Hybrid Electric Vehicle

Rishi Mishra, Vikas Gupta, Ashwini Khade

Rishi Mishra , student V.E.S. Polytechnic
Vikas Gupta, student V.E.S. Polytechnic
Lecturer, Dept. of Electrical Engineering, V.E.S. Polytechnic Maharashtra, India

Abstract - *In the current scenario, global warming is a threat to society. One of the major reasons is the release of carbon-di-oxide from automobile exhaust due to the combustion of fossil fuels which pollutes the environment. One of the optimistic solutions for this problem is to use hybrid vehicles. Generally, Hybrid vehicles involve a combination of transmission system driven through electrical, solar as well as internal combustion (IC) engines. Due to having an IC engine in hybrid electric vehicles, it pollutes 70% more than solar electric vehicles (SEV) or battery electric vehicles (BEV). To reduce or eliminate this pollution, we have designed this hybrid electric vehicle which runs on 100% green energy.*

***Key Words*: Electric vehicle, motor, battery system, hybrid system**

1.INTRODUCTION

The combustion of fossil fuels to produce electrical power releases harmful greenhouse gasses (GHGs) and pollutes the atmosphere. There has been a dramatic increase in global warming and melting of ice caps due to the release of harmful gasses in the environment. Environmental monitoring and timely precautionary services are required to slow the deteriorating impacts of climate change. According to International Energy Agency (IEA) projections, the average world temperature rise must be limited to only two degrees Celsius by 2050. If no measures are considered to address this problem, greenhouse gasses emissions are estimated to double by 2050. In 2018, the automotive sector emitted 25% of all energy-related greenhouse gasses emissions. Several initiatives are being proposed to minimize transportation-related pollution. The objective is to lower greenhouse gasses emissions while also improving the performance of the vehicle by innovating and developing new fuels from renewable energy sources. Using electricity to power vehicles is a viable option that has numerous advantages. Electric vehicles (EVs) have the potential to reduce environmental impact by reducing emissions from the vehicle's tailpipes. Moreover, the use of more efficient topology and electric motors in EVs results in superior performance than that of IC engine vehicles. Developed and developing countries all over the globe are taking various steps to promote the use of electric vehicles. EVs are gaining interest in achieving public acceptability, indicating the efforts that have been fruitful. The development in design of EV, selection of battery, and charging methods has received much attention during research and development. Researchers have modeled the series, parallel, and series-parallel configurations of the EVs to fulfill various challenges faced by the conventional EVs. The introduction of extremely effective electric motors in the EV topologies could improve fuel efficiency and increase the driving range of the vehicle.

1.1 Hybridization?

A hybrid vehicle has multiple distinct energy sources which could be separately or simultaneously operated to drive the vehicle. In this vehicle, the drive is obtained from an electric motor through the power stored from the battery by solar energy and energy generated from the generator.

1.2 What is new in this Vehicle?

This is a hybrid vehicle that does not have any IC engine. It runs completely on green energy and does not cause any kind of pollution. The vehicle has two charging sources making it hybrid. This ''vehicle is a combination of solar electric vehicle (SEV) and battery electric vehicle'' (BEV).

1.3 Battery Electric Vehicle (BEV)

Since BEVs are exclusively powered by the charge stored within the battery packs, the mobility of these vehicles is directly related to the size of the battery. Most of them have a range of 100–250 kilometers, while the best models have a range of 300–500 kilometers. Several factors influence the range of BEV. These include the driver's style and habits, automobile design, road surfaces, climatic condition, battery type, and lifespan. BEVs have significant benefits of being easy to configure, operate, and convenient to use. Because they do not release any greenhouse gasses (GHGs) or make any noise, they are environmentally friendly. Even at slower speeds, the electric propulsion system delivers significant torque instantly. Due to such benefits and their own limited range, electric vehicles are ideal for city driving. BEVs such as the Nissan Leaf, Tesla, and several Chinese models are some of the best-selling automobiles in the world. Figure 1 presents the structure of a BEV. In BEV, the batteries supply electric power to the motor, which makes the tires rotate. A power electronic driver circuit controls the operation of the motor. Most of the time, driving the vehicle is done between 2200 and 4800 rpm with a large quantity of torque. Since vehicles used in cities frequently start and stop, they must run at torques of up to 125 Nm to keep their rpm low.

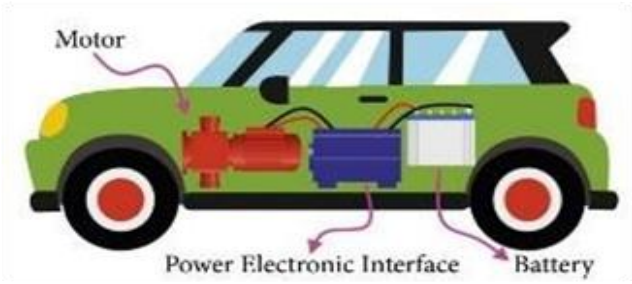

Fig -1: Battery Electric Vehicle

2. Solar Electric Vehicle (SEV)

Solar electric vehicles are the future of the automobile industry because they require renewable and sustainable forms of energy. It uses photovoltaic cells to convert solar energy from sunlight to electrical energy. These vehicles are also known as green vehicles because they prevent environmental pollution. Figure 2 presents the solar electric vehicle. The initial cost of solar vehicles is high, but they require less maintenance since solar energy is unlimited and free. "Sun mobile" was the first solar vehicle. William Cobb demonstrated Sun mobile at General Motors Power auto show held in Chicago, Illinois. Solar electric vehicles utilize solar energy for their traction. The vehicles are fitted with solar panels, and the generated electrical power may be used right away or may be stored in a battery for later use. Usually, such vehicles are flat shaped with more surface area to incorporate more solar panels. Sudevan and Selvakumar developed a feasible solar car that can reach up to a top speed of 100 kmph. Even though many solar cars were developed, there are no commercially available solar cars in the market.

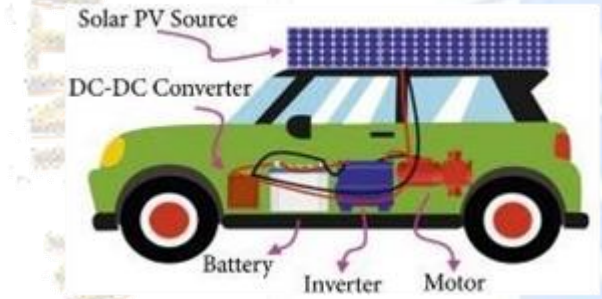

fig-2: Solar Electric Vehicle

2.1 Charging System of the vehicle

The power supply to the electric motor comes from the batteries. When driving a vehicle on an electric motor the stored energy in the battery is used up quickly. At the same time another battery is charging through the DC generator and solar panels. Figure 3 presents the power flow of the vehicle. This vehicle has two charging sources, (solar energy, DC generator).and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

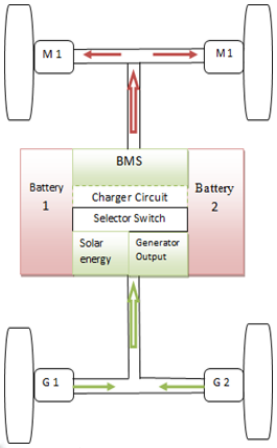

Fig -3: Power Flow of Vehicle

Solar Energy Charging: It typically consist of a few key components-

1. Solar panels: solar panels are responsible for capturing energy from the sun and converting it into usable electricity. They are typically mounted on the roof of the vehicle and connected to the charging system.
2. Charge controller: a charge controller is used to regulate the amount of current that flows from the solar panel to the battery. It ensures that the battery is not overcharged or undercharged and protects the battery from the damage.

DC Generator Charging: A DC generator is typically powered by the DC motor of a vehicle; the DC generator is indirectly connected through the Running motor which provides the mechanical energy to the generator. And then the generator converts it into electrical energy and feeds it back to the battery.

Energy Storage Systems/Battery Storage Systems for EVs

Energy storage technologies oversee supplying a steady supply of energy to the motors, but they are prone to unreliable operation, power loss, and sluggish variable reactions. The battery storage system (BSS) is an excellent candidate for providing a continuous supply of power over an extended period because of its small size, high energy density, and proven durability [58]. For EV applications, many requirements must be considered for energy storage such as energy management system, driving range, power electronics interface, conversion efficiency, safety, and protection. The conventional batteries are electrochemical batteries, in which energy is transformed from chemical energy to electrical energy and vice versa through a reversible process. These batteries store and release electrical energy by going through charging and discharging phases, and during the process, no harmful emissions are produced, and they require little maintenance. The battery life depends on the charging temperature, discharge rate, and other parameters of the vehicle. However, battery life gets affected as chemical reactions take place continuously

and the condition will get worse if it is operated exceeding the limits of their specifications. A battery management system (BMS) or energy management system (EMS) is therefore necessary for monitoring the health of batteries.

Converters for Electric Vehicles

Each DC-DC converter requires particular requirements and specifications for integrating the storage systems with the drive train's HVDC link. Bidirectional DC-DC converters support the process of regenerative braking, thereby increasing the system efficiency. major role of converter is to perform quick charging and dis-charging operations in a super capacitor-based ESS, but for timely operations, proper regulation methods and pulse-width modulation strategies are required reform, the converters with reduced component count are mostly implemented while connected with super capacitors.

Due to the long interval charging profiles of BSSs, the batteries' lifespan can be increased. Most of the charging stations contain a high-voltage gain DC-DC converter for producing high power at its output. Since the power obtained from the batteries and super capacitors is very low, a high-voltage DC-DC converter must be established for meeting the requirements of the load. A reliable DC-DC converter produces less ripples, less cost, and high output power with very few components are two types of converter configurations in electric vehicles: non-isolated and isolated. Non-isolated topologies are opted for high- power EVs, while isolated topologies are suitable for low-power EVs.

Constant Current-Constant Voltage (CC-CV)

The standard type of charging lithium-ion battery is the two-step process, CC-CV, as shown in Figure 11. During the CC stage, the current rate and the cut of voltage depend on the lithium-ion battery chemistry. The battery manufacturer shows the battery parameters; most of the lithium-ion battery manufacturers define the current below 20 A. This method has been used for the lithium-ion battery charging since it is more suitable for low to high charging rates. The main drawback of this CC-CV charging method is long charging time; for example, in general, CC-CV charging takes two hours. The main advantage of this charging is preventing the overcharging and reducing the temperature during charging. However, for reducing the charging time, the chargers with higher current rating are used. However, it reduces the charging efficiency due to the joule heating, and it creates lithium deposition during the end of CC stage.

Fast Charging

Fast charging is achieved based on the lithium-ion battery architecture. Fast charging requires a thicker electrode for high energy density. Also, the temperature of the battery and physical properties of the material are the quantities to be considered for fast charging. During low ambient temperature, the charging rate and voltage should be kept low in order to enhance safer operation. Fast charging follows the temperature threshold value based on the C-rate and cell parameters. It depends on the temperature, power converter efficiency, BMS, and power levels. This charging is not suitable for all charging due to its failure in safety.

Benefits

- Reduced environmental impact.
- Energy independence.
- Lower operating cost.
- Longer life spans.
- Zero emission.
- Quiet operation.
- Regenerative braking is possible.
- Better performances. etc

3. CONCLUSIONS

In this work solar powered electrical vehicles have been successfully fabricated with FC generators. Generally, the electric hybrid vehicles are disadvantaged during long distance travels and also require periodic plug in of their batteries. This kind of problem has been solved using hybrid electric vehicles, which consist of solar panels on their roof and DC generators connected with the batteries. It gives a car self-charging potential from the solar panel and DC generator. The efficiency of solar panels is 20-25%, and efficiency of DC generators is 35-40%. But there are various means to increase the efficiency of the panels by changing their silicon materials. This challenge now can turn out to be a good scope for further development of a pollution free vehicle

REFERENCES

C. Ma, L. Madaniyazi, and Y. Xie, "Impact of the electric vehicle policies on environment and health in the Beijing–Tianjin–Hebei region," International Journal of Environmental Research and Public Health, vol. 18, no. 2, p. 623, 2021.

F. Raymand, P. Ahmadi, and S. Mashayekhi, "Evaluating a light duty vehicle fleet against climate change mitigation targets under different scenarios up to 2050 on a national level," Energy Policy, vol. 149, Article ID 111942, 2021.

I. C. Gil-García, M. S. García-Cascales, H. Dagher, and A. Molina-García, "Electric vehicle and renewable energy sources: motor fusion in the energy transition from a multi-indicator perspective," Sustainability, vol. 13, no. 6, p. 3430, 2021.

J. Kang, T. S. Ng, B. Su, and A. Milovanoff, "Electrifying light-duty passenger transport for CO2 emissions reduction: a stochastic-robust input–output linear programming model," Energy Economics, vol. 104, Article ID 105623, 2021

S. LaMonaca and L. Ryan, "The state of play in electric vehicle charging services–a review of infrastructure provision, players, and policies," *Renewable and Sustainable Energy Reviews*, vol. 154, Article ID 111733, 2022.

A. C. R. Teixeira and J. R. Sodre, "Impacts of replacement of engine powered vehicles by electric vehicles on energy consumption and CO2 emissions," *Transport and Environment*, vol. 59, pp. 375–384, 2018.