An Overview on Hybrid Electric Vehicles

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ABSTRACT: ***Electric cars are seen to be a viable way to reduce greenhouse gas emissions. Despite significant research into the features and characteristics of electric cars, as well as their charging infrastructure design, electric vehicle development and network modelling are still in their infancy. Vehicles with hybrid engines have the potential to reduce fossil fuel usage, pollution, and allow for the use of renewable energy sources for transportation. Internal combustion engines in conventional cars are powered by gasoline or diesel. This paper involves the introduction of Hybrid vehicles as well as its types. Hybrid vehicles feature an internal combustion engine and can be fuelled like regular automobiles, but they also include an electric motor and battery that can be used to power the vehicle half or completely. Hybrid vehicles can be designed to achieve a variety of goals, including enhanced fuel efficiency, higher power, and additional auxiliary power for electronic devices and power tools. Many technologies are employed in hybrid automobiles to make them as excellent as conventional vehicles, such as regenerative braking, electric motor drive, automated start or cutoff.***

KEYWORDS: ***Automobiles, Energy, Engine, HEV, Power.***

1. INTRODUCTION

Since the early twenty-first century, several countries have debated the concerns of climate change and global warming. Plenty of papers have documented the detrimental consequences of climate change, which is mostly caused by human activity. With the rise of global civilization and industrialization, an increase in the use of fossil fuels in industry has resulted in a serious problem of air pollution. At the same time, the exhaust emissions from automobiles cannot be overlooked. Vehicle emissions, which primarily comprise CO_2, CO, NO_x and particulate matter (PM10 and PM2.5), have been identified as important contributors to the greenhouse gas impact, as well as an increase in malignancies and other serious illnesses.

About 49% of oil resources are used by the ever-expanding transportation industry[1]. The world's oil supplies are expected to be exhausted by 2038, based on current trends in oil consumption and crude oil sources. As a result, it appears that replacing non-renewable energy supplies with renewable energy sources and employing appropriate energy-saving technology is a must. Electric vehicles (EVs) have been extensively examined and studied as a viable solution for easing traffic-related environmental concerns. The power source and driving system are the most appealing aspects of EVs when compared to ICEVs.

In today's society, we are confronted with the issue of diminishing automobile fuel resources. There is little question that carbon dioxide emissions from automotive exhaust are a source of worry for the rising rate of global warming. Hybridization of the automobile is one of the most promising answers to such issues. A Hybrid Electric Vehicle (HEV) is one that combines an internal combustion engine with an electric power system. It means that HEVs can run on both internal combustion engines and electricity. Because the gasoline engine in a HEV may be tuned to run at optimum efficiency, it generates fewer emissions than a comparable-sized gasoline automobile. Figure 1 illustrates the existing work of Hybrid Electric Vehicle.

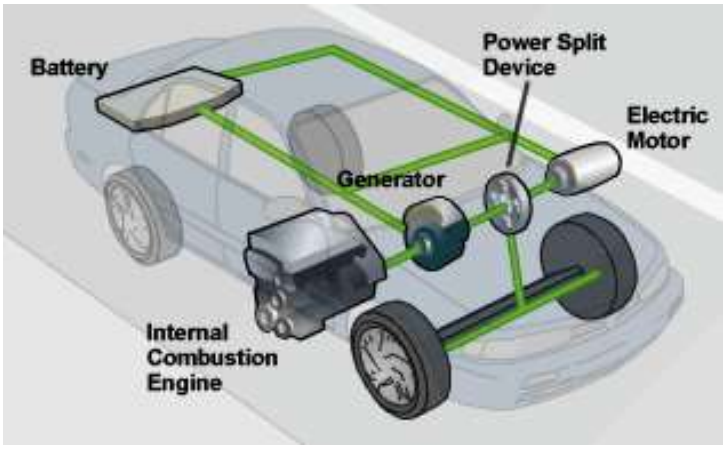

Figure 1: Illustrates the existing work of hybrid Electric Vehicle[2]

a. HEV Basics:

Hybridization: A hybrid vehicle is one that has several energy sources that may be used independently or in tandem to move the vehicle. Many hybridization designs have been proposed throughout the years, including fuel cell, gas turbine, solar, hydraulic, pneumatic, ethanol, electric, and many more. Hybrid electric cars, which combine two technically and commercially proven and well-established technologies of electric motors and internal combustion engines, allowing users to benefit from both, have been generally embraced by technology and consumers throughout the world.

b. Hybrid Electric Vehicles (HEV):

This is the hybrid car that is most often used. It combines an electric motor and an internal combustion engine for propulsion. The onboard batteries provide electricity to the electric motor. In a HEV, the internal combustion engine is combined with an electric motor, allowing for more efficient utilisation of the engine[3]. Driving in metropolitan traffic necessitates frequent vehicle starts and pauses. Idling causes the engine to use more fuel without performing any meaningful work, resulting in increased fuel consumption, worse efficiency, and wasteful exhaust emissions. By switching to power transmission through the motor and turning off the engine, the HEV addresses the problem. This manner, no gasoline is wasted when idling, and no exhaust is produced. Another significant benefit of HEVs is that if the gasoline tank runs out while travelling, the vehicle may be operated on electric power for the remainder of its range.

c. Hybrid Power Trains' Classification:

When referring to the power train of a vehicle, we are referring to the set of components that produce power and it's possible to categorise hybrid cars based on their power train systems into three main groups.

d. Series Hybrid:

In terms of architecture, a series hybrid is similar to a battery electric vehicle (BEV). Instead of driving the wheels directly, the combustion engine drives an electric generator. The generator charges a battery while also powering the vehicle's electric motor. The motor pulls electricity from both the battery and the generator when a considerable quantity of power is required. Because the gas engine only provides power for the electric motor and never directly drives the wheels, series hybrids are also known as extended-range electric vehicles (EREVs) or range-extended electric vehicles (REEVs). The Cadillac ELR, Chevrolet Volt, and Fisker Karma are recent examples. Figure 2 illustrates the configuration of series hybrid system in Electric Vehicles.

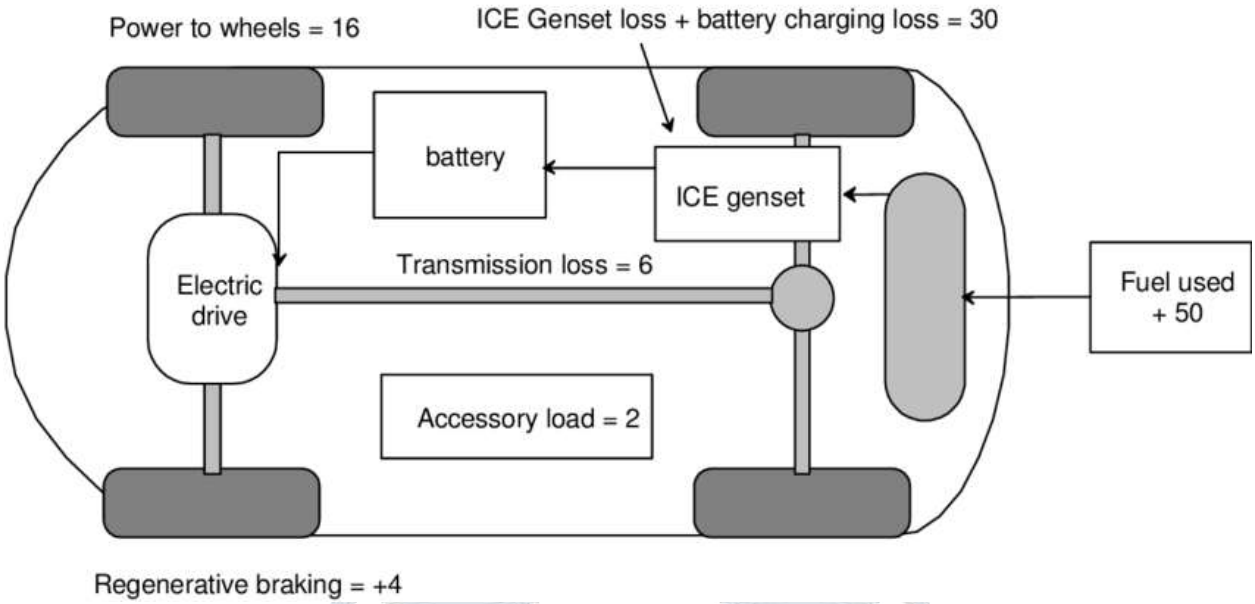

Figure 2: Illustrates the Configuration of Series Hybrid System in Electric Vehicle[4]**.**

e. Parallel Hybrid:

An internal combustion engine (ICE) and an electric motor linked to a mechanical gearbox power a parallel hybrid. The power distribution between the engine and the motor is adjusted so that both operate as efficiently as possible. In a parallel hybrid, there is no separate generator. The motor acts as a generator whenever the generator's functioning is required. The car can never drive in pure electric mode in a parallel mild hybrid. Only when a boost is required does the electric motor come on. Figure 3 illustrates the configuration of Parallel Hybrid System in Electric Vehicle.

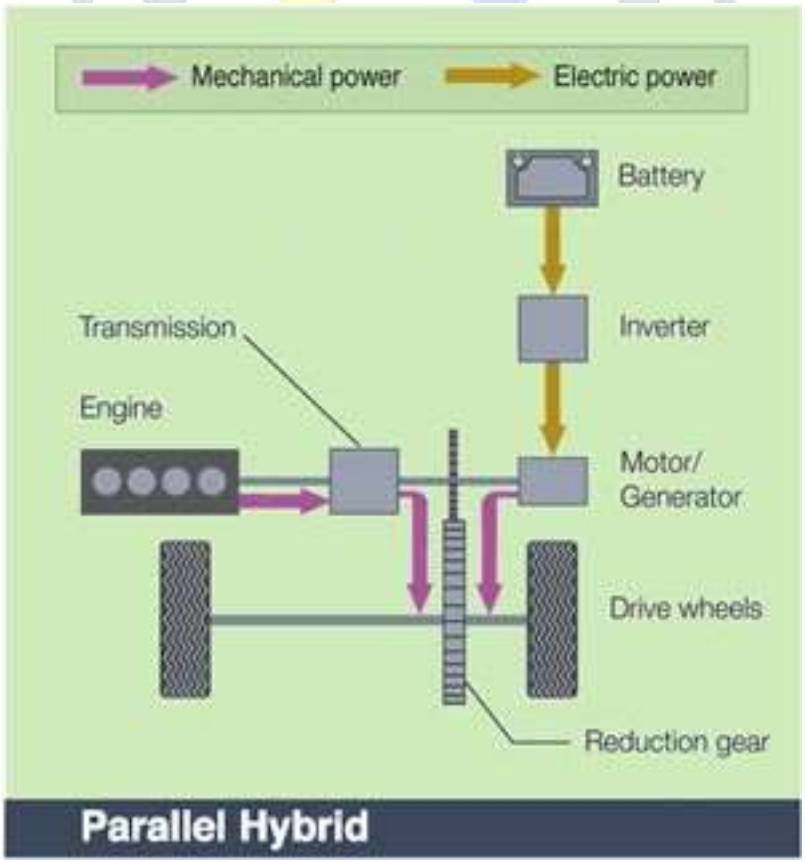

Figure 3: Illustrates the Configuration of Parallel Hybrid System in Electric Vehicle[5]

f. Series-Parallel Hybrid:

This drive train combines the two drive train types, allowing the vehicle to function as an all-electric vehicle (as a series hybrid), an all-combustion vehicle (as a parallel hybrid), or a combination of the two (as a parallel hybrid). For most applications, this is the most complicated and inefficient power train. Both series and parallel hybrid systems are included in combined hybrid systems. There are two mechanical and electrical connections between the engine and the driving axle. This split power line allows mechanical and electrical power to be interconnected at a cost of complexity.

The vehicle may be powered by a single gasoline engine, a single electric motor, or both energy converters at the same time. The power distribution between the engine and the motor is designed to allow the engine to operate as close to its ideal operating range as feasible. Figure 4 illustrates the Configuration of Serial-Parallel Hybrid System in Electric Vehicle.

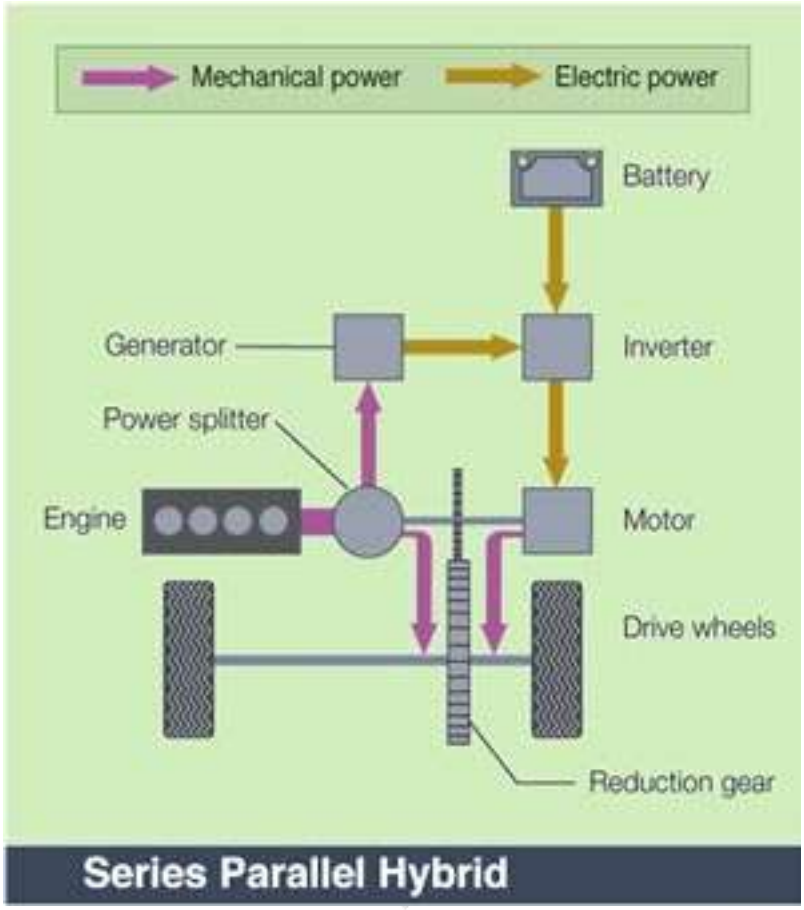

Figure 4: Illustrates the Configuration of Serial-Parallel Hybrid System in Electric Vehicle[6]

2. LITERATURE REVIEW

Ning Ding et al. discussed a review on Electric Vehicle[7]. Electric vehicles (EV) have been intensively investigated as a viable solution to reduce greenhouse gas emissions. The plug-in hybrid electric vehicle (PHEV) offers competitive driving range and fuel economy when compared to internal combustion engine vehicles thanks to advancements in power electrics, energy storage, and support (ICEV). The efficiency of the PHEV might be considerably enhanced by using optimised control techniques or the notion of an energy management system (EMS). The operation of several types of electric vehicles will be discussed in this review article. Battery and super-capacitor technologies will also be considered as options for increasing the PHEV's energy capacity.

Fan Zhang et al. discussed a review on the technology of electric vehicles as well as its applications[8]. The technological foundation of electric vehicle technology and its applications is reviewed in this study. A number of key ideas commonly encountered in this subject are presented, and technical details, including

theoretical principles, are provided alongside actual solutions for a variety of electric charging heaps. It assesses a number of state-of-the-art scientific advances in this subject that have emerged in the previous ten years. Finally, it identifies future research areas in electric car technology and applications, particularly in terms of charging strategies. Readers will receive a complete image of the research field by reading this review article, which will provide them with not only a technical foundation of electric vehicle technology, but also a thorough picture of the research area.

Wentao Jing et al. discussed a review on the network modeling of Electric vehicles[9]. Electric cars are seen to be a viable way to reduce greenhouse gas emissions. Despite significant research into the features and characteristics of electric cars, as well as their charging infrastructure design, electric vehicle development and network modelling are still in their infancy. This article offers an overview of electric vehicle research and highlights research needs in the areas of theories, modelling methods, solution algorithms, and applications. The principles, market share, features, and charging infrastructures of electric cars are initially described in this article. The studies on the traffic assignment problem with electric vehicles in the network, as well as restricted charging facilities, are then examined in detail. We conclude that while forecasting electric car routing behaviour and designing charging infrastructure networks, it is critical to take into consideration the vehicles' unique characteristics (such as range limit).

Yong J et al. discussed a review on electric vehicle, its impacts and prospects[10]. Electrifying transportation is a viable strategy for addressing climate change. The introduction of electric vehicles to the market has had important ramifications in a variety of sectors, particularly the power grid. Various regulations have been established to encourage the deployment of electric vehicles, and the upward trend in electric car adoption in recent years has been encouraging. Electric car powertrain, battery, and charger technology have all advanced in recent years, allowing for a greater use of electric vehicles. Despite the environmental and financial benefits, charging electric cars has a detrimental impact on existing network operations. To address this problem, appropriate charge management techniques may be adopted. Furthermore, integrating electric vehicles with the smart grid can open up a slew of possibilities, particularly in terms of vehicle-to-grid technology and as a solution to the renewable energy intermittency problem. This paper examines the most recent advancements in electric car technology, as well as the implications of electric vehicle adoption and prospects.

3. DISCUSSION

Electric cars are seen to be a viable way to reduce greenhouse gas emissions. Vehicles with hybrid engines have the potential to reduce fossil fuel usage, pollution, and allow for the use of renewable energy sources for transportation. Internal combustion engines in conventional cars are powered by gasoline or diesel. This paper involves the introduction of Hybrid vehicles as well as its types. Hybrid vehicles feature an internal combustion engine and can be fuelled like regular automobiles, but they also include an electric motor and battery that can be used to power the vehicle half or completely. The continual development of electric vehicle power train, battery and charger technologies have further improved the electric vehicle technologies for wider uptake. The future of these vehicles is bright as people are using it efficiently.

4. CONCLUSION

Hybrid-electric vehicles (HEVs) combine the advantages of internal combustion engines with electric motors, and may be designed to achieve a variety of goals, including enhanced fuel efficiency, higher power, and additional auxiliary power for electronic devices and power tools. Power transmission using freewheels and chain wheels are both inexpensive and dependable. One downside is that driving on electric power is not a viable long-distance alternative. Though in more stop-and-go traffic conditions, this combined power train system might be quite beneficial. The overall fuel consumption and fuel efficiency are enhanced when this power-train technology is used. Such a vehicle would operate on gasoline but would supplement its power with an electric motor when necessary. This paper discusses about the introduction to HEV and its power train types such as serial, parallel and series parallel. HEVs are more expensive than conventional automobiles, but they are more fuel efficient and emit less pollutant.

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