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Electric Vehicle : Journey from Past to Future

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ABSTRACT: This paper deals with the concept of electric cars, from the very first electric car and history of electric cars. The overview of the basic concept of electric vehicles, their parts and functions. Hybrid vehicles are also the solution that compromises a little bit with the environment. Advantages and disadvantages are also discussed here. Fuel powered vehicles are a threat to the future community and are the major contributors in increasing Global Warming. This paper also tells about the near future of such electric vehicles.

KEYWORDS: Electric Vehicle, Hybrid Vehicle, Internal Combustion Engine.

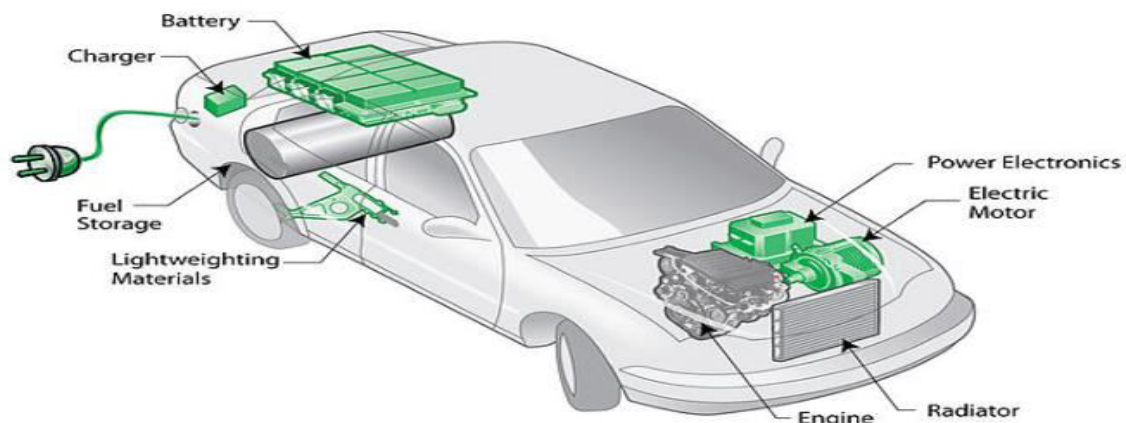
I. INTRODUCTION

Around 1960, there was realization of alternative source fueled automobiles for the first time in order to decrease the effect of exhaust emissions from internal combustion engines or diesel/petrol engines. The overall impact of the electric vehicle in the society ultimately benefits the people and the environment. Electric engines are better than the IC engines. Various important parts of an electric vehicles, its comparison with IC Engine vehicles and its future scopes are addressed in this paper. The paper begins with a history of the electric vehicle. In addition to that, a technical layout of an electric vehicle, including their parts and their functions is included in this paper. It also includes the pros and cons of introducing this electric vehicle in its future.

II. HISTORY OF THE ELECTRIC POWERED VEHICLES

The journey of electric vehicle started between 1830s when the first electric vehicle (EV) was built in Scotland by Robert Anderson. After that, William Morrison built a six passengers wagon, on which America showed concern over the concept of electric vehicles. In 1902, Wood created the electrical Phaeton, which was quite an electrified car and Surrey which had a range of 18 miles, a top speed of 14 mph and cost \$2,000 [1]. When in the later 1920's, reduced price of gasoline or other polluting fuels and a better and convenient road system decreased the popularity, production and use of the electric vehicles. The concept of electrical vehicles that was growing later on declined due to the discovery of the Texas petroleum, invention of the electrical starter, and therefore the production of the interior combustion engine vehicles [1]. According to the History of electrical Vehicles, "In 1912, an electrical roadster sold for \$1,750, while a gasoline car sold for \$650" [1, p. 1]. By mid-1930's, electric vehicles completely disappeared. Again within the 1960s and 1970s the electrical vehicles came back in national market because IC vehicles were creating an unhealthy, polluted and unsafe environment for the people in America during that period of time. [1].

III. OVERVIEW OF AN ELECTRIC VEHICLE'S BASIC CONCEPT



The electric vehicles are equipped with an electric motor which are powered or charged by rechargeable batteries instead of fuel engines. From the exterior, the vehicles are not at all different or does not appear to be electric. Majorly, electric cars are created by converting a fuel- powered car into electric one. The major difference or we can say an advantage of the electric vehicles is the fact that they are nearly silent and zero emission one's [4].

Beneath the hood, an electric car consists of the following:

- An electric motor.
- A rechargeable battery.
- A controller.

The electric vehicles operate on an electric. Set of batteries are used to deliver power to the electric motor. The electric motor then consumes or uses the power received from the batteries to make the transmission rotate and the transmission then further turns the wheels [2]. The electric motor receives its power from the controller and the controller receives its energy or power from the rechargeable batteries.

There are four main parts that make up the electric vehicle: the potentiometer, batteries, direct current (DC) controller, and motor. As shown in the figure-1:

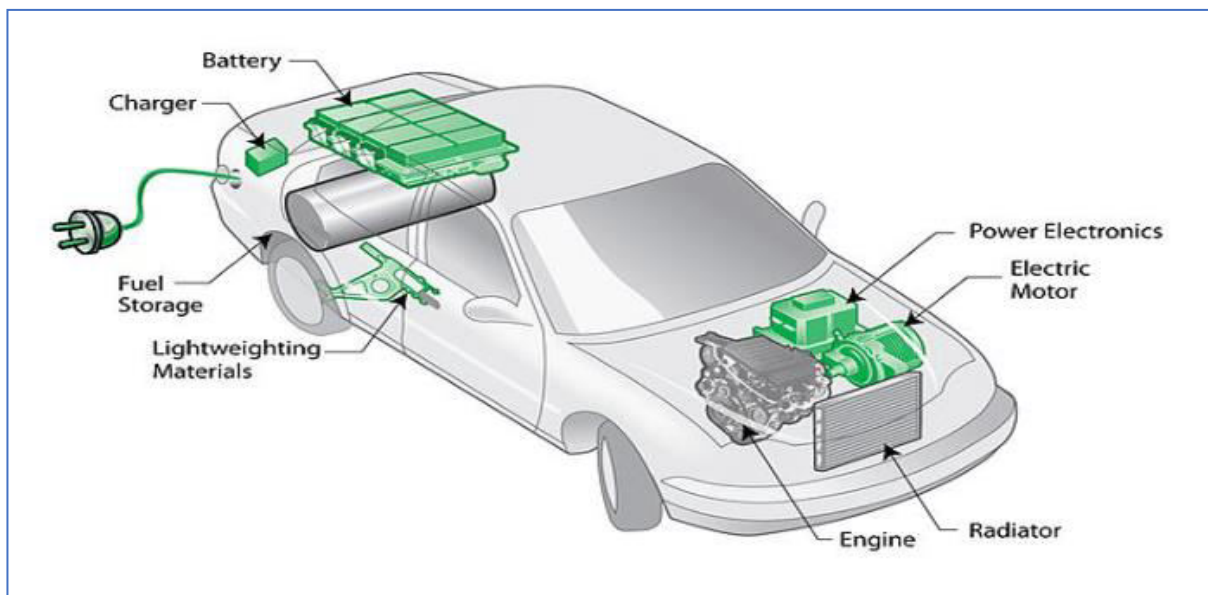


Figure-1: Parts of electric vehicle

IV. DESCRIPTION OF PARTS OF EV AND THEIR FUNCTIONS

- **Potentiometer:-** A potentiometer be a three-terminal resistor with two contact sliding or rotating contact that forms an adjustable potential divider. If only two terminals are used, one end and thus the wiper, it acts as a rheostat or rheostat.
- **Batteries:-** Controller receiver power from the batteries. There are basically three sorts of batteries: lead- acid, lithium ion, and nickel-metal hydride batteries. Batteries home in voltage (power).
- **DC Controller:-** Power received by controller is delivered to the motor. The controller can deliver zero power (when the car is stopped), full power (when the drive floors the accelerator pedal), or any power level in between. If the battery pack contains twelve 12-volt batteries, wired serial to form 144 volts, the controller takes in 144 volts DC, and delivers it to the motor during a controlled way [2].
- **Motor:-** An electrical motor is an electrical machine that converts electricity into energy to move the wheels.



V. THEORY OF OPERATION FOR EV

When the operator throttles the pedal, potentiometer is activated which provides the signals to the controller to deliver the power to the motor. Two potentiometers are present for safety purpose. The controller reads the sensitivity of touch at the accelerator pedal when it is throttled, then from the potentiometers, transfers the power as required by the driver, takes the power output from the batteries and then delivers it finally to the electric motor. The motor receives the voltage from the controller and then uses that power or energy to further rotate the transmission. The transmission of the vehicle then turns the wheels and causes the vehicle to move according to the signals received.

VI. LAYOUT OF A HYBRID [FUEL + ELECTRICITY] VEHICLE

The hybrid vehicle is the one which works on both a fuel powered engine and electric powered engine. This vehicle works simultaneously on both the engines without letting the driver know. The hybrid cars run using power output from an IC engine and electric engine. Most of the vehicle's main power is obtained from fuel engine and this provides extra torque when it is needed by the operator, such as when the driver throttles and passing [3]. Such hybrid vehicle works on a fuel and electricity energy principle. A hybrid car consists of a small fuel-efficient engine combined with an electric motor that aids the engine when acceleration is given and the electric motor is powered by batteries that are recharged automatically while the vehicle is moving [3].

There are five main parts included in the hybrid vehicle: battery, IC engine, generator, power split device and electric motor.

VII. DESCRIPTION OF PARTS OF HYBRID VEHICLES AND THEIR FUNCTIONS

1. Battery:- There are three major sorts of batteries that companies use or are considering to be used in hybrid cars: lead-acid, nickel-metal hydride (NiMH) and lithium-ion (Li-ion). By far, lead-acid is taken into account the foremost toxic of the three, and on top of that it is also extremely heavy, reducing a number of the fuel efficiency gains from the electric motor [3].
2. Internal Combustion Engine (ICE):- The hybrid vehicle has an ICE, also referred to as internal combustion engine, very similar to those found on most cars. The engine on a hybrid vehicle is smaller and uses advanced technologies and features to scale back pollution and increase overall vehicle's efficiency.
3. Power Split Device:- Power-split hybrid or series-parallel hybrid are parallel hybrids that incorporate power-split devices, allowing for power paths from the ICE to the wheels that can be either mechanical or electrical. [3]
4. Electric Motor:- The electric motor on a hybrid car acts as both a motor also as a generator. When needed, it takes power from the batteries to accelerate or move the vehicle. But working as a generator, it slows the car down and returns energy to the set of batteries.

VIII. WORKING OPERATION FOR HYBRID VEHICLE

When the driver accelerates the generator converts energy output from the engine into electricity it is stored in the batteries. The battery then provides electric power to the electric motor. The IC engine and electric motor work together and each individually provides power to the power split device. The power split device then combines both powers and transmits it to rotate the transmission. The transmission box then rotates the wheels and moves the vehicle as per the command signal. While braking the vehicle, energy used is then converted into electric power and it is stored in the batteries. When braking, the electric motor is reversed so that rotating wheels turn the motor and generate electricity. When the vehicle finally comes to rest, the IC engine and electric motor both shut off automatically to decrease the energy wastage in idling. Other features such as air conditioning, dashboard displays interior lightening, auxiliary systems and, many more features depending upon how luxury the vehicle is.



IX. ADVANTAGES AND DISADVANTAGES OF THE EV

The greatest challenge EVs face deal with the rechargeable battery. Most EVs can only set about 100–200 miles before recharging; fully recharging the battery pack can take four to eight hours. Battery packs are heavy, expensive, may need to be replaced, and take up considerable vehicle space [4].

1. Advantages of the electric vehicle: Environment-Friendly

- No Fuel or Gas Cost
- More convenient
- Wide range of speed
- Cheaper to operate
- Quieter
- Life
- & Cost of Battery More Efficient
- Improved Safety
- Energy Security

2. Disadvantages of the electric vehicle: Lack of Charging Stations

- Expensive
- Lack of Power and Reduced Range
- Minimal Amount of Pollution

3. Global Warming: Ozone Layer Depletion The process of emission of carbon dioxide and other harmful gases or black smoke emitted into the atmosphere, also known as global warming one of the world's most dangerous issue, depletion of the Earth's ozone layer, which is what occurs at this time. A very important factor that makes electric cars successful is that it has half the number of parts that are there present in the IC engine cars. 4. Affected People: Sickness Gas or fuel powered vehicles emits a particulate matter in the atmosphere known as carcinogens which can increase asthma conditions as well as problem in respiratory systems or even cancer in some cases [5]. The carbon dioxide and other harmful gases released into the atmosphere by IC vehicles depletes the ozone layer, which absorbs ninety-seven to ninety-nine percent of the sun's high frequency ultraviolet light [5].

X. FUTURE OF THE EV

Gas or fuel powered vehicles emits a particulate matter in the atmosphere known as carcinogens which can increase asthma conditions as well as problem in respiratory systems or even cancer in some cases [5]. The carbon dioxide and other harmful gases released into the atmosphere by IC vehicles depletes the ozone layer, which absorbs ninety-seven to ninety-nine percent of the sun's high frequency ultraviolet light [5]. According to Ozone Layer, "Every one percent decrease in the earth's ozone shield is projected to increase the amount of UV light exposure to the lower Atmosphere by two percent" [5]. Future electric cars will most likely carry lithium-ion phosphate (LiFePO₄) batteries that are now becoming popular in other countries. The LiFePO₄ batteries are rechargeable and powerful and are being used in electric bikes and scooters. Electric cars will most likely adopt this technology in the future. Another technology that is likely for future electric cars is the increased use of super capacitors and ultra-capacitors for storing and delivering electrical charge. Many of these batteries are currently being used in conjunction with hybrid car prototypes, so these are expected in the electric car future markets as well.[6] If the developers of future electric cars can create vehicles with a range of 300 miles per charge, a charging time of five to ten minutes, and safety in operating the vehicles, the market is wide open for them

XI. CONCLUSION

As this paper tells, the electric automobile industry has many pros and benefits over the IC engine and also a hybrid car. It is very calm, clean and much more efficient than any other moving transport; however, it also has disadvantages or cons. It consists of sets of batteries so it is heavy, limited to the distance it can travel before recharge, and costs a huge amount as compared to the fuel powered cars. The future of the electric industry totally relies on its batteries if researchers can invent or explore "ideal battery", a sustainable future is promising.



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