrid Solar Vehicle: a LCA Approach,” *IFAC-PapersOnLine*, 2018, doi: 10.1016/j.ifacol.2018.10.035.

[3] U. S. D. of Energy, “The Histroy of Solar Technology,” *Pennyhill Press*, 2013.

[4] A. Jendoubi, C. Ben Bella, W. Nsibi, and F. Bacha, “The impact of climate condition on the optimal operation of direct coupled photovoltaic solar-vehicle systems,” *Energies*, 2018, doi: 10.3390/en11071821.