ISSN: 2455 - 1597

International Journal of Engineering Research and Generic Science (IJERGS)
Available online at: https://www.ijergs.in

Volume - 10, Issue - 2, March – April - 2024, Page No. 01 - 06

The State of the Art of Recent Advancement in the Electrical Vehicles

[1]Shoaib Khan, Department of Electrical and Electronics Engineering, Eklavya University, Damoh, M.P.

[2]Dr. R D Nirala, Department of Electrical and Electronics Engineering, Eklavya University, Damoh, M.P.

[3]Sooraj Kumar Chourasia, Department of Electrical and Electronics Engineering, Eklavya University, Damoh, M.P.

[4]Amit Vishwakarma, Department of Electrical and Electronics Engineering, Eklavya University, Damoh, M.P.

Abstract

Electric vehicles (EVs) are experiencing a surge in global prominence as opposed to conventional automobiles powered by fossil fuels. Recent research indicates that a 1% increase in renewable energy sources will result in a 2%-6% increase in the demand for electric vehicles. It has been acknowledged that electric vehicles (EVs) present novel prospects in terms of delivering consumption flexibility and regulation services through the instantaneous modification of recharging power. This article is related to brief information about the functioning of different electrical vehicles their components and different motors used in electrical vehicles. This proposed review article also contains the comparative information to select the motors and their control for manufacturing of the electrical vehicles.

Keywords: Electric Vehicles, Solar Photovoltaic System, Traction Motor, Battery Energy Storage System.

Introduction

Electric vehicles (EVs) are gaining popularity around the world, outpacing traditional fossil-fuel vehicles. However, because batteries are far more expensive, the purchase price of an EV may remain the primary market barrier. Customers choose EVs for a variety of reasons, including less environmental impact due to zero carbon emissions, increased performance, and so on. Consumers that are environmentally conscious and have a vision for renewable energy are necessary for energy sustainability. According to recent research, a 1% increase in renewable energy would result in an approximately 2–6% rise in EV demand. The issues of electric vehicle (EV) charging stations are examined in this chapter, as well as the expanding use of distributed generators in today's electrical grid. The advantages of using photovoltaic (PV) sources in conjunction with battery storage systems are discussed.

In the field of energy engineering in the future, power electronics will play a significant and important role [1-2]. In the course of many years, electronics have always been a component of the vehicle system, serving a variety of purposes including entertainment, safety, sensors for smooth operation, battery charging, and so on. Recently, however, there has been a substantial amount of attention paid to the use of electronics in power trains for the purpose of improving engine propulsion and their management. In an electric vehicle, it was observed that the efficiency of the vehicle significantly increased when the traditional mechanical and hydraulic systems were replaced with electric systems. A significant amount of research on the function of power electronics in electric cars has been prompted as a result of this. The purpose of this study is to provide a concise overview of the areas in which power electronics semiconductor devices have been integrated into electric vehicles to a significant degree.

Background

The exploration of sustainable electricity and transportation has emerged as a significant societal, political, and economic concern in the twenty-first century [1]. Energy-related and transportation-related fossil fuel consumption is one of the largest contributors to anthropogenic carbon emissions, accounting for approximately 60% of global CO2 emissions. As the foundation of societal progress, electricity has already accounted for 37.5% of global CO2 emissions, or 7700 million tons of CO2 annually; this demonstrates that a global decarburization of electricity is an urgent matter that requires serious consideration [2]. Given the quantity of carbon dioxide (CO2) emitted by the electricity sector, it is indisputable that establishing a sustainable electricity supply represents the foremost obstacle for developed, developing, and underdeveloped nations worldwide. Thankfully, numerous decarburization strategies for electricity production have already been identified in the international energy industry. The methods that have been identified encompass the utilization of efficient fossil fuel electricity systems (CHP), the integration of carbon capture systems into conventional fossil fuel electricity generation machinery, and the implementation of renewable energy technologies specifically designed for small, medium, and scale electricity applications [3].

One could contend that the intermittent nature of renewable energy sources in electricity generation has been compromised, given their reliance on seasonal variations. This is the primary determinant that causes the international community to perceive renewable electricity technologies as unsustainable solutions for global energy security and provision. An approach that is straightforward to implement in order to address the challenge posed by the intermittent nature of renewable energy sources in real-time and simulated electricity generation is to analyze generation on a diurnal scale, specifically at the hourly level, and integrate various renewable energy technologies through hybrid systems [4].

Changing government policies and an increase in the concentration of pollutant gases in the atmosphere are driving the rise of electric vehicles as an alternative mode of transportation. The adoption of electric vehicles has become an increasingly prevalent notion in recent years.

A recent development in the electric vehicle (EV) industry [5] pertains to the hybridization of power storage. The hybrid power storage space configuration comprises the utilization of multiple energy storage devices to supply power to the motor. Diverse fuel cell, ultracapacitor, solar, and battery-powered vehicle models [6] have been appearing on a global scale as a result of substantial efficiency advancements in these vehicles.

The information utilized in the development of these electric vehicles [7-9] is contingent on a variety of factors, including the environmental impact of greenhouse emissions, fuel consumption efficiency, battery charging, discharging cycles, and driving range. Power, density, life, cost, and life expectancy of energy storage units (batteries, ultra capacitors) are critical determinants of success for each strategy.

Ultracapacitors (UC) [10] satisfy the necessary energy, voltage, and current ratings through the connection of multiple electrolytes to distinct modules. In contrast to ultracapacitors [11], which convert electrical energy into chemical charge storage, batteries store charge electrostatically. Extremely capacitive materials are more expensive in comparison to batteries [12]. Energy is stored in ultracapacitors [13] via charge separation at the interface of the electrodes. In addition to enduring thousands of charge and discharge cycles without degradation, ultra capacitors facilitate rapid energy transfer [14].

Ultracapacitors are applicable to a wide range of applications, regardless of whether the energy demand is high or moderate. In addition to serving as a primary energy storage strategy, ultra capacitors can be employed to provide energy support during acceleration, hill ascending, and regeneration. When an ultra capacitor and a battery are utilized in tandem, the energy storage capability is enhanced. This (UC, Battery) configuration supplies peak energy during system operation transients. The inclusion of supplementary power electronic converters [15] results in an increase in the overall cost of the system. However, ultra capacitors utilize their inherent characteristics to capture and store a greater quantity of energy, then rapidly discharge that energy during periods of acceleration. Thus, an ultra capacitor is a battery-powered solution that captures and releases a greater amount of energy from regenerative deceleration [16] during the initial stages of acceleration. The energy management system [17] functions as a superior that regulates the functioning of the motor and engine while it is not in use, storing energy and subsequently employing it during periods of high demand.

Components And Working of Electric Vehicle

The size, power, and proposed application of a battery, traction motor, and motor controller varies depending on the size, power, and proposed application, which can range from a motorised shopping cart or wheelchair to pedelecs, electric motorcycles and scooters, neighbourhood electric vehicles, industrial forklift trucks, and many hybrid vehicles. In order to offer mobility that is both efficient and kind to the environment, electric vehicles (EVs) are made up of a number of essential components that collaborate with one another. Listed here are the primary constituents:

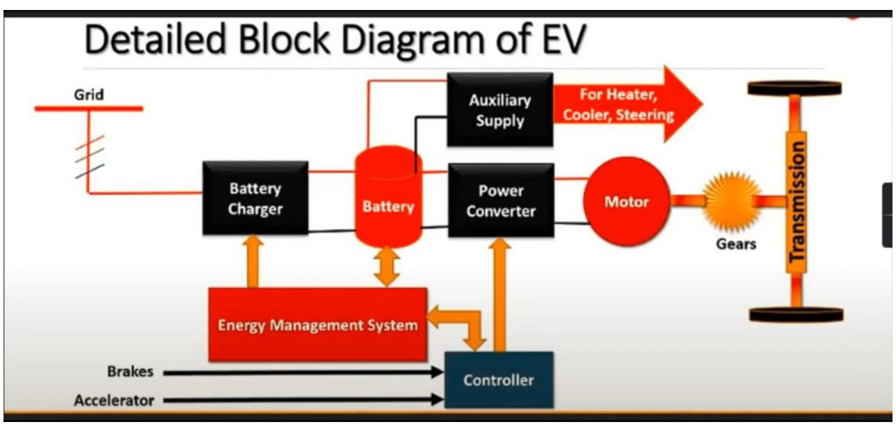

Fig.1: Block Diagram for Different Components of Electric Vehicles

Package of Batteries: The battery pack is the most important component of an electric vehicle. The vehicle is propelled by the electric motor(s) that are powered by the chemical energy that is stored in the form of electrical energy. Battery packs are often made up of lithium-ion cells that are stacked in modules or packs in order to provide the necessary voltage and capacity [18].

Electricity is controlled by power electronics, The components that make up these systems include inverters, converters, and controllers, all of which are responsible for regulating voltage, current, and frequency in order to maximize efficiency and performance. Using external power sources, there are a variety of charging standards that are supported by electric vehicles (EVs), including AC charging (Level 1 and Level 2) and DC fast charging (Level 3). These charging standards differ in terms of charging speed and compatibility.

Thermal Management System: Radiators, coolant pumps, and heat exchangers are some of the cooling components that are included in this system specifically for the purpose of dissipating excess heat that is created during operation and charging. A vehicle control unit, often known as a VCU, is the component of an electric vehicle that is responsible for managing the functioning of the vehicle's many different components and systems [19].

Regenerative Braking System: Regenerative braking is a system that enables electric cars to recover energy while they are braking and decelerating.

Auxiliary Systems: Electric cars are equipped with auxiliary systems that are powered by either the main battery pack or auxiliary batteries. These systems include heating, air conditioning, power steering, and entertainment systems.

Different types of motors used in electric vehicle

In this chapter we have discussed detailed theory and applications of electric vehicle.

AC Induction Motor (Asynchronous Motor): AC induction motors are popular in electric cars because of their simplicity and dependability. The process by which alternating current in the stator coils gives rise to a rotating magnetic field, which in turn causes the rotor to revolve. Within the realm of AC induction motors, the rotor is often of the squirrel-cage kind, which is composed of conducting bars.

Permanent Magnet Synchronous Motor (PMSM): PMSM motors are characterized by the presence of permanent magnets on the rotor, which interact with the spinning magnetic field that is generated by the stator windings. When compared to AC induction motors, this design provides benefits in terms of both efficiency and power density. As a result of its ability to give precise control over speed and torque, PMSM motors are appropriate for use in high-performance electric cars.

Brushless DC Motor (BLDC): Brushless DC motors are characterized by the use of a permanent magnet rotor and a stator that houses windings that are regulated electronically. By removing the requirement for brushes and commutators, brushless direct current (BLDC) motors are able to switch the current in the stator windings via the use of electronic commutation, in contrast to brushed DC motors.

Conclusion

The development of electric and hybrid cars (EV/HEV) has picked up speed in a world where there is a rising concern for the preservation of the environment and the conservation of energy resource. It is becoming more possible to realise the ideal of having electric automobiles that are financially feasible. Electric automobiles are becoming more accessible to consumers on the market. With a particular focus on the engineering philosophy and essential technologies, this study examines the current condition of electric cars all over the globe as well as their current state of the art. A discussion is held on the significance of integrating technologies such as automobiles, electric motor drives, electronics, energy storage and controls, as well as the significance of integrating the strength of society, which includes the government, industry, research institutions, electric power utilities, and transportation authorities. The difficulty of commercialising electric vehicles is another topic that is covered.

In the battery management of the hybrid vehicle, the future work can be extended to integrating concepts of the battery management system and power management that can be controlled with the state of charge, controlling the power flow. The vehicle can also be analyzed with different types of converters with different switching designs where a higher gain can be obtained. A vehicle can also be analyzed with different multilevel inverters and so the total harmonic distortion of the output of the inverter can be decreased. Also, the motor drive for the vehicle can be realized with different controllers to obtain control over the speed and reduction of torque ripples.Various methods can be used to realize the wireless connection to the car to eliminate the difficulty of unlocking.SC-Bank location can be used for heavy-duty vehicles and stand-up and vehicle testing. Other customizable ways to choose the rotation of the car.The fixed lanes of the vehicle can be projected to reach the maximum rate of renewal rate and rate of application.

References

1. Badea, Gheorghe, Raluca-Andreea Felseghi, Mihai Varlam, Constantin Filote, Mihai Culcer, Mariana Iliescu, and Maria Simona Răboacă. "Design and simulation of romanian solar energy charging station for electric vehicles." Energies 12, no. 1, 2019.
2. Mouli, G.C., Bauer, P. and Zeman, M., “System design for a solar powered electric vehicle charging station for workplaces”, Applied Energy, *168*, pp.434-443, 2016.
3. Vignesh, T. R., M. Swathisriranjani, R. Sundar, S. Saravanan, and T. Thenmozhi. "Controller for Charging Electric Vehicles Using Solar Energy." Journal of Engineering Research and Application 10, no. 01, pp. 49-53, 2020.
4. Suganthi, D., and K. Jamuna. "Charging and Discharging Characterization of a Community Electric Vehicle Batteries." In Emerging Solutions for e-Mobility and Smart Grids, pp. 213-223. Springer, Singapore, 2021.
5. Harika, S., R. Seyezhai, and A. Jawahar. "Investigation of DC Fast Charging Topologies for Electric Vehicle Charging Station (EVCS)." In TENCON 2019-2019 IEEE Region 10 Conference (TENCON), pp. 1148-1153. IEEE, 2019.
6. Gautham Ram Chandra Mouli, Pavol Bauer and Miro Zeman, "System design for a solar powered electric vehicle charging station for workplaces." Applied Energy, 2016.
7. Ravikant, U. Chauhan, V. Singh, A. Rani and S. Bade, "PV Fed Sliding Mode controlled SEPIC converter with Single Phase Inverter," 2020 5th International Conference on Communication and Electronics Systems (ICCES), pp. 20-25, 2020.
8. Xu, Tong, Hengshu Zhu, Xiangyu Zhao, Qi Liu, Hao Zhong, Enhong Chen, and Hui Xiong. "Taxi driving behavior analysis in latent vehicle-to-vehicle networks: A social influence perspective." In Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, pp. 1285-1294. 2016.

9. Saadullah, Shata Ahmed, Furkan Ahmed, Mahdi ShafaatiShemami, Mohammad Saad Alam, and Siddiq Khateeb, "A comprehensive review on solar powered electric vehicle charging system." Smart Science 6, no. 1, pp. 54-79, 2012.
10. Anderson, John Augustus. "Power-conditioned solar charger for directly coupling to portable electronic devices." U.S. Patent No. 9, 088,169. 21 Jul. 2015.
11. SimiranKuwera, Sunil Agarwal and Rajkumar Kaushik, "Application of Optimization Techniques for Optimal Capacitor Placement and Sizing in Distribution System: A Review", International Journal of Engineering Trends and Applications (IJETA), vol. 8, no. 5, Sep-Oct 2021.
12. T. Manglani, A. Vaishnav, A. S. Solanki and R. Kaushik, "Smart Agriculture Monitoring System Using Internet of Things (IoT)," 2022 International Conference on Electronics and Renewable Systems (ICEARS), Tuticorin, India, 2022, pp. 501-505.
13. T. Manglani, R. Rani, R. Kaushik and P. K. Singh, "Recent Trends and Challenges of Diverless Vehicles in Real World Application", 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), pp. 803-806, 2022.
14. Guo, Qijie, et al. "Fabrication of 7.2% efficient CZTSSe solar cells using CZTS nanocrystals." Journal of the American Chemical Society 132.49, pp. 17384-17386, 2010.
15. L. Shi and M. L. Crow, “Comparison of ultracapacitor electric circuit models,” in Proceedings of the IEEE Power and Energy Society 2008 General Meeting: Conversion and Delivery of Electrical Energy in the 21st Century, PES, Pittsburgh, PA, USA, July 2008.
16. H. Seki, K. Ishihara, and S. Tadakuma, “Novel regenerative braking control of electric power-assisted wheelchair for safety downhill road driving,” IEEE Trans. Ind. Electron., vol. 56, no. 5, pp. 1393–1400, May 2009.
17. O. Tremblay and L. A. Dessaint, “Experimental validation of a battery dynamic model for EV applications,” World Electr. Veh.J., vol. 3, no. 1, pp. 289–298, 2009.
18. Burke.A. and Miller, M., “Lithium batteries and ultracapacitors alone and in combination in hybrid vehicles: Fuel economy and battery stress reduction advantages”, at the Electric Vehicle Symposium 25, Shenzhen, China, November 2010.
19. T. G. S. Román, et al., "Regulatory framework and business models for charging plug-in electric vehicles: Infrastructure, agents, and commercial relationships," Energy Policy, vol. 39, pp. 6360–6375, October 2011.