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Review on Hybrid Electric Vehicle

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Abstract: *This paper reviews the current status and execution of Hybrid Electric Vehicle, plug-in electric vehicles and hybrids, battery chargers, charging power levels.In this paper we present the architecture of Electric Vehicle charging station. In a world where environmental protection and energy management are growing concerns, the growth of electric, hybrid or supercapacitors., and fuel cell vehicles has taken on an accelerated pace. In this paper, we would like to look at the growth factor of growing vehicles which one of the most pressing demands of our time is for unconventional fuels,. The technical roadmaps of Hybrid Electric Vehicle is demonstrate in the paper which shows improved fuel economy compared with conventional ICE(Internal Combustion Engine) vehicles .Various power level chargers and game plan configurations are displayed, likened, and assessed dependent on measure of intensity, charging time and area, cost, gear, and different components.*

Keywords: *Battery Energy Storage System, Growth Factor, Hybrid Electric Vehicle (HEV),Integrated Multi Drive(IMD), Photo Voltaic Panel,Plug In Electric Vehicle (EV)*

I. Introduction

As the first phase to greener aircraft, more-electric aircraft (MEA) manufacturers are moving toward replacing the emergency power system, which consists of a ram air turbine or an air-driven generator, by fuel-cell systems .This will result in better performance of the emergency power system, particularly at low aircraft speed and altitude.To improve the dynamics and power density of fuel-cell systems, hybridization of fuel cells with new energy storage devices such as lithium-ion batteries or supercapacitors is required. This hybridization allows the fuel-cell system to be optimized to achieve better fuel economy and performance as part of the load is provided by the batteries/supercapacitors[1].WIRELESS inductive power transfer (IPT)—also known more generally as wireless power transfer—is an emerging technology that uses time-varying magnetic fields to transfer power over large air gaps to energize or charge one or more electrical loads with high efficiency. The two essential side power supply designs are overwhelmingly being utilized for remote EV charging frameworks, specifically the arrangement LC (SLC) full and the half breed series– parallel thunderous (LCL) topologies ,A very desirable characteristic of the LCL power supply is that when operated at or very close to resonance, it behaves as a constant current source over a very large range of coupling and loading making its control loop design easier. This is in contrast with the SLC topology, which is quite sensitive to changes in coupling and loading and requires a combination of dc-bus voltage and frequency adjustments to maintain its constant current source operation [2].The basic idea of an HESS(Hybrid Energy Storage System) is to combine ultra-capacitors (UC) and batteries to achieve a better overall performance. This is as compared to batteries, ultra-capacitors have a high power density but low energy density. Compared to the conventional HESS, the new design has lower cost and extends the battery life. the proposed circuit configuration utilizing the existing ultra-capacitors and DC/DC converter is suitable for fast charging as well[3].The charging problem becomes prominent with the increasing number of electric vehicles. It is necessary to built charging station (CS), like the gasoline station, to satisfy the recharging and be convenient for the drivers.The architecture of the developed grid-connected PV powered EV charging station (EVCS) in this paper is shown in Fig. 1. The key components of the EVCS are the PV system, the battery energy storage system (BESS) and a grid connection system. All these components are connected to a DC voltage bus through incorporating DC/DC converters and AC/DC inverter. PV system is generally the main energy source in EVCS and operates at the Maximum Power Point Tracking (MPPT) mode to maximize the utilization of the solar energyThis paper presents the functionality of a commercialized firm charger for a lithium-ion electric vehicle driving force battery. The device is projected to function in a battery switch station,

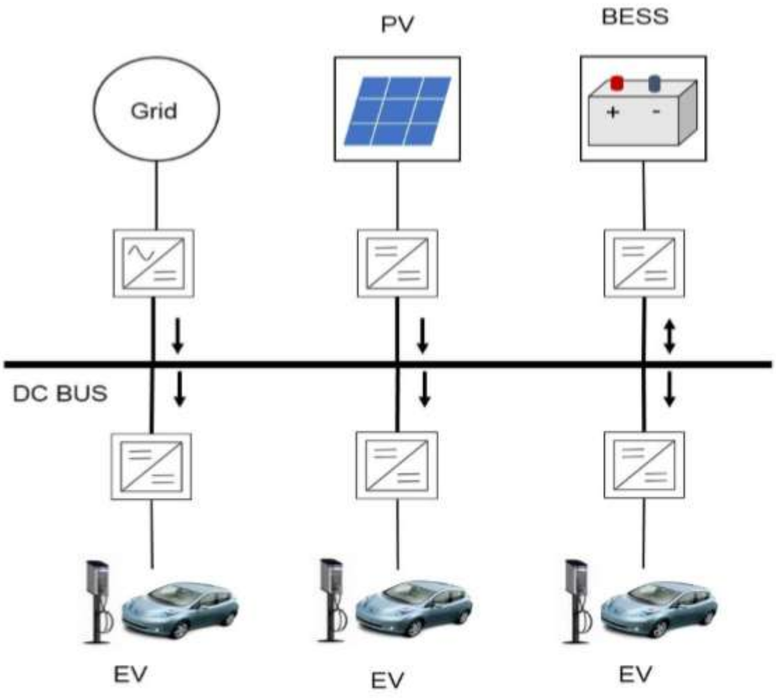

Fig. 1. Architecture of EVCS

permitting an up-to 1-h recharge of a 25-kWh exhausted battery, detached from a vehicle. The charger is planned as a double stage-controlled air conditioning/dc converter. The input stage consists of a three-phase full-bridge diode rectifier combined with a reduced rating shunt active power filter[4],[5].The challenges facing hybrid electric technology for military applications have two aspects: a technical aspect and a cost aspect. Three chemistries are being considered, Lithium Nickel Cobalt, Lithium Iron Phosphate and Lithium Titanate. If a small battery pack is added to the ISG then the brake energy can be recovered and stored in the battery and subsequently used to give a power boost to the vehicle propulsion[6].The control strategy developed in this paper can be used in the vehicle control to realize all electric operation, charge depletion, and CS operation.The control strategy developed can also operate the engine always within its low fuel consumption region, thus, yielding high overall efficiency[7].As a typical cyber-physical system (CPS), electrified vehicle becomes a hot research topic due to its high efficiency and low emissions. In order to develop innovative electric powertrains, perfect estimations of the unmeasurable hybrid states, containing discrete backlash nonlinearity and continuous half-shaft torque, are of great significance. when monitoring the powertrain, one of the boundaries of the control loop is the capability to reward for backlash and drivetrain flexibility. This is particularly essential when the driver requests the electric vehicle to go from acceleration to regenerative braking or vice versa. As a typical CPS, advanced automotive mechatronic systems requires an increasing combination of mechanical, electrical/electronic, control, and information disciplines. In this context, an algorithm dealing with simultaneous estimation of the backlash position and half-shaft torque for an automotive electric powertrain is proposed using a hybrid system approach in this paper[8].This paper advises a new five-phase dual-stator consequent-pole brushless hybrid excitation machine established on rotor permanent magnet (rotor-PM) for wide-speed range and great output torque use in electric vehicles (EVs). The electromagnetic possessions such as the torque waveform, the back electromotive force, and the flux-regulating competence are all examined by using finite-element investigation. Then, the machine parameters are enhanced and studied. For better warmth dispersal, the mechanical plan is proposed. Finally, a prototype is built; the arrangement of the tentative results and the simulations shows the projected machine can offer with high output torque, high space utilization, and good flux-regulating facility in the applications of EVs.[9]This research proposes a regenerative braking co-operative control system for the automatic transmission (AT)-based hybrid electric vehicle (HEV). The brake system of the subject HEV consists of the regenerative braking and the electronic wedge brake (EWB) friction braking for the front wheel, and the hydraulic friction braking for the rear wheel. In hybrid electric vehicle's (HEV) braking, the regenerative braking can not be used only by itself due to the following reasons: 1) the regenerative braking force is not large enough to cover the driver's demanded braking force, 2) battery state of charge (SOC) limitation, 3) vehicle (motor) speed, etc. Hence, friction braking should be desirable together with the regenerative braking and a control system is required to ensure active co-operative control among the regenerative braking and friction braking [10].This survey presented an extensive overview of electric machinery and battery technologies in EVS and HEVS, looking back over a century. The main objective was to present and analyze trends in these technologies to understand the major factors and their impact on the technologies' share of the marketplace over time. The results clearly show the rise and fall of certain technologies and a change in the share of each technology relative to others [11].This paper proposes a method of fuel consumption optimization by using a nonlinear MPC for s-HEV during a carfollowing process, which fuses the ACC(adaptive cruise control) and EMS(energy management strategy) but is not a simple addition of two methods. To reduce the computing burden, some search skills are used in optimizing algorithm of MPC. Simulations are carried out in MATLAB/SIMULINK. The proposed method may have a disadvantage of large computing burden, but as the onboard computers develop so fast the computing burden is not an intricate problem. The studies in the future will focus on two aspects: one is studying more high-efficiency and better-effect methods to achieve more comfort and economic car-following process, and another is taking the shifting process, mode transition and engine idle-stop technology into account for the car-following process of s-HEVs. Besides, the bench tests and vehicle experiments are also the emphases we are working on[12].This paper presents the development of an electrical and thermal model of a hybrid electrical vehicle (HEV) lithium-ion battery pack. This model has been produced with MATLAB/Simulink® so as to examine the yield qualities of lithium-particle batteries over the chose working scope of flows and battery limits. What's more, a warm showing technique has been set up for this model so it can anticipate the battery center and outside layer temperature by containing the impact of interior obstruction. A general two-dimensional battery pack electro-thermal model has been established to predict the temperature distribution and the voltage output inside a battery pack under different boundary and initial conditions. [13]. In this paper, a multiyear crossover arranging strategy (HPM) built up on expense benefit examination is anticipated for execution of savvy charging plans for module electric vehicles (PEVs) in a conveyance framework. Two different schemes which consider an integrated grid-to-vehicle and vehicle-to-grid charging agenda are utilized in this paper for smart charging of PEVs. The objective functions of the two strategies, namely minimization of total daily cost and minimization of peak-to average ratio, represent an economic and a technical perspective, respectively.The organize impacts and the related financial effects of the proposed HPM are evaluated against two ordinary arranging techniques (CPMs) which are created comparing to the two charging procedures. In a CPM, a single charging scheme is executed on all the nodes of the distribution system for the whole design horizon. The simulation studies performed on small and medium sized distribution systems demonstrate the effectiveness, feasibility, and scalability of the proposed HPM[14].This paper deals with the study and implementation of a losses minimization control strategy for an integrated multidrives topology (IMD) used in the drivetrain of parallel hybrid electric vehicles. In this IMD the stator sectors of a multi-winding induction machine are interfaced to the storage units over standard three-phase inverters. The target of this examination is to improve the managing of multi-directional power streams in a coordinated multi-drives game plan, diminishing both the power misfortunes of the enlistment machine and the vitality stockpiling units while keeping the computational trouble legitimately low[15].This paper explored the impact of considering PHEV(Plug-In-half breed Electric V ehicle) charging request on the ideal activity the board of run of the mill MGs (small scale networks) consolidating diverse sorts of sustainable power sources such asWT (wind turbines), FC (energy components), PV (photovoltaics) and MT (micro turbines). In addition, battery was considered to show the positive effect of storages on the MG cost. In this regard, three different charging strategies were considered, namely uncontrolled, controlled and smart charging. The simulation results ontwo test systems show the superior performance of the proposed MSOS(modified Symbiotic Organisms Search) algorithm over a number of other famous methods in the area. In addition, it was seen that while the PHEV charging demand could increase the total cost of the MG, but a smart charging strategy can reduce its total effect sufficiently. In fact, devising a smart charging pattern can result in much reduction of the cost in comparison to the uncontrolled or even controlled chargingschemes[16].This paper studied an electrical scheme for the powertrain of Hybrid Electric vehicle which is power-driven by Fuel cell, Battery and PV panel. A Simulink model is prepared and simulated successfully. Permanent magnet synchronous motor drive scheme is used in the Simulink model. The replication results like rotor speed, electromagnetic torque, current, DC-DC converter current, voltage, state of charging, grid charger enactment, photovoltaic panel demonstration and mechanical torque are discussed and equated with the state of the art systems[17].Hybrid electric vehicles are becoming more popular due to environmental consciousness. Hybrid vehicles consist of a combustion and an electric motor. Selecting appropriate electric motor is of great importance and is an interesting research area for automotive companies, since it has a significant impact on dynamic performance of the vehicle. In this paper, the performance of two induction and PM(permanent magnet) electric motors have been investigated in hybrid vehicle applications, benefiting ADVISOR software. The results indicate superior performance of PM motors for utilization in hybrid electric vehicles, in terms of standard performance indices such as traction capabilities and fuel efficiency[18]. In this paper, we would like to look at the technologies that offer the best alternatives to the current gas guzzling internal combustion engines of today's automobiles and attempt to propose a route forward for new advancement and improvement. We will do this by exhibiting a few rules or guides that incorporate specialized and business contemplations to effectively accomplish our objectives of better and cleaner transport[19].

Hybrid Electric Vehicle Technical Roadmap

An HEV(Hybrid Electric Vehicle) links a conventional propulsion arrangement with an electric propulsion arrangement. It has a considerably extended driving range than that of a battery electric vehicle. It shows enhanced fuel economy compared with conventional ICE(Internal Combustion Engine) vehicles. The ICE can be immobile if the vehicle is at a stop. The electric drive system in an HEV can adjust the efficiency of the ICE and thus moderate the oil consumption and emissions. The kinetic energy can be rejuvenated during braking and down-slope driving. A certain range of silent operation with zero emissions is probable when the hybrid is driven in the pure or fully electric mode. The pure electric driving range can be comprehensive if the battery is recharged by attaching a plug to an electricity grid. This kind of HEV is called a plug-in hybrid electric vehicle (PHEV). Though HEVs can contribute to meeting the challenges in road transport regarding the energy crisis and pollution, there have been varied results with regards to appreciation by the public. (This appears to be basically an inverse function of the current price of gasoline.) However, three main challenges for vehicle consumers are clearly patent: 1) their high securing price, 2) the reliability and the warranty related to the lack of electricians in car-repair shops, and 3) the general lack of assurance in the new electric powered vehicle technology. This last concern includes safety concerns related to the introduction of high voltage into the vehicle, the electromagnetic interference caused by high-frequency high-current switching, and so on.

a)Fuel Cell Vehicles

Further hybrids, fuel cell vehicles (FCVs), which use fuel cells to produce electricity from hydrogen and air to drive the vehicle, are also potential clean vehicles for feasibly a few decades from now. The electricity is also used to drive the vehicle or kept in an energy storage device, such as a battery pack or supercapacitors. They only release water vapors and have the potential to reach high system efficiency. The main issues associated to FCVs are 1) the high manufacture cost and 2) the short life span of fuel cells. Future research objectives to decrease the cost of platinum catalysts or to substitute the platinum catalyst by a innovative material. It is also essential to further improve an electrolyte membrane to improve the durability of the fuel cells so they can last for extended than ten years. Moreover, hydrogen onboard storage needs improvement of energy density so that the driving range can be longer than 500 km, the equivalent range of an ICE(Internal Combustion Engine).

Table 1. Commercialization Roadmap of HEVs and FCVs

YEAR	
2007	More automakers launch own hybrid systems
2007	Tighter diesel standards adopted in US
2007	Diesel Hybrids introduced
2007	Advance gasoline engine introduced
2008	Toyota launches 3rd generation Prius, creating new benchmark
2008	Full hybrids become Standard in US
2008	Lithium-based hybrids launched
2008	Tighter diesel standard adopted in Europe
2009	Plug-in commercialized using high-power batteries
2010	OEMs will have introduced over 50 hybrid models in US
2010	Toyota offers hybrids as option on all models
2010	Hybrids take 10.6% share of new sales globally
2011	Plug-in commercialized with electric driving range of 5 to 10 miles
2012	Toyota introduces 4th generation Prius
2012	Tougher emission controls due to climate change concerns
2013	Plug-ins driving range increases to 20 to 30 miles
2013	Advanced materials introduced
2013	Automakers offer hybridization as option on most models
2014	Nickel battery displaced
2015	Hybrids take 50% share of new sales globally
2020-25	Plug-ins driving range increases to >50 miles
2020-25	Fuel cell vehicle commercialized
2030	Hybrids take 85% share of new sales globally

II. Battery Chargers For Plug-In-Electric & Hybrid Vehicle

A battery charger must be efficient and consistent, with great power density, low price, and low volume and weight. Its operation depends on components, control, and switching strategies. Electric cars can be charged at night in most garages.EV can be switched from level 1 (low speed) to the corresponding charging output. Level 2 is usually described as the main method of household and public equipment and requires 240Volts[20]-[23].These power levels are shown in Table 1.The next step 2 focuses on development.1/2 power charge provides sufficient power and can be used in most environments. Single phase solutions are typically used for commercial and public purposes, such as gas stations. Step 3 the solution is not fully implemented. Public stations can be equipped with two or three level charging devices in parking lots, in shopping centers,hotels.nursing homes, theaters and restaurants[24]-[26]. EV battery chargers can be classified as on-board and off-board with unidirectional or bidirectional powerflow. Unidirectional charging is a logical first step because it limits hardware requirements, simplifies interconnection issues, and tends to reduce battery degradation [28],[29]. A bidirectional charging system supports charge from the grid, battery energy injection back to the grid, and power stabilization with adequate power conversion [30]–[33].

Table 2 .Charging Power Levels (Based In Part on [39])

Power Level Types	Charger Location	Typical Use	Energy Supply Interface	Expected Power Level	Charging Time	Vehicle Technology
Level 1 (Opportunity) 120 Vac(US) 230Vac(EU)	On-board 1-phase	Charging at home or office	Convenience outlet	1.4kW(12A) 1.9kW(20A)	4-11 hours 11-36 hours	PHEVs(5-15kWh) EVs(16-50kWh)
Level 2 (primary) 240Vac (US) 400Vac (EU)	On-board 1-or-3-phase	Charging at private or public outlets	Dedicated EVSE	4kW(17A) 8kW(32A) 19.2kW(80A)	1-4 hours 2-6 hours 2-3 hours	PHEVs(5-15kWh) EVs(16-30kWh) EVs(3-50kWh)
Level 3(Fast) (208-600 Vac or Vdc)	Off-board 3-phase	Commertial,analogous to a filling station	Dedicated EVSE	50kW 100kW	0.4-1 hour 0.2-0.5 hour	EVs(20-50kWh)

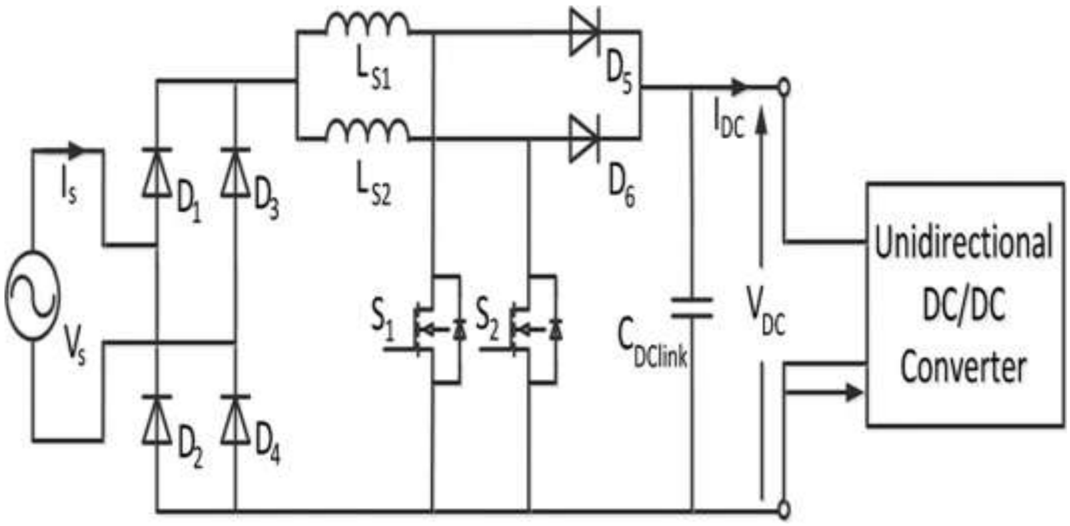

Fig. 1. Interleaved unidirectional charger topology, as in [47].

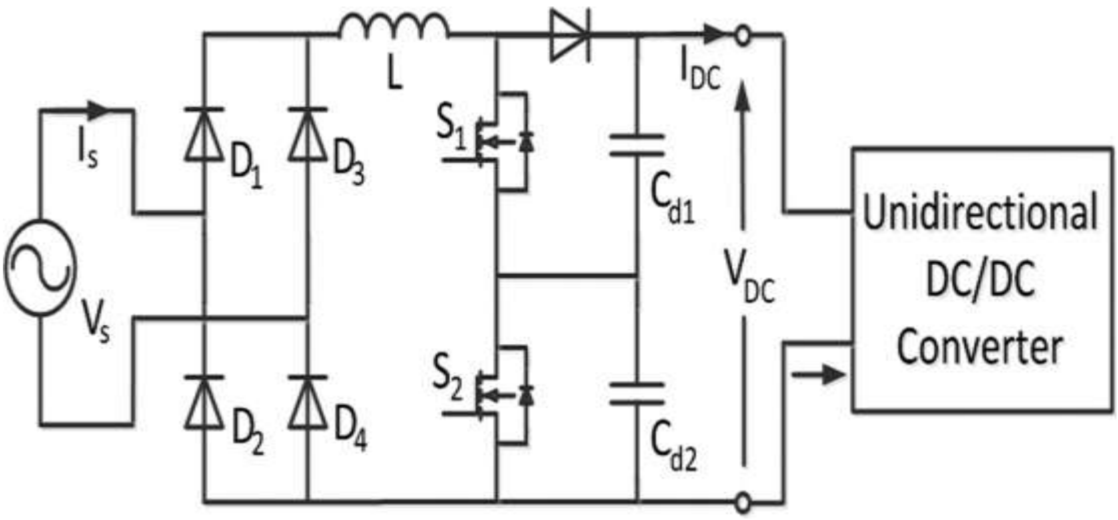

Fig. 2. Single-phase unidirectional multilevel charger circuit, as in [54].

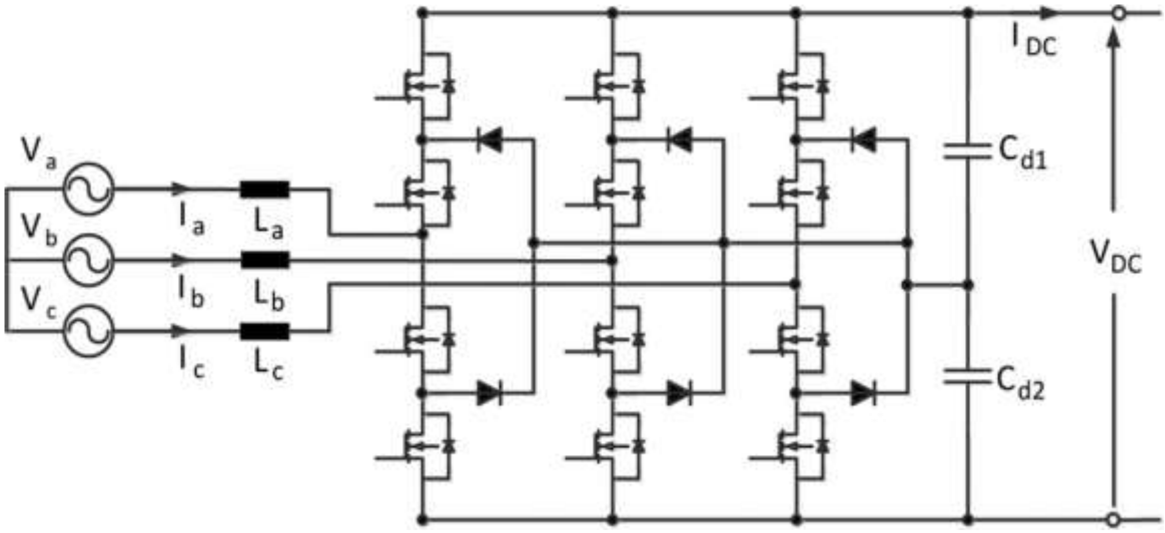

Fig. 3. Three-level diode-clamped bidirectional charger circuit, as in [28]

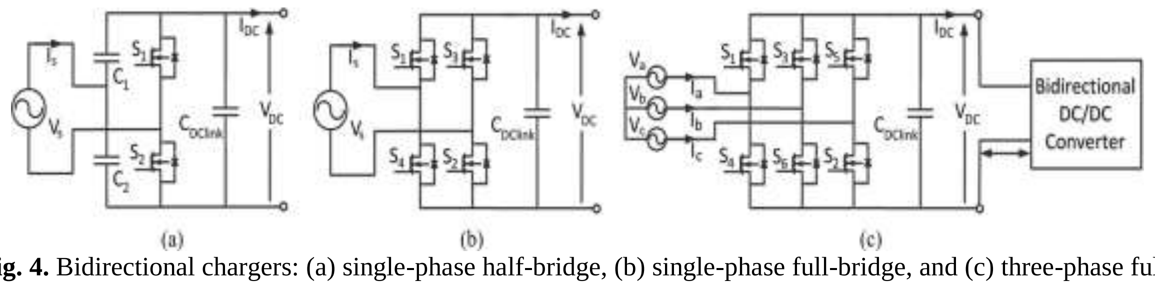

Fig. 4. Bidirectional chargers: (a) single-phase half-bridge, (b) single-phase full-bridge, and (c) three-phase full-bridge.

For active power factor correction(PFC) the modern EV contain a boost converter. According to F.Musavi, if a bridgeless boost PFC topology used it avoids the need for the rectifier input bridge yet maintains this boost topology.The converter solves the problem of heat management, but increases electromagnetic interference (EMI) . Fig. 1 shows Interleaved unidirectional charger topology is to be considered to reduce battery charging current ripple and inductor size. It consists of two boost converters in parallel operating 180◦ out of phase [47]-[53]. According to P.Kong The interleaved boost converter has the advantage of paralleled semiconductors .It reduces stress on output capacitors by cancelling the ripple at output. However, similar to the boost, this topology must provide heat management for the input bridge rectifier[55].Multilevel converters allow for a smaller and less expensive filter which can reduce size, switching frequency, and stress on devices and are suitable for Level 3 EV chargers. They allow for a smaller and less expensive filter[56] In Fig. 2, the topology of a single-phase unidirectional multilevel charger is suitable, and is a common multilevel charger topology for low-power Levels 1 and 2 charging [57].It offers a high level of power eminence at input mains with reduced THD, high power factor and reduced EMI noise and boost, and ripple-free, controlled dc output voltage unaffected to load and supply disturbances [58]–[62].Three-level bidirectional dc–dc converters have been investigated for charge station application, as shown in Fig. 3 [28]. These converters are characterized by low switch voltage stress and used in smaller energy-storage devices such as inductors and capacitors [63],[64]. Fig. 4(a)–(c) shows basic bidirectional circuits. Fig. 4(a) shows a single-phase half bridge bidirectional charger. Fig. 4(b)shows a single-phase full bridge charger, and Fig. 4(c) shows a three-phase full-bridge bidirectional unit that interfaces to a dc–dc converter

III. The Growth Factor

In 1992, our planet had well over partial a billion cars and trucks. By 2050, it has been predictable that their number will exceed 2.5 billion. If these vehicles were all to be power-driven by gasoline and diesel fuels, our world would come to a stop end. In this way, a standout amongst the most squeezing interest so four time is for elective energizes, particularly for urban transportation frameworks. We need to build up this innovation; there is no option. Oil and gas take a large number of years to shape however may be about depleted in the following 40– 60 years. Air contamination is likewise another critical concern. On the off chance that this petroleum product propensity proceeds from regular autos, the sky will turn out to be unceasingly dim. We should go over this obscured world to discover the day break. It is an ideal opportunity to ponder where we are currently and where we are going, and we should do as such with the long haul picture of blurring assets at the top of the priority list, and not the every now and again fluctuating cost of oil. Government offices and associations thusly have been growing ever beneficial stringent models for fuel utilization and releases.Battery-powered electric vehicles (BEVs) look like ideal keys to challenge this energy disaster as well as a means to decrease pollution and the buildup of carbon dioxide, which contributes to global warming. Electric vehicles have zero oil consumption and zero discharges. Though, the high initial cost, short driving range, and long charging times have demonstrated to be their primary boundaries. Hybrid electric vehicles (HEVs) were established to overcome some of these drawbacks of both conventional internal combustion vehicles as well as those entirely electric vehicles.

IV. Conclusion

This paper reviewed the current status and implementation of Hybrid Electric Vehicle, plug-in electric vehicles and hybrids, battery chargers, charging power levels, and infrastructure for EVs. Recognizing the emerging need for planning EVCS to satisfy the increasing charging demand from EVs.Various charger power levels and infrastructure configurations were presented and compared, based on the amount of power, charging time and location, cost, suitability, equipment necessary, and other factors. It is necessary to further develop an electrolyte membrane to improve the durability of the fuel cells so they can last for longer than ten years. The vision of having commercially feasible electric and hybrid vehicles is becoming a reality.

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