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Sustainability of Electric Vehicles with CO2 Emission Control

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ABSTRACT: Hybrid electric vehicles (HEVs) are a type of electric vehicle that combines an internal combustion engine with an electric motor and battery. This combination allows for improved fuel efficiency and reduced CO2 emissions compared to traditional internal combustion engine vehicles. HEVs work by using the electric motor and battery to assist the internal combustion engine during acceleration and other high-power demands, which reduces the amount of fuel needed and the associated CO2 emissions. Additionally, the electric motor and battery can power the vehicle at low speeds, such as during stop-and-go traffic, which further reduces the amount of fuel needed and the associated CO2 emissions. Full hybrid electric vehicles (FHEVs) have a larger electric motor and battery and can operate solely on electric power for short distances. Plug-in hybrid electric vehicles (PHEVs) have even larger batteries and can be charged from an external power source, allowing them to travel longer distances solely on electric power. Overall, HEVs offer a way to reduce CO2 emissions from transportation by improving fuel efficiency and reducing the amount of fuel needed for driving. As battery technology improves, HEVs are also becoming more efficient and able to travel longer distances solely on electric power, further reducing their CO2 emissions.

I.INTRODUCTION

Hybrid electric vehicles (HEVs) are a type of vehicle that combines an internal combustion engine (ICE) with an electric motor and battery system to improve fuel efficiency and reduce emissions. The ICE and electric motor work together in a hybrid system to power the vehicle, with the electric motor assisting the ICE during acceleration and other times when extra power is needed.

Overall, hybrid electric vehicles offer a promising technology for reducing the environmental impact of transportation while still providing the performance and convenience that consumers expect from their vehicles.

HEVs, or hybrid electric vehicles, are automobiles that combine both an internal combustion engine (ICE) and an electric motor to improve fuel efficiency and reduce emissions. While HEVs are considered to be a step towards more sustainable transportation, they still produce CO2 emissions through their ICE.

There are several ways to achieve CO2 control in HEVs, including improving the efficiency of the ICE, increasing the battery capacity and electric motor power, and implementing regenerative braking systems.

Additionally, the production and disposal of electric vehicle batteries can generate some CO2 emissions, but studies have shown that these emissions are relatively small compared to the emissions savings from operating an electric vehicle. Furthermore, government policies and incentives such as tax credits, rebates, and subsidies can encourage consumers to purchase electric vehicles and help to further reduce CO2 emissions from the transportation sector.

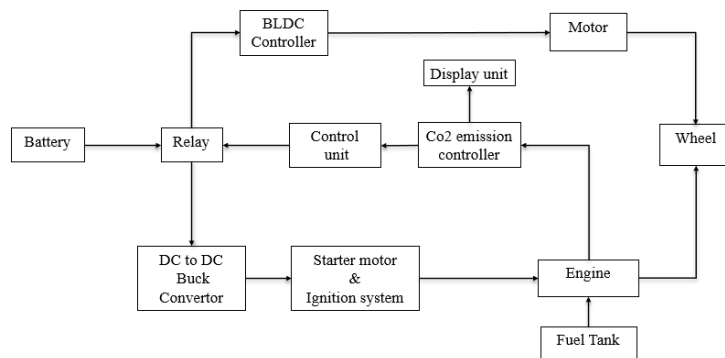
II.PROPOSED METHOD

HEVs have become increasingly popular in recent years as automakers strive to meet emissions regulations and reduce their carbon footprint. They offer a way to reduce fuel consumption and greenhouse gas emissions without sacrificing performance or range. Additionally, many HEVs come equipped with features such as start-stop technology and advanced driver assistance systems that further improve fuel efficiency and safety.

A hybrid electrical vehicle uses a combination of an internal combustion engine and an electric motor to power the vehicle. The fuel system and cooling system of the internal combustion engine are similar to those in a petrol vehicle. CO2 control in HEVs refers to the various technologies and strategies used to reduce or eliminate the amount of carbon dioxide (CO2) emissions produced by the ICE in hybrid electric vehicles. However, the hybrid also has a battery system, which powers the electric motor. The power electronics and control system manage the flow of energy between the battery, the electric motor, and the internal combustion engine. The electric motor provides additional power to the

vehicle, particularly during acceleration, and can also act as a generator to recharge the battery during deceleration or when the internal combustion engine is running. The drive system is similar to that in a petrol vehicle, consisting of a shaft, transmission, and differential that work together to transfer power from the engine and electric motor to the wheels.

III. BLOCK DIAGRAM



IV. CIRCUIT EXPLANATION

The control system in a parallel HEV manages the power flow between the ICE, electric motor, and battery to ensure that the vehicle operates efficiently and smoothly. The control system can also decide when to use the electric motor, ICE, or both based on driving conditions, battery charge level, and other factors.

In a parallel HEV, both the ICE and electric motor are mechanically connected to the vehicle's wheels and can propel the vehicle separately or in combination. The electric motor provides additional power during acceleration, while the ICE provides power during cruising and high-speed driving. The battery is charged through regenerative braking and excess engine power.

1. BATTERY :



Battery management is mandatory for LiFePO4 batteries to ensure energy availability, lifetime and safety of the energy storage system. Battery current, voltage and temperature over time are the major inputs of an electronic battery management system.

2. MOTOR :



Brushless DC motor has only two basic parts: rotor and the stator. The rotor is the rotating part and has rotor

magnets whereas stator is the stationary part and contains stator windings. In BLDC permanent magnets are attached in the rotor and move the electromagnet to the stator.

3. DC TO DC CONVERTOR :



DC to DC convert the voltage of a DC supply to a high voltage, for low-power applications.

4. POLLUTION SENSOR :



A pollution sensor is a device that detects and measures the levels of various pollutants in the environment. There are different types of pollution sensors that can detect different types of pollutants such as particulate matter, carbon monoxide, ozone, nitrogen oxides, sulfur dioxide, and volatile organic compounds.

5. RELAY :



A 60-volt relay is an electrical switch that operates at a maximum voltage of 60 volts. Relays are commonly used in electrical circuits to control the flow of current to various devices or components. They are useful in applications where it is necessary to control high voltage or high current loads with a low voltage control signal.

V. PROPOSED METHOD

i. Optimize the engine performance:

The first step is to optimize the performance of the engine to reduce CO₂ emissions. This can be achieved by adjusting the fuel injection, ignition timing, and valve timing to improve fuel

efficiency and reduce emissions.

ii. Implement regenerative braking:

Regenerative braking is a process where the motor is used to generate electricity during braking, which can be stored in the battery. This energy can be used to power the vehicle later, reducing the reliance on the engine and therefore reducing emissions.



iii. Use electric-only mode:

Electric-only mode is when the vehicle operates solely on the electric motor, with the engine turned off. This is ideal for low-speed and stop-and-go driving conditions, where the engine is less efficient. By using the electric-only mode, the vehicle can reduce CO₂ emissions and improve fuel efficiency.

iv. Implement stop-start technology:

Stop-start technology is a system that automatically turns off the engine when the vehicle comes to a stop, and restarts it when the driver presses the accelerator. This reduces idling and improves fuel efficiency, reducing emissions.

v. Optimize the battery charging:

The battery charging can be optimized to reduce emissions. This can be done by using regenerative braking to charge the battery, or by charging the battery during periods of low engine load, when the engine is more efficient.

vi. Implement aerodynamic improvements:

Aerodynamic improvements, such as reducing the vehicle's drag coefficient, can improve fuel efficiency and reduce emissions.

vii. Optimize the control strategy:

The control strategy can be optimized to ensure that the engine and motor are used in the most efficient manner possible. This can be achieved by using advanced control algorithms that take into account the driving conditions and the state of the battery. By implementing these methods, HEVs can be designed to reduce CO₂ emissions and improve fuel efficiency, while still providing the performance and comfort that drivers expect from modern vehicles.

VI.ADVANTAGES

I. Improved fuel efficiency:

The combination of an ICE and electric motor allows HEVs to use less fuel than traditional ICE-only vehicles. This leads to reduced CO₂ emissions and lower operating costs for the owner.

II. Lower emissions:

HEVs emit fewer pollutants, including CO₂, compared to traditional ICE-only vehicles. This makes them an attractive option for environmentally conscious consumers who want to reduce their carbon footprint.

III. Regenerative braking:

HEVs use regenerative braking, which captures energy that is normally lost during braking and stores it in the battery. This not only reduces wear and tear on the brakes but also improves the overall efficiency of the vehicle.

IV. Increased range:

The electric motor in HEVs can provide additional power to the vehicle, which can increase its range. This means that HEVs can travel further on a single tank of gas than traditional ICE-only vehicles.

V. Improved driving experience:

HEVs often have smoother acceleration and deceleration compared to traditional ICE-only vehicles. This can provide a more comfortable and enjoyable driving experience.

VII.APPLICATION

The application of CO₂ control in HEVs is essential to reduce carbon emissions and mitigate the impact of transportation on the environment. Here are some specific applications of HEV CO₂ control:

i. Engine efficiency optimization:

HEVs can improve the efficiency of the ICE by optimizing the combustion process, reducing friction losses, and implementing technologies such as variable valve timing and turbocharging. This reduces the amount of fuel consumed by the ICE and, consequently, reduces CO₂ emissions.

ii. Electric motor power increase:

HEVs can increase the power of the electric motor to allow for more electric-only driving. By relying less on the ICE, the amount of CO₂ emissions produced is reduced.

iii. Battery capacity increase:

Increasing the battery capacity of HEVs allows for more electric-only driving, further reducing CO₂ emissions.

iv. Regenerative braking systems:

Regenerative braking systems in HEVs capture the energy produced during braking and use it to recharge the battery. This reduces the load on the ICE, which reduces fuel consumption and CO₂ emissions.

v. **Use of alternative fuels:**

HEVs can also use alternative fuels, such as biofuels or hydrogen, which emit less CO₂ than traditional gasoline or diesel fuels.

Overall, the application of CO₂ control technologies in HEVs is essential to achieve more sustainable and environmentally-friendly transportation. By reducing carbon emissions from vehicles, we can mitigate the impact of transportation on the environment and work towards a more sustainable future.

VIII. RESULTS AND CONCLUSION

Hybrid Electric Vehicles (HEVs) generally emit less CO₂ than conventional gasoline-powered vehicles, although the actual reduction in emissions depends on a variety of factors such as the type of hybrid technology, driving conditions, and the size and weight of the vehicle. According to a report by the United States Environmental Protection Agency (EPA), HEVs emit, on average, about 25% to 35% less CO₂ than their conventional counterparts. This is because HEVs use both a gasoline engine and an electric motor to power the vehicle, which can result in better fuel economy and lower emissions. However, it's worth noting that not all HEVs are created equal when it comes to emissions. Some hybrid models may emit more CO₂ than others depending on their design, size, and driving conditions. Additionally, the environmental benefits of HEVs can be further enhanced if the electricity used to charge the vehicle comes from renewable sources. Overall, while HEVs are not a complete solution to reducing CO₂ emissions from transportation, they can be a step in the right direction, especially as the technology continues to evolve and become more efficient.

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