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FABRICATION OF HYBRID VEHICLE BY USING LITHIUM-ION BATTERY

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Abstract: A hybrid vehicle combines two or more distinct power sources to propel the vehicle, typically an Internal Combustion Engine (ICE) and an electric motor. This combination aims to fuel efficiency and reduce emissions compared to conventional vehicles solely reliant on ICEs. Hybrid vehicles often employ regenerative braking and advanced energy management systems to store and reuse energy, enhancing overall efficiency. As technology advances, hybrid vehicles continue to evolve, offering increasingly sustainable transportation solutions with improved performance and reduced environmental impact. While this offer Using the electric vehicle benefits like reduced emissions and challenges include battery cost and capacity, thermal management. The fabrication process would involve integrating a lithium- ion battery pack, an electric motor, and a control system into an existing vehicle framework. The Internal Combustion Engine would be retained to provide additional power and extend the vehicle's range.

Keywords – Hybrid powertrain, Internal combustion engine (ICE), Electric motor, Regenerative braking, Energy management system.

I. INTRODUCTION:

As concerns about environmental impact and fuel efficiency rise, hybrid vehicles are gaining significant traction. These innovative machines combine the power of an internal combustion engine (ICE) with an electric motor, offering a compelling solution. This marriage of technologies not only reduces emissions but also improves fuel economy compared to traditional gasoline-powered vehicles. Hybrids achieve this feat through regenerative braking, where the kinetic energy from slowing down is captured and stored in a battery pack for later use. Additionally, advanced energy management systems become crucial to optimize power delivery and maximize overall efficiency.

While electric vehicles (EVs) offer the ultimate goal of zero emissions, their range limitations and current battery technology pose challenges for some drivers. Hybrids bridge this gap, providing the environmental benefits of an electric motor combined with the extended range of an ICE. This makes them a viable option for a wider range of consumers seeking eco-conscious transportation solutions.

This section dives into the fascinating world of crafting a hybrid vehicle using a lithium-ion battery pack. We'll embark on a journey exploring the process of integrating this advanced technology into the framework of a conventional car, while strategically keeping the internal combustion engine for extended travel capabilities. Throughout this exploration, we'll dissect the essential components that make up a hybrid powertrain, unveil the challenges that need to be tackled during the conversion process, and delve into some of the critical considerations that ensure a successful transformation from a gasoline-powered vehicle to a hybrid machine. Additionally, we'll shed light on the safety aspects paramount when working with high-voltage lithium-ion batteries and the regulatory framework that guides such conversions.

II. EXISTING SYSTEM:

1. Existing Vehicle Framework

As concerns about environmental impact and fuel efficiency rise, hybrid vehicles are gaining significant traction, often built upon existing vehicle frameworks. These innovative machines combine the power of an internal combustion engine (ICE) with an electric motor, offering a compelling solution. This approach leverages the existing manufacturing infrastructure and consumer familiarity with traditional car designs, making the transition to hybrid technology more accessible and affordable. Modifying an existing framework also reduces the overall environmental impact of the conversion process compared to building a car from scratch.

2. Existing Internal Combustion Engine

While electric vehicles (EVs) offer the ultimate goal of zero emissions, their range limitations and current battery technology pose challenges for some drivers. Hybrids bridge this gap, providing the environmental benefits of an electric motor combined with the extended range of an existing internal combustion engine. This integration strategy allows drivers to experience the advantages of electric propulsion for everyday commutes while maintaining the familiar functionality and extended range of a gasoline-powered engine for longer journeys. By retaining a proven technology like the ICE, hybrid vehicles offer a practical and less disruptive alternative for consumers who are hesitant to fully commit to an electric vehicle.

III. PROPOSED SYSTEM:

This section delves into a proposed system for a hybrid vehicle utilizing a lithium-ion battery pack. Our focus lies on transforming a conventional car into a hybrid by integrating this advanced battery technology. We'll explore the key components that come together to create this eco-conscious powertrain.

The core of this system revolves around seamlessly integrating a lithium-ion battery pack into the existing framework of a car. This battery pack serves as the energy storage unit, capturing energy recovered through regenerative braking and providing power to the electric motor. The electric motor acts as the alternative propulsion source, working in tandem with the existing internal combustion engine (ICE). This collaboration allows the vehicle to operate solely on electric power for shorter distances or utilize the combined power of both the electric motor and ICE for extended journeys.

To ensure optimal performance and efficiency, a sophisticated control system becomes crucial. This system acts as the brain of the hybrid vehicle, managing power flow between the battery pack, electric motor, and ICE. It constantly monitors various parameters, including battery state of charge, engine load, and driver input, to determine the most efficient power delivery strategy. Additionally, the control system plays a vital role in ensuring smooth transitions between electric and hybrid modes, providing a seamless driving experience.

The following sections will delve deeper into the specifics of each component, exploring their functionalities, integration challenges, and how they work together to create a functional and efficient hybrid powertrain. We'll also discuss critical considerations like thermal management and safety protocols when working with high-voltage lithium-ion batteries.

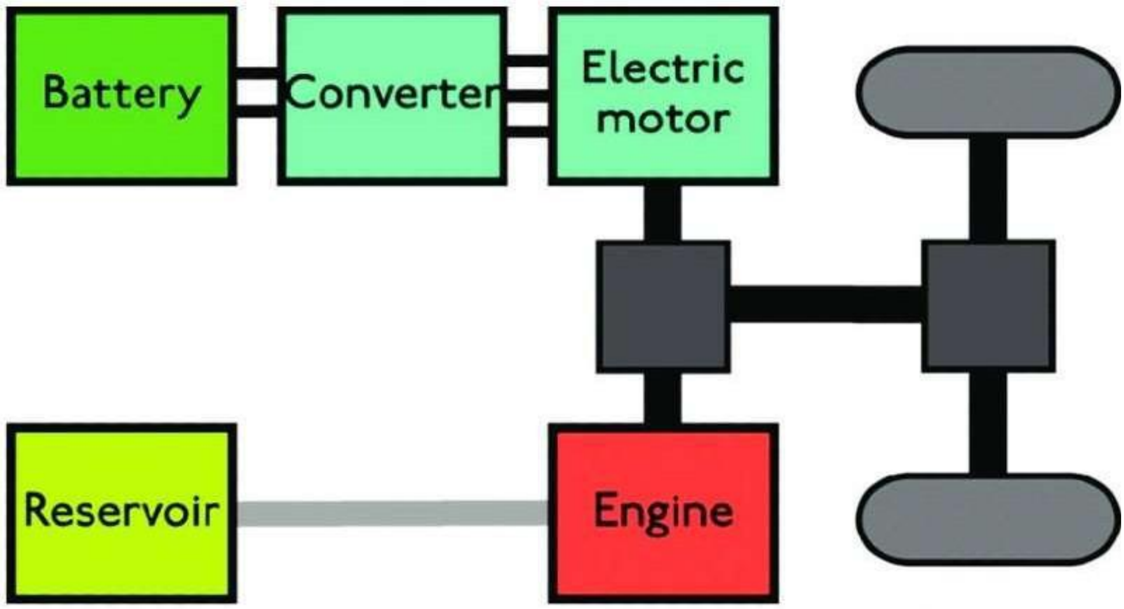

Fig 3.1 Block Diagram

IV. THEORETICAL BACKGROUND:

The concept of a hybrid vehicle hinges on the synergy between two distinct power sources: an internal combustion engine (ICE) and an electric motor. This section explores the underlying theoretical principles that govern their operation and the role lithium-ion batteries play in this system.

1. Powertrain Dynamics

Internal Combustion Engine (ICE): Traditional gasoline or diesel-powered engines provide the primary propulsion for the vehicle. They operate by burning fuel in a controlled manner, converting the released chemical energy into mechanical work that drives the wheels. However, ICEs are inherently less efficient at all operating points, particularly during stop-and-go traffic or idling.

Electric Motor: Electric motors offer high efficiency and the ability to generate peak torque instantly. They convert electrical energy from the battery pack into rotational motion, propelling the vehicle. Unlike ICEs, electric motors produce zero tailpipe emissions while operating.

2. Regenerative Braking:

Hybrid vehicles capture kinetic energy that would otherwise be lost as heat during braking. When the driver applies the brakes, the electric motor acts as a generator, converting the car's momentum into electricity. This generated electricity is then stored in the lithium-ion battery pack for later use.

3. Lithium-Ion Battery Technology:

Lithium-ion batteries are the heart of the hybrid electric system, acting as the energy storage unit. Compared to traditional lead-acid batteries, lithium-ion offers several advantages:

- High Energy Density: Lithium-ion batteries store more energy per unit weight, allowing for longer electric-only range.
- High Power Density: They can deliver high power output quickly, crucial for electric motor operation.
- Long Lifespan: Lithium-ion batteries offer a longer lifespan compared to other battery technologies, making them a more sustainable choice.

4. Control System:

A sophisticated control system is the brain of the hybrid vehicle, managing the complex interplay between the ICE, electric motor, and battery pack. It determines the optimal power source or combination depending on real-time factors such as:

- Battery State of Charge (SOC): The amount of energy remaining in the battery pack.
- Driver Demand: Acceleration needs and desired vehicle speed.
- Engine Load: The amount of work the ICE is performing.

Based on these factors, the control system decides whether to operate solely on electric power, utilize the ICE, or combine both for optimal performance and efficiency.

V. HARDWARE DESCRIPTION:

Controller Hardware:

This is the electronic brain of the hybrid system, responsible for managing the complex interplay between the battery pack, electric motor, and ICE. It constantly monitors various sensors and readings from the battery management system (BMS) to determine the most efficient and optimal power delivery strategy in real-time. Factors like battery state of charge, engine load, and driver demand are all taken into consideration by the controller to ensure smooth transitions between electric and hybrid modes, maximizing fuel efficiency and performance.

Fig 5.1 Controller Hardware

Battery:

As mentioned previously, the lithium-ion battery is the energy storage unit of the hybrid system. During regenerative braking, kinetic energy captured while slowing down is converted to electricity and stored in the battery. The battery also supplies power to the electric motor, enabling electric-only operation for shorter distances or providing additional power during acceleration. Lithium-ion batteries are chosen for their high energy density, allowing for more energy storage in a compact space compared to traditional lead-acid batteries, and their high power density, which ensures the battery can deliver the required power output to the electric motor.

Fig 5.2 Battery

Battery Management System (BMS):

This critical component plays a vital role in ensuring the safe and efficient operation of the lithium-ion battery. It acts as the guardian of the battery pack, constantly monitoring factors like cell voltage, temperature, and current. The BMS safeguards the battery against overcharging, overheating, or any other conditions that could lead to damage or safety hazards. By regulating these parameters, the BMS extends the lifespan of the battery pack and optimizes its overall performance.

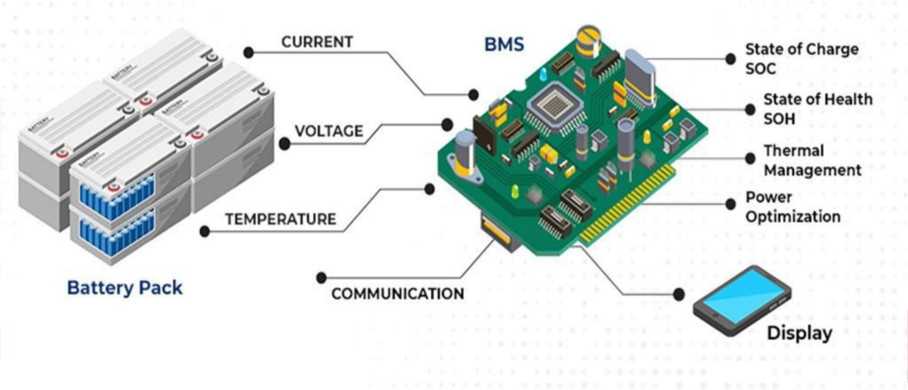

Fig 5.3 Battery Management System

Hub Motor:

The hub motor is the heart of the electric propulsion system in a hybrid vehicle. It converts electrical energy drawn from the battery pack into mechanical rotation, propelling the car forward. Electric motors offer several advantages over traditional gasoline engines, including high efficiency, especially during stop-and-go traffic conditions, and the ability to generate peak torque instantly, providing responsive acceleration. In a hybrid vehicle, the electric motor can operate alone for electric-only driving at lower speeds or combine with the ICE for increased power and performance during high-demand situations like highway driving or rapid acceleration.

Fig 5.4 Electric Motor

DC-DC Converter:

This component acts as the bridge between the high-voltage battery pack (typically around 300V) and the lower voltage of the car's existing electrical system (12V). It performs two key functions: boosting the 12V system to power vehicle accessories and lights, and regulating voltage to ensure optimal performance for various electrical components. By regulating voltage levels, the DC-DC converter ensures the safe and efficient operation of all electronic systems within the vehicle.

Fig 5.5 DC-DC Converter

VI. WORKING PRINCIPLE:

Hub motors are typically brushless motors which replaces the commentator and brushes with separate coils and an electronic circuit. The circuit switches the power ON and OFF in the coils in turn creating forces in each one that make the motor spin. Since the brushes press against the axle of a normal motor, they introduce friction, slow it down, and make a certain amount of noise. That's why brushless motors are more efficient especially at low speeds. 250-watt motors are the most used motor on commercially available electric bikes. They are popular in Europe and Asia where in many countries there is a 250 watt power limit on E-bikes.

Because millions of these 250-watt motors have been made for the European and Asian market, the cost to buy them from the factories in China is low, but at the same time it is a motor that is proven to be reliable and efficient. The 250-watt hub motor comes very close to being a perfect piece of E-bike technology, cool looking. lightweight, reliable, and cheap. It could have been the very best way to make a bicycle into an electric bike. However, the only caveat is the simple question is 250 watts enough? If 250 watts is enough for you, then this might be the ideal power plant for your E-bike.

Most 250-watt motors are geared hub motors, meaning they have a planetary gear reduction so that the motor spins at an optimal RPM. This makes the motor more efficient than a simpler direct drive hub motor. At 250 watts, the planetary gears mean a more torque and more efficient motor. In this motor pictured below. you can see the planetary gears which allow the motor to spin up to 5 times faster than the wheel. Since electric motors love fast RPMs, the planetary gear allows the use of a smaller and lighter motor, with the same power output of a larger motor. Power to weight, the geared hub motor is much better than a direct drive hub motor. Although a few companies make a 250-watt direct drive motor. A 250W brushless de hub motor is used. It has been selected over normal DC motor.

It has a better power/weight ratio, greater efficiency and hence is more compact, robust and reliable. The absence of a commentator and carbon brushes enables this type of motor to have a longer life. The armature is the stationary part and has three coils. while the rotor is a permanent magnet. Each motor has three hall sensors used to detect the position of the rotor. The stator speed Ns and the rotor speed Nr are both the same at steady state as this is asynchronous motor. The rotor speed Nr is measured by taking feedback from the hall sensors while the stator speed Ns is the frequency at which you alternately switch the coils. By taking feedback Nr and Ns are kept the same. Hence the speed of the rotor is directly proportional to the frequency of switching and the output torque is inversely proportional.

Choosing the right motor for your e-bike depends on your individual needs and riding style. The 250W geared hub motor remains a fantastic choice for budget-conscious riders seeking a reliable and efficient way to experience the joy of electric cycling. However, for those seeking more power and tackling challenging terrains, exploring higher wattage hub motors or mid-drive options can unlock a whole new level of performance and riding possibilities. Remember to consider factors like regulations, weight, and battery capacity to ensure your e-bike setup perfectly complements your riding goals.

As the wattage rating increases (from 350W to 750W and beyond), the motor delivers more power, translating to greater acceleration, higher top speeds, and the ability to conquer steeper inclines with ease. This enhanced performance makes e-bikes more versatile, allowing riders to tackle a wider range of terrains and riding styles. However, there are trade-offs. These motors tend to be heavier and slightly less efficient, and regulations in some regions might restrict their use.

VII. OUTPUT:

Fig 7.1 Output

VIII. CONCLUSION:

The fabrication of hybrid vehicle by using Lithium-ion battery in two- wheeler was Successfully Demonstrates the feasibility and Benefits of using Electric Vehicles for Transportation. Solar Powered vehicle cannot be charged at night time but we designed two Sources in the two-wheeler Electrical and fuel Source to run the two-Wheeler and travelling long distance are the major advantages of our concept. In Rural areas, there is no more petrol Bunks. We can use the Electrical Energy by Battery to travel our designated Place.

In that our main aim, reduce the consumption of fuel and less pollution. In that IC Engine long distance only can give more mileage but when we use Electric Source. It gives efficiently at low cost. The integration of an Internal combustion Engine (ICE) with a lithium-ion battery system represents a powerful energy in the automotive industry. This hybridization offers the benefits of both conventional combustion engines and advanced battery technology. The ICE provides reliable power for long-range driving, while the lithium-ion battery enhances efficiency, reduces emissions, and enables regenerative braking, thereby maximizing energy utilization.

This combination not only improves fuel economy and reduces environmental impact but also enhances overall performance and driving experience. With the dual power sources working in tandem, hybrid vehicles embody a sustainable solution for transportation, addressing the challenges of energy efficiency and environmental conservation in the modern era.

IX. RESULT AND DISCUSSION:

9.1 RESULT:

Online resources like conversion guides and component suppliers exist, but these projects require expertise and safety precautions. Consider online communities for support, but remember the complexity, regulations, and costs involved. Explore "mild hybrid" kits for a potentially simpler option.

Converting a car to a hybrid is complex, requiring technical expertise and adherence to safety regulations. It can also be costly and time-consuming.

These kits typically focus on adding a small electric motor and battery pack to the existing drivetrain of a gasoline-powered car. This approach offers some of the benefits of a hybrid system, such as improved fuel efficiency and reduced emissions, without the extensive modifications required for a full hybrid conversion. Additionally, mild hybrid kits are generally more affordable and easier to install compared to full hybrid conversion projects.

However, it's important to understand the limitations of mild hybrid systems. They typically offer a smaller increase in fuel efficiency compared to full hybrids, and their electric-only range is usually very limited, often just enough to assist with starting and low-speed driving. Nevertheless, for those seeking a taste of hybrid technology and a slight improvement in fuel economy without undertaking a complex conversion project, mild hybrid kits can be a viable option.

9.2 DISCUSSION:

While the idea of crafting a hybrid car using a lithium-ion battery holds immense appeal, the search results paint a realistic picture. Building a hybrid vehicle from scratch is a complex undertaking. The challenges include the high level of technical expertise required, stringent safety protocols for handling lithium-ion batteries, and navigating regulations for modified vehicles. Additionally, the cost of acquiring components and specialized tools can be significant.

For most people, commercially available hybrid cars offer a more practical solution. However, the search results do highlight some interesting alternatives. Online communities exist for those determined to tackle a full conversion, but these resources emphasize the importance of safety and expertise.

A potentially more accessible option lies in "mild hybrid" kits. These kits involve adding a small electric motor and battery to an existing gasoline-powered car. While offering a smaller boost in fuel efficiency compared to full hybrids, they provide a taste of hybrid technology and potentially improved fuel economy with a less complex installation process. This approach could be a stepping stone towards more widespread hybrid adoption, especially if the process becomes more standardized and user-friendly.

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