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Automotive Hybrid-Electric System That Runs on Renewable Resources

Mohammed Harris Suhail T N I
Department of Electrical and Electronics Engineering, Dhaanish Ahmed College of Engineering, Chennai,
Tamil Nadu, India.

Sabaricharan E
Bachelor of Engineering,
Department of Electrical and Electronics Engineering, Dhaanish Ahmed College of Engineering, Chennai,
Tamil Nadu, India.

Muhsin Ahamed N T S
Assistant Professor,
Department of Electrical and Electronics Engineering, Dhaanish Ahmed College of Engineering, Chennai, Tamil Nadu, India.

M. Gandhi
Assistant Professor, Department of Electrical and Electronics Engineering, Dhaanish Ahmed College of Engineering, Chennai, Tamil Nadu, India.

Annotation: In earlier iterations, many alternators were connected in series to produce electrical power. The vehicle's weight grows dramatically due to the current system's many restrictions, necessitating a higher torque output. These problems prevented its widespread adoption. This paper challenges you to create a charging system for an electric vehicle that would harvest kinetic energy from the vehicle's front axle and store it in the vehicle's batteries. The system's built-in alternator, solar panels, and plugged-in AC electricity can all be used to charge the battery simultaneously. An electric vehicle's battery can be charged in this way while it is at rest or in motion. The charges can be retrieved from the axle-mounted alternators in this way. In addition to the BLDC pulse control, battery management system (BMS), charge controller, and booster circuit, the design of the Hybrid Electric Vehicle Intelligent Control System (HEVICS) is part of this project. The vehicle can be simulated and verified with the use of existing software like Proteus 8, PSIM, and Matlab. This method allows for a full charge of the battery (16.67 percent) while recovering and reusing the energy that would otherwise have been wasted.

Keywords: Hybrid, Electric Car, Renewable Resources, plug-in AC voltage,

One or more electric motors, often called traction motors, provide the motive force for an electric vehicle. Depending on its design, an EV can either draw power from the grid via a collector system or generate its own power using a fuel cell, solar panels, or an internal combustion engine [11].

Electric vehicles (EVs) encompass a wide range of transportation modes, from land to air to sea to space. Electric vehicles (EVs) were initially developed in the middle of the 19th century, when electricity was among the most popular techniques for motor vehicle propulsion since it allowed for greater comfort and ease of use than gasoline-powered vehicles. While electric power has become less frequent in larger vehicles and more common in smaller ones, such as trains and motorcycles, it has remained common in motor vehicles for almost a century [12-17]. Due to advancements in technology and a greater emphasis on renewable energy, EVs have had a renaissance in the 21st century. As interest in EVs grew, a community of do-it-yourself (DIY) engineers started disseminating how-to guides for transforming conventional vehicles into their electric equivalents [18]. The United States and the European Union are only two examples of where governments have implemented incentives to boost adoption rates [19-21].

The current standard for electric vehicles is to employ electric drives, which are powered by the batteries. The gasoline engine was an effective contributor to the initial and ongoing costs of the car before the invention of the internal combustion engine, but it wasn't until the late 19th century that the electric car gained widespread popularity [22-26]. There were primarily four reasons why electric automobiles didn't catch on at the time: The initial cost to produce was considerable, as were the ongoing costs, the range of travel was restricted, and the top speed was slow [27]. The oil crises of the 1970s and the present day have prompted automakers to reevaluate electric drives as a practical alternative to the traditional internal combustion engine. Manufacturers, armed with the results of the available research, set out to find a solution, ultimately settling on electric drives and batteries as the primary elements of electric vehicles [28-33]. Increasing oil prices, efforts to mitigate climate change, greenhouse gas emissions, and air pollution, and the need to preserve nonrenewable energy sources were the primary motivations for automakers to consider electric vehicles [34-37]. It is arguable that if the aforementioned issues could be resolved, electric automobiles could be used more widely in the real world. According to this hypothesis, mechanical energy can be converted into electrical energy by use of an AC alternator. The primary goal of this work is to propose a new method of producing electricity based on this notion. As a result, the batteries may be charged while driving thanks to the power provided [38-41]. With the electric car's alternator-based self-charging system, we can create the electricity needed to partially charge the batteries while the car is in motion, as shown in the block diagram. This has the potential to improve the effectiveness of electric vehicles by lengthening their range and decreasing the amount of time needed to charge their batteries [42-47].

Aims

The primary objective of this project is to create a design for an electric car that can generate electricity while in motion by utilising an attached alternator, allowing for extended range with reduced recharging times.

Objective

- To design an electric car with minimum charging time and high run time.
- To design and develop the electric car which has a capacity to charge itself with its running energy.

- To develop an electric car that can travel for longer distance with minimum time for charging.
- To develop a self-generating electric car for the purpose of reducing the charging time.
- To provide the energy to the battery bank by reclaiming the power given to the motor.
- To design an open-source electric vehicle control system.
- To reduce the fuel consumption to reduce the usage of natural fuels.
- To provide low cost and highly efficient electric vehicle for commercial purpose.
- To provide a eco-friendly transport to the public for developing a happier environment to future

Literature Survey

Superior hybrid energy systems are required by Aditi et al. [1]. Wind, solar, hydro, and other renewable energy sources combined with transmission and distribution infrastructure create a hybrid energy system. This study examines hybrid power system stability. This study explores hybrid power system stability and controls that affect output power. Hybrid systems struggle most with stability and power quality. Various facts, devices, and methods are used to address these concerns. Hybrid power systems are increasingly used. Many controllers and tactics are needed to maximise power generation and power quality in hybrid systems. This study examines hybrid power system literature to improve power quality. using many FACTS tools. Fuzzy logic controllers stabilise system power. This study also discusses maximum power point tracking for wind and solar energy consumption. Multilevel inverters reduce harmonics and improve power quality in hybrid power systems. Artificial neural networks improve system performance. Another approach for improving hybrid power quality is hybrid filters. Life cycle cost analysis aids hybrid power system cost-benefit analysis.

An alternator linked to the back wheel shaft is the main idea, according to Zarkesh et al. [2]. As the alternator shaft turns, electricity charges the batteries. The front-wheel motors are linked to Battery 1. The alternator runs on these car batteries when charged. The proposed battery charging infrastructure modification will boost electric vehicle sales, which could threaten internal combustion engine vehicle sales. Most of the parts needed are also commonplace in electric vehicles. According to Anna Joy et al. Motor for electric vehicle International Journal of Electrical, Electronics, and Instrumentation Engineering, Volume 2, Issue 4 (April) This paper designs brushless DC motor electric vehicle drive circuits. Through real-time mathematical calculations, this technology provides the typical electric car driving circuit. This project should use a brushless DC motor drive due to its higher torque, efficiency, speed control simplicity, lower operating noise, and longer service life. The analysis anticipates a bright future for the business of switching gasoline engines with brushless DC motors to make electric cars.

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Rossi et al. [4] describe a high-performance small electric vehicle with two battery packs, two motors, and two axles and a low-voltage engine. An analytical approach for selecting front and rear axle drives, performance and cost parameters for low-voltage active components, and the traction inverter's power stage layout are offered. High-performance compact cars may use two motors and two axles for traction (the Amber ULV project). Under mechanical and electrical constraints, the paper gives a method for determining the best front-rear motor transmission combination for driving performance. Distributing traction power between two drives allows a low-voltage solution. The 50-140 V range is investigated for performance and cost. The research closes with an inverter power stage design. This arrangement is unique since it can test IMS and DBC mounting methods simultaneously. Road testing the automobile and developing a traction control system for this powertrain will be revealed in future publications. The traction control system generates torque references for the two motor drives based on driver input, drive restrictions, battery pack limitations, and power sharing. The traction control system employs torque references from the active stability control system to regulate the powertrain in difficult conditions. Wang et al. [5] say vehicle, driver, route, traffic, and weather can all play an impact. BEV energy use is hard to predict due to its interconnection and fluctuation. This work proposes an online way to fine-tune driving energy consumption forecasts. One algorithm estimates vehicle parameters and another corrects driver behaviour. The vehicle parameter estimation technique can estimate mass and rolling resistance while driving. Driver behaviour and environmental factors like wind speed and road slope can alter energy consumption predictions. Twenty-one driving tests on highways, cities, countryside, and hills verify the online energy consumption forecast algorithm. The experiments show that the online estimate generally matches energy use within 5%. This study describes a web-based power usage forecasting system. The online algorithm includes driving behaviour correction and vehicle parameter estimate. The online system adjusts energy consumption projections based on driving behaviour. Estimating vehicle mass and rolling resistance coefficient does this.

Proposed Technology

The current setup has a total of six alternators, two battery banks, and two motors. The purpose of this setup is to replenish any power used up during exercise [48-52]. Two battery banks are utilised so that one can be charged while the other is discharged, and vice versa. The system's primary negative is the increased cost and size of the motor, which slowed the widespread adoption of this method. (Fig. 1).

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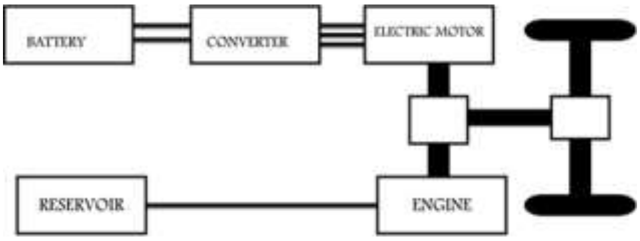


Fig. 1 Existing System

Basic Concept of Proposed System

This project's central idea is to harness the moving vehicle's kinetic energy, transform it into electrical energy, and store it in a battery for later use. (fig. 2).

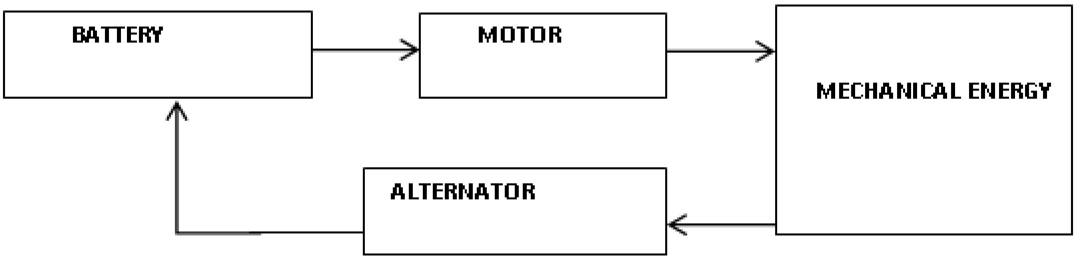
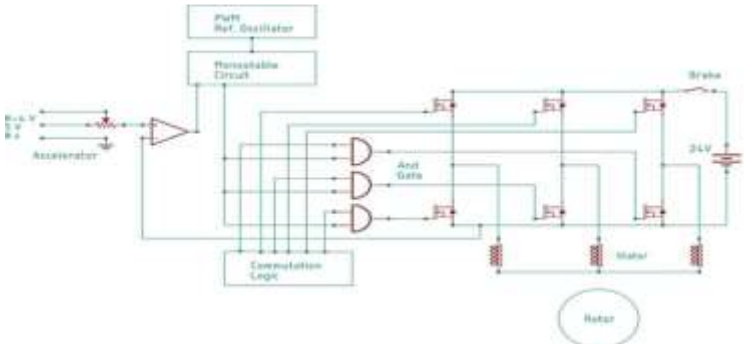


Fig. 2 Framework of proposed system

Therefore, the generated energy can be saved for later uses by charging the battery and providing additional support for the charging system by means of an alternator.

Proposed Circuit Diagram

The proposed block diagram consists of two sections: i) speed control, and ii) charging circuit.



Speed Control

Fig. 3: Speed Control Circuit Diagram

This circuit consists of a PWM-based speed control (Fig. 3). The PWM reference oscillator is used for generating the pulses. It is passed through a monostable circuit, and those pulses are given to the AND gate. The AND gate has been given the input signal of both pulses as well as gate logic. The output of this gate is used to trigger the MOSFETs. This signal is given only to the lower leg in order to reduce the current ripples. The commutation logics were provided for both legs [53-59]. The variation in the accelerator pedal varies the variable resistor, and the input has been given

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accordingly. Thus, the FETs were used for the purpose of providing speed control to the motor and also for controlling the speed of the motor with respect to that of the varying accelerator constant. Here, the pulse logic was provided by the technique known as the pulse width modulation technique. The train of pulses is obtained by a pulse oscillator with reference to that of the monostable generator. By changing the pulses given to the gates of the MOSFET, the voltage of the motor varies, and thus the speed of the motor also varies [60-65].

Charge Control

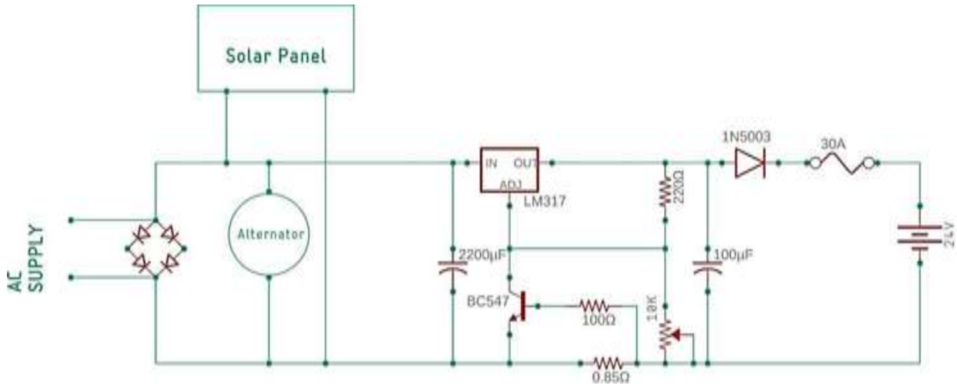

Fig. 4: Charge Control Circuit Diagram

The charge controller of the proposed technology consists of a supply source, rectifier unit, smoothing capacitor, voltage regulator, automatic trip-off circuit, and a protection fuse (Fig. 4). The various supply sources of the proposed technique were a plugin AC, an alternator, and a solar panel. Out of these, the plugin AC is the only charging source that requires an idle mode for charging. The alternator is used for charging the battery while running, and the solar panel uses the energy from the sun for charging. The single-phase bridge rectifier is used for the purpose of converting the single-phase 220 V 50 Hz AC voltage to a suitable 24 V DC voltage. It is an uncontrolled rectifier, i.e., it does not require any control pulses for conduction. It uses a PN diode, in which two pairs of diodes are used for each half of the cycle. But the rectifier produces the pulsating DC voltage. In order to obtain a constant DC voltage, the smoothing capacitor is used here [66-71]. The smoothing capacitor is used to filter out the pulsating DC voltage and produce a nearly constant DC voltage. Due to the alternating nature of the supply voltage, the magnitude of the DC voltage also varies; due to this, it is difficult to attain a constant voltage. So the voltage regulator is used to overcome this problem. The LM317 voltage regulator is used for the purpose of providing a constant 27 V DC voltage with respect to the minimum DC voltage. Thus, these DC voltages were given to the battery via a protection fuse. The fuse is used here for the purpose of safety and protection. The voltage level of the battery is regularly monitored by using a voltage divider, and when the battery attains a maximum voltage, it trips off the circuit. Thus, by using this technique, overcharging of the battery can be avoided [72-81].

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Working Operation

It functions in much the same way as a conventional battery-powered electric car. After everything was properly connected, the automobile began to move when the motor began to spin thanks to power from the battery. So, the car's movement causes the alternator, which is attached to the axle, to begin rotating. As a result, electrical power is produced by the alternator [82]. The battery can be charged as soon as the alternator reaches 900 revolutions per minute (RPM). This method allows the energy to be recycled by returning it to the battery to be utilised again. Although it is difficult to recover all of the energy that is expended, the alternator can make up for at least 16.67 percent of the loss [83-87]. This method allows us to build an energy-efficient electric vehicle that generates its own power while in operation by employing an alternator to store energy [88].

Working Principle

The underlying principles for the working of a BLDC motor are the same as for a brushed DC motor, i.e., internal shaft position feedback. In the case of a brushed DC motor, feedback is implemented using a mechanical commutator and brushes. With a BLDC motor, it is achieved using multiple feedback sensors. The most commonly used sensors are hall sensors and optical encoders [89-91]. The torque is at its maximum when the rotor starts to move, but it reduces as the two fields align with each other. Thus, to preserve the torque or build up the rotation, the magnetic field generated by the stator should keep switching. To catch up with the field generated by the stator, the rotor will keep rotating [92-95]. Since the magnetic fields of the stator and rotor both rotate at the same frequency, they fall under the category of synchronous motors (fig.5).

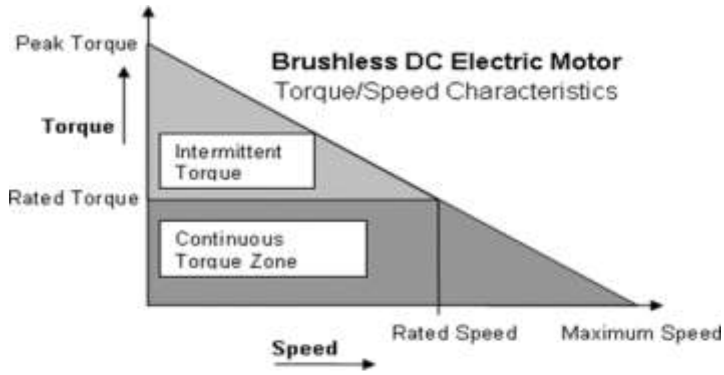

Fig. 5: Speed Torque Characteristics [7]

DC Alternator

Mechanical energy is transformed into electrical energy in the form of current by an electrical generator called an alternator. Most alternators employ a spinning magnetic field with a stationary armature due to the former's lower manufacturing cost and greater ease of operation. A linear alternator or a spinning armature with a fixed magnetic field is employed on rare occasions. While the name "alternator" can be used to describe any AC electrical generator in theory, it is more commonly applied to the compact rotating machines that are driven by automobile and other internal combustion engines [96-101]. A magneto is a type of alternator in which the magnetic field is created by a permanent magnet. Turbo-alternators are the term for the

alternators used in power plants that are propelled by steam turbines. Most of the world's electricity comes from massive 50 or 60 Hz three-phase alternators in power plants and is transmitted via electrical power networks. DC alternators (like generators) use electromagnetic induction to convert mechanical energy into electrical energy. DC alternators, in comparison to DC generators, are often smaller, lighter, and more efficient. An alternator has a straightforward operating principle. The underlying concept is identical to that of a DC generator. It also relies on Faraday's law of electromagnetic induction, which states that when a conductor is moving relative to a magnetic field, a current is induced in the conductor [102-109].

Fig. 6: DC Alternator [8]

Advantages

Better results. The moving elements of an alternator are sturdier, so they may spin faster. A smaller-diameter driving pulley is utilised to get to faster speeds. More power is needed at higher speeds, but the gains at lower engine speeds are far more noticeable [110-115]. lighten the load and shrink the footprint. An alternator's greater efficiency and compact design allow for a smaller device to provide the necessary power. Reduced upkeep. Failure due to brush wear or surface contamination is avoided in an alternator since output current does not need to be routed via a commutator and brushes. tighter regulation of output. Accurate output regulation is made possible by a solid-state regulator installed in the alternator [116-122].

Battery

Powering electronics like torches, smartphones, and electric vehicles requires a device called an electric battery, which consists of one or more electrochemical cells with external connections. The positive terminal of a battery, when used to supply electricity, is called the cathode, whereas the negative end is called the anode. Electrons will travel from the "negative" terminal to the "positive" terminal via an external electric circuit. When a battery is hooked up to an electric load, the free-energy difference between the reactants and the products of a redox reaction is transferred to the external circuit as electricity. The term "battery" originally only referred to devices made up of numerous cells; however, its use has expanded to encompass single-cell devices. Because the electrode materials are altered irreversibly after discharge, primary (single-use or "disposable") batteries can only be used once before being thrown away. Alkaline batteries, which power flashlights and many other portable electronics, are a good example. The electrodes of a secondary (rechargeable) battery can be returned to their original composition by applying a reverse electric current, allowing the battery to be depleted and recharged several times [123-128]. The lead-acid

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batteries found in automobiles and the lithium-ion batteries found in laptops and smartphones are only two examples.

Electro Chemical Reaction

Discharged batteries have lead (II) sulphate (PbSO4) on both their positive and negative plates and mostly water as their electrolyte instead of dissolved sulfuric acid. When two hydrated protons (2 H+ (aq)) of the acid react with oxygen-containing ions (2 O2-) of PbO2, they produce the strong O-H bonds in water (H2O), which drives the discharge process (ca. -880 kJ per 18 g of water). Even while the synthesis of Pb2+ (aq) ions and lead sulphate (PbSO4(s) is energetically unfavourable, this highly exergonic process more than makes up for it.

Negative Plate Reaction:

1) $Pb(s) + HSO^{-}_{4}(aq) \rightarrow PbSO_4(s) + H^{+}(aq) + 2e^{-}$

A double layer forms close to the surface because an electric field is generated when electrons accumulate, attracting hydrogen ions and repelling sulphate ions. Reaction may proceed only if charge is allowed to flow away from the electrode, which is blocked from the solution by the hydrogen ions [129-131].

Positive Plate Reaction:

2) $PbO_2(s) + HSO^{-}_{4}(aq) + 3H^{+}(aq) + 2e^{-} \rightarrow PbSO_4(s) + 2H_2O(l)$

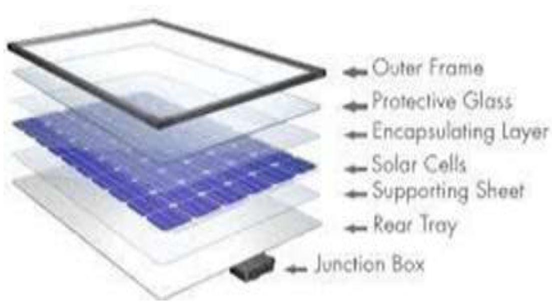
The total reaction can be written as

3) $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l) = 2.05\ V$

Per mol (207 g) of Pb(s) transformed to PbSO4(s) or per 36 g of water produced, the net energy released is about 400 kJ. There are 642.6 g of reactants required to generate one faraday of charge (192,971 coulombs), which equates to 83.4 ah/kg (ampere-hours per kilogramme) (or 13.9 ampere-hours per kilogramme for a 12-volt battery). This equates to 167 watt-hours per kilogramme of reactants for a 2-volt cell, but in reality, due to the weight of the water and other components, a lead-acid cell only provides 30-40 watt-hours per kilogramme of battery (fig. 7).

Fig. 7: Solar Panel

Light from the sun is converted into power using photovoltaic solar panels. A PV module is an interconnected, preassembled group of solar cells that converts light into electricity. The solar electricity used in businesses and homes is generated by a photovoltaic system, which is made up of an array of photovoltaic modules. Modules that convert solar radiation (photons) into usable power are called photovoltaic cells. Crystalline silicon cells or thin-film cells are used in the vast majority of modules. A module's top or bottom layer can serve as its structural (load-carrying) member. Mechanical damage and moisture must be prevented from reaching cells. Although rigid modules predominate, semi-flexible options with thin-film cells are also on the market. The cells must be wired together in a series circuit [132-135]. An output interface, the PV junction box is mounted on the back of the solar panel. The MC4 connector type is widely used on the exterior of photovoltaic modules because it allows for quick and reliable watertight connections to the rest of the system. A USB port can be used as a power source as well. To get the desired voltage from a string of modules, connect them in series, and to get the desired current capacity, link them in parallel (amperes). Silver, copper, or other non-magnetic conductive transition metals may be used in the cables that drain power from the modules. When only a portion of a module is shaded, bypass diodes can be built in or added externally to the circuit to increase the power generated by the uncovered areas. Concentrators are a subset of solar photovoltaic modules that employ lenses or mirrors to concentrate light on a smaller number of cells. Because of this, expensive-per-square-inch cells (like gallium arsenide) can be used economically. Metal frames, including racking hardware, brackets, reflector shapes, and troughs, are used to reinforce solar panels [136-141].



Technology Used:

Fig. 8: Layout of Solar Panel [10]

Crystalline silicon (c-Si) solar cells, both multi- and mono-crystalline, are currently used in the manufacturing of the vast majority of solar modules (fig. 8). More than 90% of global PV production in 2013 came from crystalline silicon, while the remaining 10% came from thin-film technologies employing cadmium telluride and CIG Sand amorphous silicon [142-144]. Thin-film solar cells are a key component of emerging third-generation solar technology. When compared to other solar technologies, they produce a high efficiency conversion at a low cost. In addition, solar panels on spacecraft are ideally made out of expensive, efficient, and closely packed rectangular multi-junction (MJ) cells since they provide the most generated power per kilogramme hoisted into orbit. Gallium arsenide (GaAs) and other semiconductor materials are combined to create MJ-cells,

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which are compound semiconductors. Concentrator photovoltaics are another developing PV technology that makes use of MJ-cells (CPV).

Working

Panels that absorb sunlight and transform it into power are among the most popular examples of renewable technology. Photovoltaic cells are the ingenious pieces of technology responsible for this. Semiconducting materials (often silicon, but also glass or polymer resin) with various electrical characteristics are used to create an electric field around the solar cells. Semiconductors in solar panels generate electricity when struck by photons, or sunshine. This process, called the "photoelectric effect," generates the electric current used in power generation. The diagram below illustrates the composition of a multi-crystalline solar panel. It provides an excellent view of the solar panel's internals. However, there is a lot of work being done to better utilise the complete spectrum and allow electricity generation from UV and infrared photons, which are not currently used by most solar panels. (fig.9).

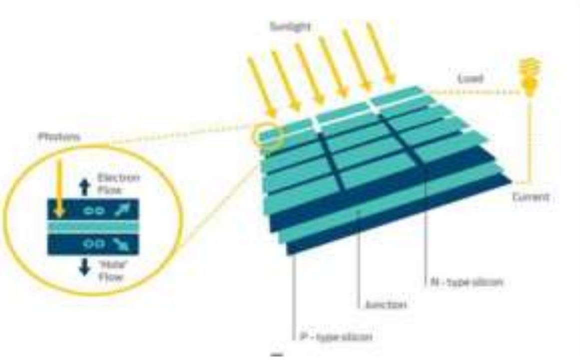

Fig. 9: Structure of Solar Panel [9]

Thin Film

Rigid thin-film modules have the cell and module made simultaneously. In a so-called "monolithic integration," the cell is built directly on a glass substrate or superstrate, complete with all of the necessary electrical connections. A front or back sheet, typically another sheet of glass, is bonded with an encapsulant to the substrate or superstrate. Cd-Te, a-Si, a-Si+uc-Si tandem, and CIGS are the primary cell technologies in this group (or variant). Solar energy conversion efficiency for amorphous silicon is 6-12%. The photoactive layer and other required layers are deposited on a flexible substrate to construct flexible thin film cells and modules on the same assembly line. Monolithic integration is utilised when the substrate is an insulator (such as a polyester or polyimide film). If it turns out to be a conductor, a different method of electrical connection will have to be employed. Modules consist of cells laminated to a polymer appropriate for adhering to the final substrate and a transparent, colourless fluoropolymer (usually ETFE or FEP) on the front side.

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Maintenance

The efficiency of a solar panel's conversion is diminished by the accumulation of dust, filth, pollen, and other pollutants to the tune of about 20%. Professor of Physics at the University of Houston and Director of the Institute for Nano Energy, Seamus Curran, states that "a dirty solar panel can reduce its power capabilities by up to 30 percent in high-dust, polluted, or desert areas." The Institute for Nano Energy focuses on the design, engineering, and assembly of nanostructures. Paying to have solar panels cleaned is not always worth it. Panels that had not been cleaned or rained on for 145 days during a California summer drought lost only 7.4 percent of their effectiveness, according to the study's authors. Until the summer drought ends, which would be around two years from now, cleaning panels midway through the summer would result in a measly $20 boost in power generation for a typical household solar system of 5 kW. The financial losses are greater for larger commercial rooftop systems, but they still rarely justify the cost of cleaning the panels. The average daily loss in performance for the panels was less than 0.05%.

Recycling

Large percentages of ferrous and non-ferrous metals, as well as up to 95% of some semiconductor components or the glass, are recyclable from a solar module. End-of-life modules are currently being collected and recycled by a few private enterprises and non-profit organisations. The modules' technological make-up determines whether or not they can be recycled. At the outset, we manually disassemble things like silicon-based modules, aluminium frames, and junction boxes. After being placed in a mill, the module is broken down into its constituent parts, such as glass, plastic, and metal. More than 80% of the entering mass can be recovered. Since a PV module is structurally and chemically identical to flat glass used in the construction and automotive industries, it may be recycled by the same companies. The glass foam and glass insulation businesses, for instance, gladly welcome the recovered glass. Modules that aren't built on silicon need specialised recycling methods like chemical baths to recover their constituent semiconductors. The first step in recycling cadmium telluride modules is to crush the module and then sort out the various components. Up to 95% of the semiconductor materials and 90% of the glass can be recovered with this recycling method. Private companies have built a few large-scale recycling facilities in recent years. Fabricating aluminium flat plate reflectors with the aluminium coating found inside non-recycled plastic food packaging has increased the reflectors' cool factor. This coating is just about 0.016 mm to 0.024 mm thick. Mounting and Tracking

The electric vehicle's solar panel is aligned perpendicular to the sun's beams from its perch atop the roof. As a result, the mounting cannot be modified from its predetermined orientation. So long as the solar panel is mounted on the car's roof, it will receive plenty sunlight to charge the battery.

Controller

An electronic speed controller adjusts the switching frequency of a group of field effect transistors in response to a speed reference signal (from a throttle lever, joystick, or other manual input) (FETs). The rate at which the motor spins can be altered by manipulating the duty cycle or switching frequency of the transistors. The high-pitched whine that the motor produces, especially at lower speeds, is caused by the quick switching of the transistors. Brushed DC motors and brushless DC motors call for different sorts of speed controllers. By altering the voltage applied to the armature, the speed of a brushed motor can be adjusted. (In industry, the strength of the motor field current is used to regulate the speed of motors that use electromagnet field windings in place of permanent magnets.) To function, a brushless motor must depart from the conventional model. By manipulating the intervals between current pulses sent to the motor's many windings, its rotational velocity can be altered. To power its motors, brushless ESCs generate three-phase alternating current (AC) like a VFD. Hobbyists who enjoy flying remote-controlled aeroplanes often prefer brushless motors over conventional ones due to their higher efficiency, greater power, longer lifespan, and lower weight. Controllers for brushless AC motors are significantly more complex than those for brushed motors. The ESC must account for the fact that the proper phase shifts as the motor rotates. This rotation is often detected using back EMF from the motor, though there are variants that use magnetic (Hall effect) or optical detectors. Low-voltage cut-off limits, timing, acceleration, deceleration, and rotational direction can typically be programmed into computerised speed controls.

Any two of the three wires connecting the ESC to the motor can be switched to reverse the motor's direction. Electric vehicles like the Nissan Leaf, Tesla Roadster (2008), Model S, Model X, Model 3, and Chevrolet Bolt need enormous, high-current ESCs. Power consumption is often expressed in kilowatt hours (the Nissan Leaf, for instance, uses an 80-kilowatt motor that produces 210 foot-pounds of torque). The majority of mass-produced EVs have AC motors, which allows the ESC to generate kinetic energy during coasting by turning the motor into a generator. The captured energy is utilised to recharge the vehicle's batteries, increasing its range (this is known as regenerative braking). This can be utilised to efficiently slow down some vehicles, like Teslas, to the point that regular brakes are only needed at very low speeds (the motor braking effect diminishes as the speed is reduced). Some vehicles, like the Nissan Leaf, have a negligible "drag" effect when coasting, and its electronic stability control (ESC) regulates energy harvesting to work with the regular brakes to come to a stop. This project utilises a MY1020 general-purpose motor controller. Here, this controller regulates every facet of the electric car's operation, from its speed to its charge to its brakes to its lights to its battery management system (fig.10).

Fig. 10: MY1020 e-Vehicle Controller

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The electric speed controllers (ESCs) used in mass-produced electric vehicles often support bidirectional operation of the AC motor. There is only one gear ratio and switching the motor to run backwards makes the vehicle go in the opposite direction. Some one-off electric vehicles are equipped with DC motors that can be switched to run in reverse, while others stick with the tried-and-true method of always spinning the wheels in one direction and switching gears with the help of a manual or automatic transmission. Since the gearbox already exists in the vehicle being converted, all that needs to be done to make it electric is to swap out the engine for an electric motor. Therefore, the controller is made in such a way that it handles all the tasks that the mechanical car's transmission system did, including reversing, gear transmission, battery management system, and more. This controller is in charge of everything in the electric car.

Single-phase electric power refers to the distribution of alternating current electric power in which all voltages of the supply vary at the same rate. When lights, heating, and a few large electric motors make up the bulk of the load, a single-phase distribution system is employed. Connecting an AC electric motor to a single-phase supply doesn't generate a revolving magnetic field; single-phase motors require extra circuits for starting (capacitor start motors), and they're rarely used for loads more than 10 kilowatts (kW). From a three-phase distribution transformer, a single-phase load can be supplied either by connecting one phase and neutral, or by connecting two phases. Single-phase electrical systems typically operate at either 50 or 60 hertz as the usual frequency. In India, 220 V is the standard phase-to-neutral voltage.

To convert the alternating current (AC) from the wall outlet into direct current (DC), a bridge rectifier is used. The DC voltage required by electronic components or devices is often supplied by bridge rectifiers housed in power supplies. Four or more diodes, or another type of solid-state switch that can be remotely controlled, can be used to build one. The type of bridge rectifier used is determined by the required load current. When choosing a rectifier power supply, various factors such as the breakdown voltage, operating temperature range, transient current rating, forward current rating, mounting requirements, and more must be taken into account. A step-down transformer, which reduces the input voltage's amplitude, serves as the initial component in the circuit. A 230/24 V transformer is used in most electrical projects because it converts the 220V AC mains to a more manageable 24V AC supply. The next component is a diode-bridge rectifier, which, depending on the design, can have as many as four diodes. The device's peak inverted voltage (PIV), forward current (IF), voltage ratings, and so on must all be taken into account when selecting a diode or other switching device for a related rectifier. By switching on and off a pair of diodes at the frequency of the input signal, it generates a DC current in the load. Because of the pulsing nature of the output following the diode bridge rectifiers, filtering is required to provide pure DC.

Conclusion

A voltage regulator is used as the final component of this controlled DC supply to keep the output voltage stable. Assuming the battery needs 24V DC, but the output from the bridge rectifier varies, a voltage regulator is required to bring the voltage down to a constant level regardless of the input voltage. In order to regulate the voltage, an LM317 was employed. Thus, the electric vehicle's battery is charged by the converted 24 V DC voltage, which was originally a single-phase AC supply. Therefore, the electric vehicle's battery can be charged via the AC supply alongside the alternator and the solar panel. That's why it's possible to charge an EV utilising the power supply from a standard home installation. In this setup, the input alternating current (AC) voltage is reduced by a step-down transformer, rectified into direct current (DC) using a bridge rectifier, and finally filtered via a smoothing capacitor. Electric motors will take the place of the IC engines in some cases. As technology improves, it's possible that vehicles could soon be able to generate as much as 80% of their own energy. Semiconductor technology advancements may lead to the creation of cutting-edge controllers for driving electric vehicles. An electric vehicle that can travel up to 1,000 kilometres on a single charge is technically feasible in the not-too-distant future.

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