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An Update on Types of Hybrid Electric Vehicles (HEVs) and Associated Challenges

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ABSTRACT: ***The proliferation of hybrid electric technology in automobiles is covered in the paper that is being given. Vehicles with hybrid engines have the potential to consume less fossil fuels, produce less pollution, and enable the transportation of renewable energy sources. Internal combustion engines in conventional automobiles are powered by gasoline or diesel. In addition to having an internal combustion engine and the ability to be fuelled like regular automobiles, hybrid vehicles also feature an electric motor, a battery, and can run either partially or entirely on electricity. Hybrid automobiles may be set up to achieve a variety of goals, including better fuel efficiency, more power, or extra auxiliary power for electronics and power tools. In order to make hybrid vehicles as efficient as possible, several technologies, including electric motor drive, regenerative braking, automated start or cutoff to make them good as conventional vehicles.***

KEYWORDS: ***Automobile, Hybrid, Hybrid Electric Vehicles, Fuel, Motor.***

1. INTRODUCTION

Modern cities are under tremendous pressure to prioritise green technologies. Today's cities have seen substantial expansion, which has increased transportation usage and, in turn, exacerbated pollution and other critical environmental issues. Vehicle emissions should be restricted, and proactive efforts should be implemented to reduce them. In order to reduce the usage of internal combustion engines, the automobile industry has produced hybrid vehicles like the Honda Insight and the Toyota Prius. By lowering gas emissions, such technology benefits the environment. The creation of propelled cars with almost no emissions is now the biggest scientific challenge. As they only release natural byproducts and not exhaust fumes, electrical vehicles driven by renewable energies may provide an answer. This will enhance the air quality in urban areas and, in turn, the health of the people who live there[1], [2].

We have to deal with the issue of diminishing car fuel supplies in the modern world. There is no question that the carbon dioxide emissions from automotive exhaust pose a threat to the planet's warming trend. The hybridization of the automobile is one of the hopeful answers to such issues. A hybrid electric vehicle combines an electric power system with a traditional internal combustion engine. It suggests that HEVs can operate on both electric and internal combustion engine power. HEV emits less emissions than a gasoline vehicle of comparable size because its gasoline engine may be tuned to operate at optimum efficiency. Electric power trains are significant because they operate with minimal power loss, increasing total fuel efficiency. Vehicle electrification can lower CO2 emissions as well as fuel costs. Currently, commercial vehicles, armored trucks, and civilian automobiles all have access to hybrid electric vehicles[3], [4].

1.1. Typical Configurations for HEVs

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A powertrain system must generally fulfil a number of requirements for a vehicle:

• Superior performance.

• Low pollution from fossil fuels

• Integrated energy storage with sufficient capacity for appropriate autonomy.

• Ample power generation to meet a vehicle's different needs for operation and behaviour. The intersection of a source of energy and an electricity converter is known as the powertrain, which is sometimes alluded to as a source of power. For instance, gasoline and an ICE, a battery and an electric engine, an electric motor and hydrogen fuel cells etc (Figure 1).

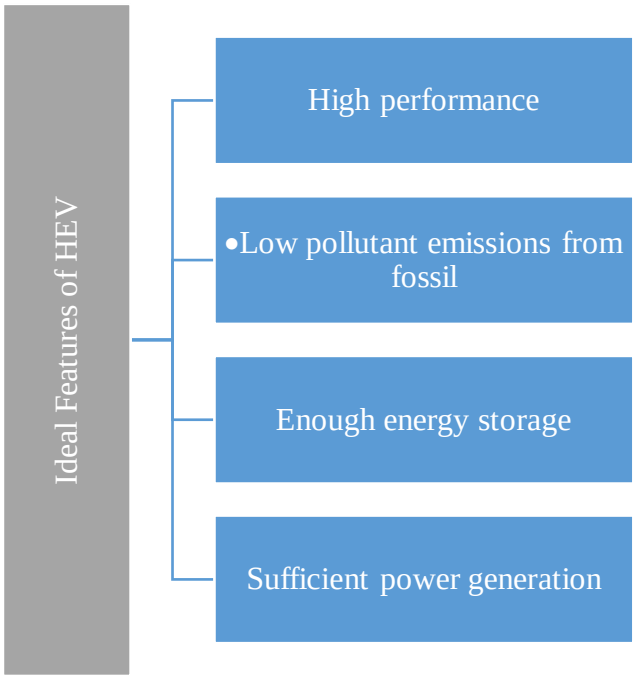

Figure 1: Illustrating the Ideal characteristics of Hybrid Electric vehicles.

1.2. Hybrid Vehicle

A hybrid vehicle is one that may be propelled by a variety of energy sources, either independently or all at once. Numerous hybridization designs, including solar, fuel cell, gas turbine, pneumatic, electric, hydraulic, ethanol, and many more, have been proposed throughout the years. The hybrid electric vehicles, which combine two technologically and commercially established and well-proven technologies electric motors and I.C. engines and allow users to take advantage of each one's unique advantages have gained widespread acceptance from users and technology providers worldwide[1], [5].

The hybrid vehicle that is used the most frequently is this one. It combines an internal combustion engines and an electrical motor's propulsion technology. The onboard batteries provide the electric engine with electricity. The combination of an electric motor with an internal combustion engine in a hybrid vehicle allows for a more efficient utilisation of the engine. The vehicle often begins and ends when driving in metropolitan traffic. The engine uses more fuel when idling without performing any meaningful work, which results in decreased efficiency and unneeded exhaust emissions. By turning off the engine and switching

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to power transfer through the motor, the HEV finds a solution to the issue. Due to the lack of exhaust emissions, no fuel will be used up when the engine is idle (Figure 2).

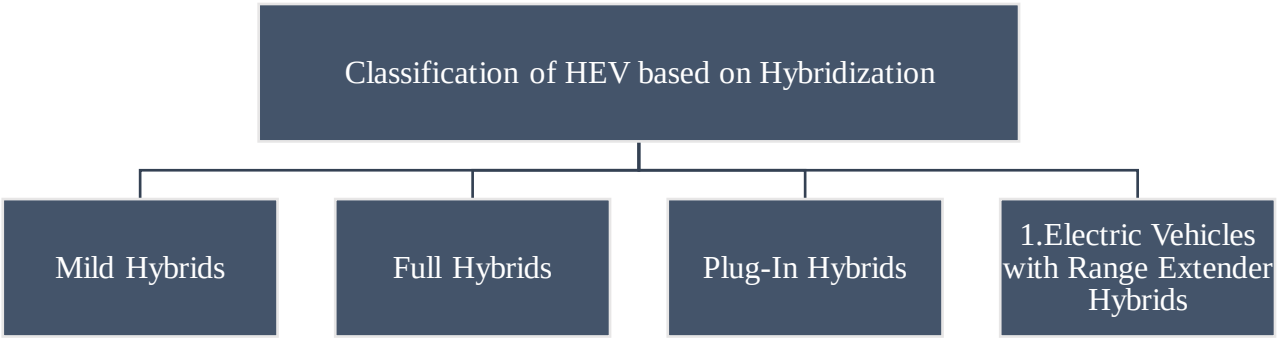

Figure 2: Illustrating the Classification of Hybrid Electric Vehicles based on Hybridization.

1.2.1. Mild Hybrids

A "mild" hybrid system is one of the most recent developments in hybrid technology. A mild hybrid system won't usually allow the car to run entirely on electricity, as the name suggests. Instead, the system is utilised to help the gasoline engine of the car get a little push as it starts up from a stop and to help take some of the load off of other power-hungry systems like the air conditioner. Mild hybrids do not require a plug because they are typically found as 48-volt electric systems. As an alternative, the batteries are refilled using a mix of energy from the gasoline engine and energy collected during braking (also referred to as regenerative braking). Mild hybrid systems are known by a variety of names, including EQ Boost (Mercedes), eTorque (Fiat/Chrysler), and eAssist (General Motors).

1.2.2. Full Hybrids

Full hybrid vehicles include an electrical device in addition to a gasoline engine, much like mild hybrids. However, compared to a mild hybrid, a complete hybrid vehicle's electric motor is able to manage a far higher workload. In reality, the majority of complete hybrids can travel a certain distance using only electric power. This usually occurs at slower city speeds, but it is one of the possible explanations for why a full hybrid's City MPG number may be greater than its Highway MPG figure (where in standard gasoline-powered vehicles, the opposite is true). There are two primary categories of power-trains used in complete hybrid vehicles: series hybrids and the second one parallel hybrids. One of three ways directly from the electrical motor, directly from the engine, or jointly from both systems can drive the motor in a parallel hybrid. In a Series hybrid, the gasoline engine acts as a kind of generators to fuel the electric motor, which in turn powers the tires exclusively. In reality, the wheels are never propelled by the gasoline engine. As hybrid technology has evolved, some vehicles now combine the two modes of operation (aptly called "series-parallel" hybrids), with the onboard computer network selecting the most effective mode to function at any given moment[6]–[8]. Similar to mild hybrid systems, full hybrids use both re-generative braking and power from the gasoline engine to power their battery storage.

1.2.3. Plug-In Hybrids

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All of the hybrid cars that have been discussed so far only use internal energy to recharge their batteries. The primary distinction between plug-in hybrids and other automobiles is that these ones have both internal and exterior battery charges. Plug-in hybrids typically have longer electric-only driven ranges than complete hybrids as a consequence. In a sense, plug-in hybrids act as a transitional kind of car between full hybrid and all-electric models[2].

1.2.4. Electric Vehicles with Range Extender Hybrids

Despite the fact that all-electric vehicles aren't considered hybrids, some do have a tiny gasoline engine to help out when necessary. Electric cars need to be recharged once they run out of juice in order to resume operating. In order to prevent leaving you stranded, these range-extending hybrids use their gasoline engine to power the electric motor or charge the battery. This might be a few hundred kilometres to hundreds of kilometres, based on the scale of the gasoline engine[9].

2. DISCUSSION

The most promising form of transportation for the coming generation will be hybrid electric automobiles. Over the past few decades, the price of crude oil has significantly climbed, forcing customers to look for alternate energy sources for transportation. In comparison to hybrid vehicles with internal combustion engines (ICE), BEVs and PHEVs use less energy and produce almost no harmful emissions. Numerous studies have helped to increase the performance and efficiency of PHEVs. According to research now available, these technologies are capable of performing HEV well, but their dependability and intelligent systems are still not up to par. As a result, there are several aspects that must be taken into account before HEVs go on sale in full, in addition to a number of present obstacles, which are as follows:

- The cost of these cars is still considerable, and renewable energy sources for automotive applications have issues with energy and power density.
- It is necessary to do a thorough analysis of hydrogen generation for FCs, including tank supply and storage systems.
- It is necessary to gauge the infrastructure of filling stations. There must be a tiny storage tank for a light vehicle. Exchange storage tanks can be used as an alternative.

Crude oil continues to be a major source of energy for transportation across the globe. The demand for fossil fuels never decreases but instead rises linearly each year. People already know that there will be a shortage of crude oil in the upcoming years. The maximum oil output may actually decline in the next five to ten years if no new sources of crude oil are found. This may result in a significant gap between supply and demand, which would have a significant influence on oil prices. As a result, in the near future, alternative power production for vehicles will be based on renewable energy.

3. CONCLUSION

Electric vehicles are becoming increasingly popular as a result of both environmental concerns and consumer demand, although electrochemical energy storage technologies are still far from living up to expectations to be competitive with fuel-based automobiles. Even though recent developments in battery storage have offered excellent potential to build electric vehicles that

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can fairly competitors in the market, the thermo-dynamics and energetics limitations of the electro-chemical reactions implicated in a battery do not entirely fulfil the needs of anomalous energy usage of vehicles.

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