A REVIEW ON HYBRID ELECTRIC VEHICLES TECHNOLOGY

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Abstract : Transportation is vital in everyday existence of individuals in the whole world. A large portion of the present vehicles utilize Internal Combustion Engine(ICE). In any case, nonstop use of IC Engines prompts several issues like air contamination and global warming These regular ICEs can be superseded by proposed three common structures like like Electric vehicles (EV), Hybrid electric vehicles (HEV), and Fuel cell vehicles (FCV). Consequently advanced vehicle technology focuses on HEVs. Limited accessibility of fuel based energy sources, required the development of substitute sources, for example, hybrid electrical vehicle. HEV consolidates internal combustion engine, electric machines and power electronic gear. This paper presents history, classification, vehicle types, and strength strategies of HEV'S. A hybrid electric vehicle (HEV) has two sorts of vitality storage space units, electricity and fuel. Exactly when power is used, a battery is utilized to store the vitality; an electromotor will be used as footing engine, when fuel is utilized , a tank is required, and an Internal Combustion Engine (ICE) is used to make mechanical power. Contingent upon the drive train structure HEVs can be recognized as parallel, series or combined HEVs. The correlation of the real characteristics of EVs, HEVs, and FCVs is exhibited. The examination demonstrates that HEV'S are prevalent as far as efficiency, nearby discharges, driving reach when contrasted with EVs and FCVs

Index Terms **-** Hybrid electric vehicle, Electric vehicle, Fuel cell vehicles, Internal Combustion Engines.

I. INTRODUCTION

Current HEVs utilize efficiency-improving innovations, for example, regenerative braking, which changes over the vehicle's kinetic energy into electric energy to charge the battery, rather than wasting it as heat energy as ordinary brakes do. A few assortments of HEVs utilize their internal combustion engine to produce electricity by turning an electrical generator, to either revive their batteries or to directly power the electric drive engines. Numerous HEVs decrease discharges by closing down the ICE out of gear and restarting it when required; this is known as a start- stop system. A hybrid electric creates less emissions from its ICE than a similarly estimated gas vehicle, since a HEV's gas engine is regularly tinier than an unadulterated gasoline-consuming vehicle and if not used to rightfully drive the vehicle, can be equipped to keep running at most extreme efficiency, further improving mileage [1][2]

Depending upon the possibility of the non-electric imperativeness source, we can perceive combustion (ICE), fuel cell vitality unit, water driven or pneumatic power, and human power. In the main case, the ICE is a flash start engines (fuel) or pressure start direct infusion (diesel) motor. In the initial two cases, the energy conversion unit might be powered by gas, methanol, compacted flammable gas, hydrogen, or other fuels. Engines are the "work steeds" of Hybrid Electric Vehicle drive systems. The electric footing engine drives the wheels of the vehicle. In contrast to a customary vehicle, where the motor must "increase" before full torque can be given, an electric engine gives full torque at low speeds. The engine additionally has low sound and high efficiency. Different characteristics incorporate magnificent "off the line" increasing speed, great drive control, great adaptation to internal failure and adaptability in connection to voltage variances The correlation of the significant characteristics of EVs, HEVs, and FCVs will likewise be mentioned[3].

The front-running engine advancements for HEV applications incorporate PMSM, BLDC, SRM and AC induction engine. A principle preferred standpoint of an electromotor is the likelihood to work as generator. In all HEV frameworks, mechanical braking energy is recovered. The most extreme Operational braking torque is not exactly the greatest footing torque; there is dependably a mechanical stopping mechanism incorporated in a vehicle. The battery pack in a HEV has an a lot higher voltage than the SIL car 12 Volts battery, so as to lessen the flows and the I2R losses. Accessories such as power steering and air conditioning are fueled by electric motors as a substitute of being joined to the combustion engine. This permits efficiency gains as the adornments can keep running at a consistent speed or can be turned off, paying little heed to how quick the combustion engine is running. Particularly in whole deal trucks, electrical power directing recoveries a great deal of energy.The primary destinations of hev's are referenced as follows:

Augment the mileage, Minimize fuel discharges, Minimize the drive framework cost to keep moderate, Maintain satisfactory execution with a sensible expense.

An electric vehicle is likewise called an EV, it utilizes at least one electric engines or footing engines for propulsion. An electric vehicle might be controlled through an collector system by electricity from off-vehicle sources, or might act naturally contained with a battery, solar pannels or an electric generator to change over fuel to electricity. EVs incorporate road and rail vehicles, surface and submerged vehicles, electric air ship and electric rocket. EVs originally appeared in the mid-nineteenth century, when electricity was among the favored strategies for engine vehicle drive, giving a level of solace and simplicity of activity that couldn't be achieved by the fuel autos of the time. Present day internal combustion engines have been the predominant impetus strategy for engine vehicles for just about 100 years, however electric power has stayed typical in other vehicle types, for example, trains and littler vehicles of different types.

A fuel cell vehicle (FCV) or fuel cell electric vehicle (FCEV) is a sort of electric vehicle which utilizes an fuel cell, rather than a battery, or in mix with a battery or super capacitor, to control its on-board electric engine. Fuel cell Energy components in vehicles create electricity to control the engine, by and large utilizing oxygen from the air and compressed hydrogen. Most power device vehicles are delegated zero-discharges vehicles that transmit just water and warmth. As contrasted and inner ignition

vehicles, hydrogen vehicles unify toxins at the site of the hydrogen creation, where hydrogen is typically gotten from improved petroleum gas. Transporting and putting away hydrogen may likewise make contaminations.

III. CLASSIFICATION OF HEV'S , EV'S, FCV'S

A.TYPES OF ELECTRIC VEHICLES

There are three main types of electric vehicles (EV'S) classified by degree that electricity is used as their energy source.

1. **Hybrid Electric Vehicles (HEVs)**

HEVs are controlled by both petrol and electricity. The electric energy is created by the vehicle's own slowing mechanism to revive the battery. This is called 'regenerative braking', a procedure where the electric engine moderates the vehicle and uses a portion of the vitality regularly changed over to heat by the brakes.[4] HEVs begin utilizing the electric motor, at that point the oil motor cuts in as load or speed rises. The two engines are constrained by an internal computer which guarantees the best economy for the driving conditions.

2. **Plug-in Hybrid Electric Vehicles (PHEVs)**

Plug-in Hybrid Electric Vehicles are controlled by both petroleum and electricity. PHEVs can restart the battery through both regenerative braking and 'plugging-in' to an external electrical charging outlet [4]. In EREVs the petrol engine expands the scope of the vehicle by additionally recharge the battery as it gets low. These EVs shift extraordinarily depending on decision of essential vitality source.

example: Toyota Prius favors petroleum while the Mitsubishi Outlander PHEV, our new armada vehicle, favors electricity.

3. **Battery Electric Vehicles (BEVs):**

BEVs are completely electric vehicles, meaning they are just controlled by electricity and don't have petroleum engine, fuel tank or fumes pipe.BEVs are otherwise called 'plug-in' EVs as they utilize an outside electrical charging outlet to charge the battery. BEVs can likewise revive their batteries through regenerative braking.

B. TYPES OF HYBRID ELECTRIC VEHICLES

This section presents the classification of Hybrid Electric vehicle structures.

i. Types by derivization structure

a) Series hybrid

In a series hybrid system, the combustion engine drive an electric generator instead of reasonably driving the wheels. The basic diagram of arrangement hybrid Electric vehicle is appeared in Fig.1 The electric engine is the main methods for providing capacity to the wheels. The generator charges a battery and forces an electric engine that moves the vehicle. At the point when a lot of intensity are required, the engine draws electricity from both the batteries and the generator. Series hybrid configurations exist for long time: diesel-electric trains, water driven earth moving machines, these can be support by ultra capacitors which can improve the efficiency by diminish the misfortunes in the battery. The structure of a series hybrid vehicle with flywheel or ultra capacitors is appeared in Fig.2. They deliver peak energy during acceleration and take regenerative energy during braking. They convey top vitality during speeding up and take regenerative vitality during braking.

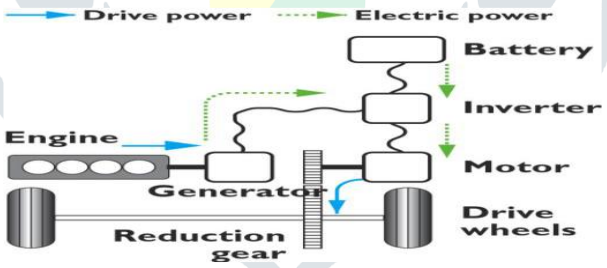

Fig .1 Structure of a series hybrid vehicle

Hence, the ultra capacitors are kept charged at low speed and practically void at top speed. Profound cycling of the battery is decreased; the pressure factor of the battery is brought down. A perplexing transmission among engine and wheel isn't required, as electric engines are efficient over a wide speed go.If the motors are attached to the vehicle body, adaptable couplings are required.

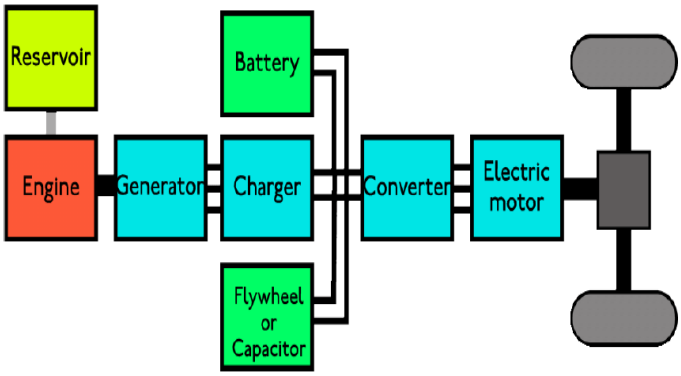

Fig. 2 Structure of a series hybrid vehicle with flywheel or ultra capacitors.

Some vehicle structures have separate electric engines for each wheel. Engine integration into the wheels has the detriment that the mass increases, decreasing ride execution. Points of interest of individual wheel engines include improved footing control for all wheels, and allowing lower floors, which is valuable for transports.

b) Parallel hybrid

Parallel hybrid frameworks have both an internal combustion engine (ICE) and an electric engine in parallel associated with a mechanical transmission. The auxiliary outline of parallel hybrid Electric vehicle is appeared in Fig.3. Most plans combine a vast electrical generator and an engine into one unit, regularly situated between the ignition engine and the transmission, replacing both the ordinary starter engine and the alternator. The battery can be re-energized during regenerative breaking because there is a fixed link between the wheels and engine , therefore battery can't be charged when the vehicle is not moving [1,5,6].

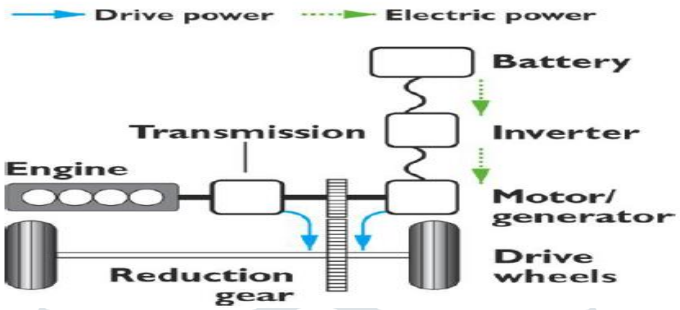

Fig. 3 Structure of a parallel hybrid vehicle.

C) Combined Hybrid

Combined hybrid frameworks have highlights of both series and parallel hybrids. There is a twofold association between the engine and the drive hub: mechanical and electrical. This split power way permits interconnecting mechanical and electrical power, at some expense in unpredictability. Power-split gadgets are incorporated in the power train. The ability to the wheels can be either mechanical or electrical or both. This is additionally the situation in parallel hybrids.The main principle behind the combined framework is the decoupling of the power provided by the engine from the power requested by the driver. .[7] The power-split HEV includes a wide assortment of execution modes. For Example, at lower speeds, this framework works as an series HEV, while at high speeds, where the series control train is less productive, the engine dominates. The Structural outline of chart of combined hybrid Electric vehicle is appeared in Fig. 4.

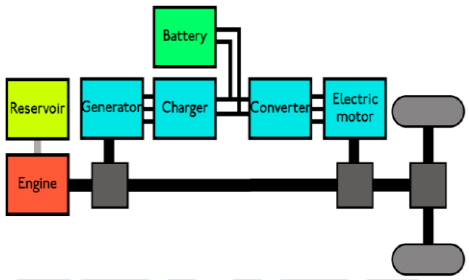

Fig. 4. Structure of a combined hybrid vehicle.

This framework is more costly than an parallel system as it needs an additional generator, a mechanical split power system and all the more computing capacity to control the double framework.

ii. Types by degree of hybridization

Parallel and combined hybrids can be arranged depending upon how to balance different portions which provide motive power. Sometimes,, the combustion engine is the dominant part; the electric engine turns on just when a lift is required. Others can keep running with simply the electric framework operating.

Strong Hybrid (=Full Hybrid)

A full hybrid EV can keep running on simply the engine, simply the batteries, or a combination of both. An extensive, high-limit battery pack is required for battery-operation. For instance, The Toyota Prius, Auris and Lexus are full hybrids, as these cars can be pushed ahead on battery control alone. The Toyota brand name for this innovation is Hybrid Synergy Drive.

Medium Hybrid (= Motor Assist Hybrid)

Motor assist hybrids utilize the engine for essential power, with a torque-boosting electric engine associated in parallel to a to a great extent regular power train. EV mode is workable for a constrained timeframe, and this is certifiably not a standard mode. Contrasted with full hybrids, the measure of electrical power required is smaller, accordingly the extent of the battery framework can be reduced.[13] .The electric engine, mounted between the engine and transmission, is basically an extremely expansive starter engine, which works not just when the engine should be turned over, yet in addition when the driver "ventures on the gas" and requires additional power. The electric engine may likewise be utilized to re-begin the ignition

engine,[8] deriving similar advantages from shutting down the main engine out of gear, while the improved battery framework is utilized to control frill. The electric engine is a generator during regenerative breaking.

Mild Hybrid / Micro Hybrid

An inactive stop framework, for example, might be found on European little autos with an alternator that serves as an engine for warm restart of the engine by means of the belt qualifies as a small scale hybrid. Power dimensions of smaller scale hybrids are normally 3 to 5 kW. Gentle hybrids are an indent up in power rating, ordinarily 7 to 12 kW and by and large have the electric engine generator situated in the vehicle transmission at the engine crankshaft. The Honda Civic and Accord hybrids just as the GM Silverado get truck are gentle hybrids and display economy gains on the request of 10%[12,14].

Plug-In Hybrid

A plug-in hybrid electric vehicle (PHEV) is a hybrid electric vehicle with battery-powered batteries that can be reestablished to fully charge by a plug to an electric power source. A PHEV shares the attributes of both a regular hybrid electric vehicle, having an electric engine and an internal ignition engine of an all-electric vehicle, additionally having a plug to associate with the electrical network. PHEVs have an a lot bigger all-electric range when contrasted with traditional gasoline-electric hybrids, and furthermore eliminate the "extend nervousness" related with every single electric vehicle, in light of the fact that the burning engine fills in as a reinforcement when the batteries are exhausted

iii. Types by nature of the power source

Electric-Internal Combustion Engine Hybrid

There are numerous approaches to make an electric-internal combustion hybrid. The assortment of electric-ICE plans can be separated by how the electric and burning bits of the power train interface (arrangement, parallel or combined), at what times each part is in activity, and what percent of the power is given by every hybrid segment. Numerous plans shut off the internal burning engine when it isn't required in request to spare energy.[9].

Fuel Cell Hybrid

Fuel cell vehicles have a series hybrid configuration. They are regularly fitted with a battery or super capacitor to transport peak acceleration power and to reduce the size and power limit on the fuel cell.The structure of fuel cell hybrid vehicle is shown in Fig. 6. Fuel cell vehicles use hydrogen gas to power an electric motor. Unlike unadventurous vehicles which run on gasoline or diesel, fuel cell cars and trucks combine hydrogen and oxygen to produce electricity, which runs a motor. Since they're controlled completely by electricity, power device vehicles are viewed as electric vehicles yet other EV. Converting hydrogen gas into electricity delivers just water and warmth as a side-effect, meaning power module vehicles don't make tailpipe contamination when they're driven. Producing the hydrogen itself can prompt contamination, including ozone harming substance discharges, yet notwithstanding when the fuel originates from one of the dirtiest wellsprings of hydrogen, flammable gas, the present early energy component vehicles and trucks can cut emanations by more than 30 percent when contrasted and their gasoline-controlled counterparts[11,10].

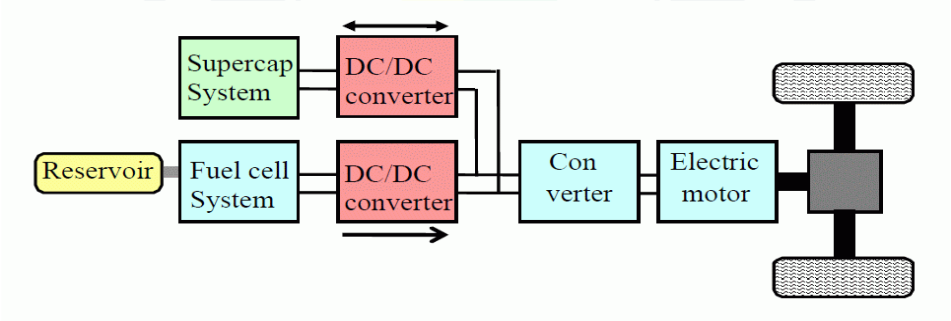

Fig 6 Structure of a fuel cell hybrid vehicle

The major characteristics of EV, HEV, FCVs are shown in Table 1.

Table 1 Comparison of major characteristics of EV's, HEV's, and FCV's.

	EV	HEV	FCV
Propulsion	• Electric motor force • Internal combustion engine	• Electric motor drives	• Electric motor drives
Energy storage sub system	• Battery	• Battery • Super capacitor • Fossil or alternate fuels	• Hydrogen tank • Battery or super capacitor needed to enhance power
Characteristics	• Zero local emissions • High energy efficiency • Relatively short	• low local emissions • High fuel economy • Dependent of fossil fuels	• Zero local emissions • High energy efficiency • Independent of fossil fuels • High initial cost

	range • High initial cost • Commercially available	• long drive range • High cost than ICE • Vehicles • Commercially available	• Under development
Energy storage infrastructure	• Electrical grid charging facilities	• Electrical grid charging facilities • Gasoline station	• Hydrogen

6.1 CONCLUSION

HEV are intriguing issue today since they have numerous advantages like low fuel utilization low clamor contamination and long task range.HEV innovation will be most prevalent in future years with advancement of battery innovation to help auto versatile proprietors and producers and investigate future patterns of HEV. Finally, the extensive review of this writing records present patterns and investigate future patterns of HEV.

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