IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2022
Impact Factor: 6.252

Sorts of Electric Vehicle- An Overview

Poonam A. Thorat[1], Pawan C. Tapre[2], Dipesh B. Pardeshi[3], Ganesh V. Gavhane[4]
PG Student, Department of Electrical Engineering[1]
Associate Professor, Department of Electrical Engineering[2,3]
Lecturer, Department of Mechanical Engineering[4]
SND College of Engineering, & Research Center, Yeola, Maharashtra India[1,2]
Sanjivani College of Engineering, Kopargaon, Maharashtra India[3]
SND Polytechnic, Yeola, Maharashtra, India[4]
poonamthoratelect@sanjivani.org.in, pawan.tapre25@gmail.com,
pardeshidipeshelect@sanjivani.org.in,gavhaneganesh2012@gmail.com

Abstract: *Nowadays, pollution is increasing very rapidly and causes adverse effects on the environment. This pollution is because of conventional vehicles. The conventional vehicles emit various harmful gases like unburned hydrocarbons, oxides of nitrogen (NOx), carbon monoxide (CO), etc. To reduce this pollution electric and hybrid electric vehicle plays a very important role. The fuel price is also increasing day by day. So there is need to find the alternate solution for this. So, various researchers perform their research on the Hybrid Electric Vehicles (HEVs) and Energy Management System (EMS). In this paper various aspects and types of hybrid electric vehicle are reviewed also ad- vantages of hybrid electric vehicles are discussed..*

Keywords: Pollution, Electric vehicles, Hybrid Electric Vehicles (HEVs), Flex-Fuel Engine (FFE).

I. INTRODUCTION

Electrical vehicle are the vehicles that use electric motors for its propulsion. These vehicles are pollution free and ecofriendly vehicle [24]. As we know that electrical vehicles are not much popular for consumers due to limitation of to travel long dis- tances without being charged [27]. The vehicle which gives best performance of con- ventional vehicle and zero emission characteristics of electric vehicle are more ac- cepted by consumers. Hybrid electric vehicle is combination of electrical vehicle and conventional vehicle [26, 30].

The different thing in electrical vehicle is that energy can be fed back in the battery and that battery stores energy at a time of regenerative braking and in conventional vehicle this energy is wasted in the form of heat [2]. There are two main types of electrical vehicle i.e. Plug in and hybrid electric vehicle. These vehicles increase the efficiency of vehicles and known as pollution free vehicle [29].

II. TYPES OF ELECTRIC VEHICLES

2.1 Plug in Electric Vehicle

Construction of plug in type electric vehicle is very simple. It consists Components like Battery, Converter & Motor Battery is used to store energy from AC supply and it gives DC power for vehicle at the time of running. The motor requires to drive the vehicle may be Induction motors or DC motors or brushless DC motors, synchronous motors having permanent magnet. For splitting the torque, we can use more than one motor. The location of motors is in the wheel hubs. For that purpose, each motor re- quires separate convertor along with speed and torque control. An electric vehicle is pollution free and ecofriendly vehicle but it has drawback of battery getting dis- charged rapidly so that it is not used for long distances [9].

2.2 Hybrid Electric Vehicle

Automobile sector made biggest contribution to the heightening of current society by fulfilling the needs for eminent mobility in day today life. In automobile sector the development of internal combustion engine has contributed in more

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2022
Impact Factor: 6.252

extent. But there is emission of toxic gases in very large amount. The toxic gases are unburned hydro- carbons (HCs), nitrogen oxides (NOx), carbon dioxide (CO2), carbon monoxide (CO), unburned hydrocarbons (HCs) etc. These gases may cause harmful effect on Ozone layer, global warming and Human life also. We know that internal combustion engine resources are very limited in our country so that there is need to reduce the use of this resources. One of great solution for this problem is to choose alternate technol- ogy for conventional transportation system which can use IC engine and batteries [12, 26].

III. The Hybrid Electric Vehicles (HEVs)

3.1 According to Structure

- Series hybrid
- Parallel hybrid
- Series-Parallel hybrid
- Complex hybrid

A. Series Hybrid

In case of series hybrid structure, without directly giving the wheels of vehicle, com- bustion engine drives generator. An electric motor is only one source of providing power to wheels of vehicle [31]. The main advantage of series hybrid is that generator used for charging the batteries as well as drive the vehicle. When there is need of large power then motor uses both batteries and generator [4]. As there is no direct connection used between IC engine and transmission, IC engine operated at highest efficiency [3].

B. Parallel Hybrid

Parallel hybrid structure, battery and combustion engine both are connected in parallel form. Electrical system and engine connected to the mechanical transmission system. In this case when there is need if large power then internal combustion engine activate otherwise vehicle run only with the help of electrical system. Many designs combine electrical generator as well as motor into one common unit which is placed between internal combustion engine and transmission which replaces starter and alternator. [5, 25].

C. Series -Parallel Hybrid

Series Parallel hybrid electric vehicle has a feature of series and parallel hybrid elec- tric vehicle. Series hybrid involves one mechanical link and generator. In case of Par- allel hybrid such type of links are not involve. As structure of this system is complex then cost of manufacturing also high but control is easy [4, 5].

D. Complex Hybrid

Complex hybrid is somewhat similar to series parallel hybrid as motor and generator is present. This structure includes minimum two electric motors or more than that and overall efficiency is increased. The main difference in complex hybrid and series parallel hybrid is that direction of power flow. In case of series parallel hybrid, there is unidirectional direction of power flow and it is bidirectional in case of complex hybrid type [6].

3.2 According to the Function of the Electric Motor and Level of the Electric Power.

- Full Hybrid
- Mild/Micro Hybrid
- Medium Hybrid

A. Full Hybrid

A full hybrid electric vehicle means it can be run on only engine, only batteries, or combination of engine and batteries. For that purpose, very large battery pack is required for running vehicle just on battery operation. Followings are the

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2022
Impact Factor: 6.252

examples of full hybrid electric vehicle, Toyota Prius, Auris, and Lexus [14]. These vehicles can operate on only battery packs [3].

B. Mild/Micro Hybrid

Mild hybrid electric vehicle shows a conventional vehicle provided with a bulky starter motor which enables the internal combustion engine to stop whenever the break of movement of vehicle is detected. The engine of vehicle can be again started rapidly by applying force on clutch pedal [8].

C. Medium hybrid

Medium hybrid electric vehicles use the internal combustion engine as a primary source of energy.an additional electric system is designed to increase the torque. The running mode of the electrical system is available for a very limited time [8].

3.3 Other Type of Hybrid Electric Vehicle [32]

- Hybrid electric vehicle plug in type
- Fuel cell hybrid electric vehicle
- In wheel motor hybrid electric vehicle

A. Hybrid Electric Vehicle Plug In Type

Hybrid electric vehicle plug in type is a type of electrical vehicle. It consists of batter- ies which can be restored energy while recharging when plug is connected to other type of external electric power source. Hybrid electric vehicle plug in type gives characteristics of hybrid electric vehicle which consist of IC engine and motor. The size of this vehicle is large as compared to conventional hybrid electric vehicle. There is a very large battery pack [6, 23].

B. Fuel Cell Hybrid Electric Vehicle

We already know that conventional power system uses internal combustion engines and due to the increase in exhaust gases and noise, hybrid electric vehicles fuel cell type are solution for this. Fuel cell electric vehicles prime source of energy is fuel cell which is very good option for conventional vehicle. As fuel cell provides electrical energy from chemical energy which is very clean energy conversion [7].

C. FC–HEV Classifications

In case of FC-HEV various sources of energy should be manage to feed sufficient energy for electric motor according to the demand and power. Numerous research was conducted on HEVs. Sakka et al. [10, 16] discussed about energy devices having high energy storage capacity and high power reversibility. The studies done on the fuel cell type HEVs and classification is discussed in following sections [9].

- Fuel Cell–Battery Hybrid Electric Vehicles
- Fuel Cell–SC Hybrid Electric Vehicles
- Fuel Cell–battery–SC Hybrid Electric Vehicles

Fuel Cell–Battery Hybrid Electric Vehicles (HEVs)

In this type there are two modules, first one is module for power distribution dividing demand power into battery power and DC power, another module is braking strategy module that may be in series or in parallel [17]. The battery with fuel cell improves the performance of electric vehicles [9].

Fuel Cell–SC Hybrid Electric Vehicles (HEVs)

The (SC) Super Capacitor is used for fast transient response and for high power densi- ty for improving efficiency of the HEVs. Alternative to increase the performance and the efficiency of the hybrid electric vehicles can be the combination of fast and slow transient response of Super Capacitor (SC) [9].

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2022
Impact Factor: 6.252

Fuel Cell-Battery SC Hybrid Electric Vehicles (HEVs)

The HEVs with battery and SC i.e. secondary energy source are made to supply the power for minimum timing of demand of peak power [18]. The high power and high energy density is required for good acceleration. Both the battery and the SC is re- quired due to the battery having the lower power density and the SC having lower energy density and higher power density [15].

In Wheel Motor Hybrid Electric Vehicle

In wheel motor hybrid electric vehicle is very new technology in hybrid electric vehi- cle (HEVs). In this type an electric motor is placed at the wheel of car/vehicle, so that this vehicle is called as in wheel motor hybrid electric vehicle. There is no need of any transmission and other complex mechanical component to drive the torque and braking the force. As in wheel motor hybrid electric vehicle has poor torque density and overload capability it is not suitable for most of machines. [5].

3.4 Start -Stop Hybrid

This vehicle is not included in real hybrid vehicle, because there is no use of batteries to run the vehicle. This is very useful type of technology which has support to in- crease the saving of constituent for Hybrid vehicles. This hybrid can preserve the energy by turning off internal combustion engine at the time of stop period. Internal combustion engine will be pick up once the driver compresses the pedal of vehicle again to move in forward direction. At the earliest driving stage internal combustion engine just starts instantly after the vehicle has started to shift out of rested position. Regenerative braking and conventional braking both are used in start stop type of vehicle [13].

3.5 Flex-Fuel or Flexible Fuel Engine Vehicle

The methanol or ethanol is combined with the conventional fuel the alternative fuel get formed known as Flex-Fuel or Flexible Fuel [20]. Ministry of union road transport and highways, government of India once again highlighted the importance of ethanol in a transport sector[19]. There are some alternatives available which are CNG, Etha- nol, Electric and Bio-LNG [28] Due to the application of flex fuel engine, the demand of ethanol will have increased at least four times. According to the ministry, govern- ment would make mandatory to all manufacturers of vehicles that they make the flex fuel engines that fulfils today's demand of fuel. Various countries like Canada, UK, and Brazil are also making such type of engine [22]. This type of engines could re- duce the dependence on conventional crude oil [21]. Now a day the prices of petrol and diesel are on hike so option of flex fuel engines would be more beneficial.

It should be noted that, while designing the flex fuel engines, the performance of gas- oline engine should not be affected. The biofuels having both physical and chemical properties so the efficiency of the flex fuel engine will be high.

IV. Advantages of Hybrid Electric Vehicle

- HEVs are environmentally friendly.
- More Financial benefits compared to conventional vehicles.
- HEVs are less dependent on fossil Fuels.
- HEVs having Regenerative Braking System.
- HEVs built from light materials.
- Automatic start and stop system is available with smaller engine

V. Disadvantages of Hybrid Electric Vehicle

- Charging stations are under development so deficiency of charging stations.
- Initial cost is more than that of conventional vehicle.
- There is limitation on driving range and speed.
- Takes more time to get fully recharge.
- Silence may cause the accidents.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2022
Impact Factor: 6.252

- Need to replace battery after several days.

VI. Conclusion

As discussed in paper, the electric vehicles are pollution free, economical but it also has some limitations over other vehicles, like lack of charging stations, more cost, replacement of batteries etc. Many types of electric vehicles like series, parallel, se- ries-parallel and complex hybrid configurations are available. Many other configura- tions are also available for electric vehicles. The fuel cell HEVs are also having bat- tery HEVs, SC HEVs and SC-battery HEVs configuration. The super capacitor (SC) is used to improve the performance output of the hybrid electric vehicles (HEVs). For minimum duration peak power demand, another energy source i.e. battery-super ca- pacitor (SC) can be used.

In construction of hybrid electric vehicles, light materials are used and it also has some financial benefit over conventional vehicles. The smaller engine size, automatic starts and stop and having Regenerative Braking System are also the features for these types of vehicles. Flex-Fuel Engine vehicle is more ecofriendly and beneficial. In coming 6-8 months' government will make this type of engine compulsory to all types of vehicles.

References

[1]. M. Habib Ullah, T.S. Gunawan, M. R. Sharif, R. Muhida, "Design of Environmental Friendly Hybrid Electric Vehicle",978-1-4673-0479-5/12/$31.00 ©2012 IEEE, 2012, pp.544-548

[2]. Mr. Anurag M. Lulhe, Mrs. Tanuja N. Date, "A Technology Review Paper for Drives used in Electrical Vehicle (EV) & Hybrid Electrical Vehicles (HEV)",978-1-4673-9825- 1/15/$3l.00 ©2015 IEEE,2016, pp. 632-636

[3]. Mohammad Kebriaei, Abolfazl Halvaei Niasar, Behzad Asaei, "Hybrid Electric Vehicles: An Overview"978-1-5090-0264-1/15/$31.00 ©2015 IEEE, 2016, pp.299-305

[4]. Caiying Shen,1 Peng Shan,1 and Tao Gao2, 3, 4 ,"A Comprehensive Overview of Hybrid Electric Vehicles", International / 2011 / Article,pp.1-7

[5]. Omonowo D. Momoh, Michael O. Omoigui "An Overview of Hybrid Electric Vehicle Technology",978-1-4244-2601-0/09/$25.00 ©2009 IEEE, 2009, pp.1286-1292

[6]. Vipul Agarwal and Mayank Dev, "Introduction to Hybrid Electric Vehicles: State of Art",978-1-4673-5630-5//13/$31.00 ©2013 IEEE, 2013

[7]. Sabah Saib, Zahir Hamouda, Khoudir Marouani, "Energy Management in a Fuel Cell Hybrid Electric Vehicle using a Fuzzy Logic Approach", the 5th International Conference on Electrical Engineering – Boumerdes (ICEE-B) October 29-31, 2017, Boumerdes, Algeria.

[8]. Alexandru Drosu, George Suciu, Andrei Scheianu, Ioana Petre, "An Analysis of Hy- brid/Electric Vehicle Monitoring Systems and Parameters"978-1-7281-0791-2/19.

[9]. Zeinab Rezvani, Johan Janson, Jan Bodin "Advances in consumer electric vehicle adop- tion research A review and research agenda", Transportation Research Part D 34 (2015) 122–136

[10]. Sakka MA, Mierlo JV, Gualos H. DC/DC converters for electric vehicles. Electric vehi- cles – modelling and simulations; 2011.

[11]. Thounthong P, Pierfedereci S, Martin J-P, Hinaje M, Davat B. Modelling and control of fuel cell-super capacitor hybrid source based on differential flatness control. IEEE Trans Veh Technol 2010; 59(6):2700–10.

[12]. Review article "A Review of Optimal Energy Management Strategies for Hybrid Electric Vehicle", Hindawi Publishing Corporation, International Journal of Vehicular Technolo- gy, Volume 2014, Article ID 160510, pp 1-19.

[13]. Diego Sánchez-Repila, John Edgar William Poxon, "Hybrid Electric Vehicles: Cur- rentConcepts and Future Market Trends", Rama De Estijdiantes Del IEEE De Barcelona.

[14]. Burress T, Campbell S. Benchmarking EV and HEV power electronics and electric ma- chines. In: Proceedings of the 2013 IEEE Transportation Electrification Conference and Expo (ITEC); 2013. p. 1–6.

[15]. Pollet BG, Staffell I, Shang JL. Current status of hybrid, battery and fuel cell electric vehi- cles: from electrochemistry to market prospects. Electrochem Acta 2012; 84:235–49.

[16]. Ali DM, Salman SK. A comprehensive review of the fuel cells technology and hydrogen economy. In:

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2022
Impact Factor: 6.252

Proceedings of the 41st international universities power engineering confer- ence; 2006.

[17]. Xiao D, Wang Q. The research of energy management strategy for fuel cell hybrid vehi- cle. In: Proceedings of the international conference on industrial control and electronics engineering; 2012. p. 931–34.

[18]. Paladini V, Donateo T, Ad Risi, Laforgia D. "Super-capacitors fuel-cell hybrid electric vehicle optimization and control strategy development", Energy Convers Manag 2007; 48:3001–8

[19]. N.A.Policarpo,F.S.Frutuoso,D.R.Cassiano,F.S.A.Cavalcante,R.S.Araújo,B.V.Bertoncini,M.L.M.Oliveira "Emission estimates for an on-road flex-fuel vehicles operated by etha- nol-gasoline blends in an urban region, Brazil" Volume 24, June 2018, Pages 111-120

[20]. Demostenes R.Cassiano,JoãoRibau,Francisco Sales A.Cavalcante,Mona Lisa M.Oliveira,Carla M.Silva "On-board Monitoring and Simulation of Flex Fuel Vehicles in Brazil" Volume 14, 2016, Pages 3129-3138

[21]. Hsieh, W.D., Chen, R.H., Wu, T.L., Lin, T.H., 2002. Engine performance and pollutant emission of an SI engine using ethanol-gasoline blended fuels. Atmos. Environ. 36, 403– 410.

[22]. R.Suarez-Bertoa, A.A.Zardini,H.Keuken,C.Astorga "Impact of ethanol containing gasoline blends on emissions from a flex-fuel vehicle tested over the Worldwide Harmonized Light duty Test Cycle (WLTC)" Volume 143, 1 March 2015, Pages 173-182

[23]. C.H. Stephan, J. Sullivan, "Environmental and energy implications of plug-in hybrid elec- tric vehicles"Environ. Sci. Technol., 42 (2008), pp. 1185-1190

[24]. K.M. Tan, V.K. Ramachandaramurthy, J.Y. Yong "Integration of electric vehicles in smart grid: a review on vehicle to grid technologies and optimization techniques" Renew. Sus- tain. Energy Rev., 53 (2016), pp. 720-732

[25]. S.M. Lukic, A. Emadi "Effects of drive train hybridization on fuel economy and dynamic performance of parallel hybrid electric vehicles" IEEE Trans. Veh. Tech-nol., 53 (2) (2004), pp. 385-389

[26]. S.C.B. Kramer, B. Kroposki "A review of plug-in vehicles and vehicle-to-grid capability" Proceedings of the Industrial Electronics, 2008. IECON 2008. 34th Annual Conference of IEEE (2008)

[27]. SonaliGoel,RenuSharma,Akshay KumarRathore, "A review on barrier and challenges of electric vehicle in India and vehicle to grid optimization",Volume 4, June 2021, 100057.

[28]. Cristian Huse," Fuel choice and fuel demand elasticities in markets with flex-fuel vehi- cles", © 2018 Macmillan Publishers Limited, part of Springer Nature.

[29]. Tulasi Krishna Gannavaram V, Rahul Bejgam, Saideep Sunkari, Sai Bhatt Keshipeddi, Madhava Rao Rangaraju, Venu Dunde. "A Brief Study on Hybrid Electric Vehicles", 2021 Third International Conference on Inventive Research in Computing Applications (ICIRCA), 2021

[30]. Rizzo,S. Naghinajad, F.Tiano and M. Marino,"A Survey on Through-the-Road hybrid Electric Vehicles",Electronics, vol. 9, no. 5, pp. 879, May 2020.

[31]. Ahmad S. Al-Adsani , Member, IEEE, and Omid Beik , Member, IEEE," Design of a Multiphase Hybrid Permanent Magnet Generator for Series Hybrid EV", IEEE Transactions On Energy Conversion, Vol. 33, No. 3, September 2018

[32]. Roberto FinessoEzio SpessaMattia Venditti," Layout design and energetic analysis of a complex diesel parallel hybridelectric vehicle", R. Finesso et al./Applied Energy 134 (2014) 573–588