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HYBRID ELECTRIC VEHICLE POWERED BY PETROL AND BATTERY

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ABSTRACT:

A hybrid electric vehicle (HEV) is a modern transportation system that operates using a combination of a petrol engine and an electric motor powered by a battery. The petrol engine is mainly used for high-speed driving and long-distance travel, while the electric motor supports the vehicle during low-speed and light-load conditions. Both power sources work together to improve overall efficiency and performance. The battery supplies electrical energy to the motor and is charged by the petrol engine during operation. In this type of hybrid system, regenerative braking is not used for battery charging. The intelligent control unit manages power distribution between the engine and motor based on driving conditions. This arrangement helps reduce fuel consumption compared to conventional petrol vehicles. Hybrid vehicles also produce lower exhaust emissions, contributing to a cleaner environment. They provide smooth accele ration and better fuel economy, especially in urban driving. Overall, hybrid electric vehicles offer an effective balance between performa nce, fuel efficiency, and environmental sustainability.

I. INTRODUCTION

A hybrid electric vehicle (HEV) powered by both petrol and battery represents one of the most significant technological advancements in the evolution of modern transportation systems. This dual-power setup integrates an internal combustion engine (ICE), typically fueled by petrol, with an electric propulsion system operating on rechargeable batteries, enabling the vehicle to intelligently switch between or simultaneously use both energy sources. The hybrid configuration is designed to overcome the limitations of conventional petrol-powered vehicles such as high fuel consumption, increased emissions, and dependency on fossil fuels while also addressing the shortcomings associated with fully electric vehicles, including limited driving range, long charging times, and the need for extensive charging infrastructure. By combining the strengths of both technologies, hybrid electric vehicles offer a balanced performance that enhances efficiency, reduces environmental impact, and meets the practical mobility needs of modern society.

The global demand for sustainable transportation solutions as concerns regarding climate change, air pollution, and depleting petroleum reserves continue to grow. Traditional petrol engines emit substantial amounts of carbon dioxide (CO_2), nitrogen oxides (NO_x), and particulate matter, contributing to environmental degradation and public health issues. On the other hand, electric vehicles, despite producing zero tailpipe emissions, rely heavily on battery capacity and charging stations, which are not evenly available across all regions. Hybrid vehicles bridge this gap by enabling the petrol engine to operate only when necessary such as during high-speed driving or heavy load demands while the electric motor handles low-speed and start-stop driving conditions. This not only reduces fuel consumption but also optimizes energy usage, resulting in a smoother and more efficient driving experience.

Hybrid vehicles lies in their ability to recover and store energy that would otherwise be wasted. Through regenerative braking, kinetic energy produced during deceleration is converted into electrical energy and stored in the battery for later use. This mechanism significantly enhances energy efficiency and contributes to the extended lifespan of the battery pack. Additionally, the onboard power management system continuously monitors driving conditions and intelligently determines the most efficient power source at a given moment. This advanced electronic control ensures seamless transitions between petrol and electric modes, thereby delivering a superior balance of power, efficiency, and environmental sustainability.

The rise of hybrid electric vehicles can also be attributed to advancements in battery technology, power electronics, lightweight materials, and control algorithms. Modern HEVs utilize lithium-ion batteries with higher energy density, improved thermal stability, and longer lifecycles compared to older battery technologies. Furthermore, innovations in electric motor design such as brushless DC motors and permanent magnet synchronous motors have resulted in improved torque characteristics, reduced maintenance requirements, and enhanced overall system reliability. These technological developments collectively ensure that hybrid vehicles remain competitive and practical for a wide range of applications, from personal transportation to commercial fleets.

The hybrid electric vehicle powered by petrol and battery serves not only as an intermediate step toward full electrification but also as a long-term solution capable of reducing dependency on fossil fuels while maintaining convenience and performance. It caters to users who seek improved fuel economy, lower greenhouse gas emissions, and reduced operational costs without compromising on driving range or refueling convenience. For countries where electric charging infrastructure is still developing, hybrid vehicles offer a realistic and accessible pathway toward more eco-friendly mobility.

A petrol-battery hybrid electric vehicle represents a strategic fusion of mechanical and electrical engineering principles aimed at delivering clean, efficient, and reliable transportation. It demonstrates how innovative engineering and sustainable technologies can be combined to address environmental challenges, economic constraints, and consumer expectations simultaneously. As the world moves toward greener alternatives, hybrid electric vehicles are playing a crucial role in shaping the future of the automotive industry and paving the way for widespread adoption of energy-efficient mobility solutions.

The high-energy density of a traditional petrol-powered internal combustion engine (ICE) and the high-efficiency, instant torque of an electric motor. By integrating these systems, the vehicle operates as a "bridge technology" that effectively eliminates the common drawbacks of both standalone platforms. For instance, while pure electric bikes often suffer from "range anxiety" due to limited battery life and sparse charging infrastructure, a hybrid uses its petrol engine to provide long-distance reliability and high-speed cruising. Conversely, where traditional petrol engines are least efficient specifically in stop-and-go urban traffic where fuel is wasted during idling the hybrid switches to its electric motor, providing a silent, zero-emission, and cost-effective ride.

The technical synergy is achieved through an Electronic Control Unit (ECU) that acts as the "brain," seamlessly managing the power flow between the fuel tank and the lithium-ion battery based on real-time riding conditions. In a Parallel Hybrid configuration, both the engine and motor can power the rear wheel simultaneously to provide an extra boost for hill climbing or overtaking, whereas a Series Hybrid might use the engine primarily as an on-board generator to recharge the battery while moving. Beyond just fuel savings, which can reach up to 50%, these bikes incorporate advanced features. The hybrid electric bike offers a pragmatic solution for modern transportation, combining environmental sustainability and lower urban noise pollution with the unmatched freedom and range of traditional petrol-powered travel.

LITERATURE REVIEW

1. **Pooja V. Lokhande, Tejas V. Devrukhkar, Aniket V. Naigade, Sajid D. Inamdar, Akshata S. Yadav(2021):** The hybrid electric bikes due to rising fuel costs, pollution, and limited fossil fuel availability. The authors explain that a hybrid bike uses both an internal combustion engine and an electric hub motor, allowing switching between petrol mode and electric mode. They highlight that electric mode helps during low-speed, stop–and-go city riding where petrol engines waste fuel. Petrol mode is useful for high torque and long-distance travel. The study shows that hybrid technology improves fuel economy, reduces emissions, and offers better efficiency compared to conventional bikes. The paper discusses different hybrid types such as series, parallel, and series-parallel systems. It also describes essential components like the hub motor, controller, battery, throttle, and dc-dc converter. The authors conclude that hybrid bikes provide flexible operation, longer range, lower running cost, and reduced pollution. Overall, the paper shows that hybrid electric bikes are practical, economical, and suitable for future transportation needs.

2. **Balaraj P, Harshith D Raj, Manoj G, Srisham S M, Kiran Kumar G R(2022):** The paper explains how a conventional petrol-engine motorcycle can be converted into an electric bike by replacing the ICE with a BLDC motor and battery system. The authors highlight the need for this conversion due to rising fuel costs, pollution, and the depletion of fossil fuels. They describe how the battery supplies DC power to the motor through a controller, which manages speed and torque. A throttle is used to control acceleration, similar to a motorcycle. The chain sprocket transmits rotation from the motor to the wheel, ensuring smooth motion. The paper also discusses the use of a suitable battery pack to run the electric motor efficiently. Their proposed method reduces pollution, operating cost, and maintenance compared to petrol engines. The authors also explain the experimental setup using a 750W BLDC motor and 48V battery pack. Overall, the analysis shows that converting existing petrol bikes into electric ones is practical, economical, and environmentally beneficial.

3. **Ritesh Tambade, Sagar Yede, Manish Karkud, Vivek Gogawale, Mahesh Rankhamb(2023)**: A hybrid electric vehicle works using two types of power: petrol and battery. The petrol stored in the fuel tank is used by the internal combustion engine (ICE) to run the vehicle like a normal bike. Along with this, a battery supplies electrical power to a BLDC motor, which can move the vehicle without using petrol. A controller manages the power flow from the battery to the motor and decides when the motor should run. At low speeds or in traffic, the electric motor is used to save petrol and reduce pollution. At higher speeds, the petrol engine takes over because it is more powerful. During heavy load or climbing, both the engine and the motor can work together for better performance. When the brakes are applied, the electric motor acts as a generator and charges the battery this is called regenerative braking. The battery can also be charged using an external charger. Because the vehicle can run on both petrol and electricity, it gives better mileage, reduces pollution, and works efficiently in all types of road conditions.

4. **Hideki Furuta And Jun Yoshida (Yamaha Motor Co., Ltd., 2024):** A hybrid two-wheeler using an Electrical Variable Transmission (EVT). The EVT replaces a conventional gearbox with a double-rotor electric machine, allowing the engine to run at its most fuel-efficient speed while the motor manages wheel torque and electricity generation. The system supports multiple modes: electric drive, hybrid drive, engine-generator mode, regenerative braking, and boost acceleration. It improves fuel efficiency and performance while remaining compact for two- wheeler packaging. Control strategies optimize torque, battery, and temperature management. Prototype tests show notable fuel savings compared to conventional ICE motorcycles, making it a practical design for mass-market hybrid two-wheelers.

SYSTEM OVERVIEW

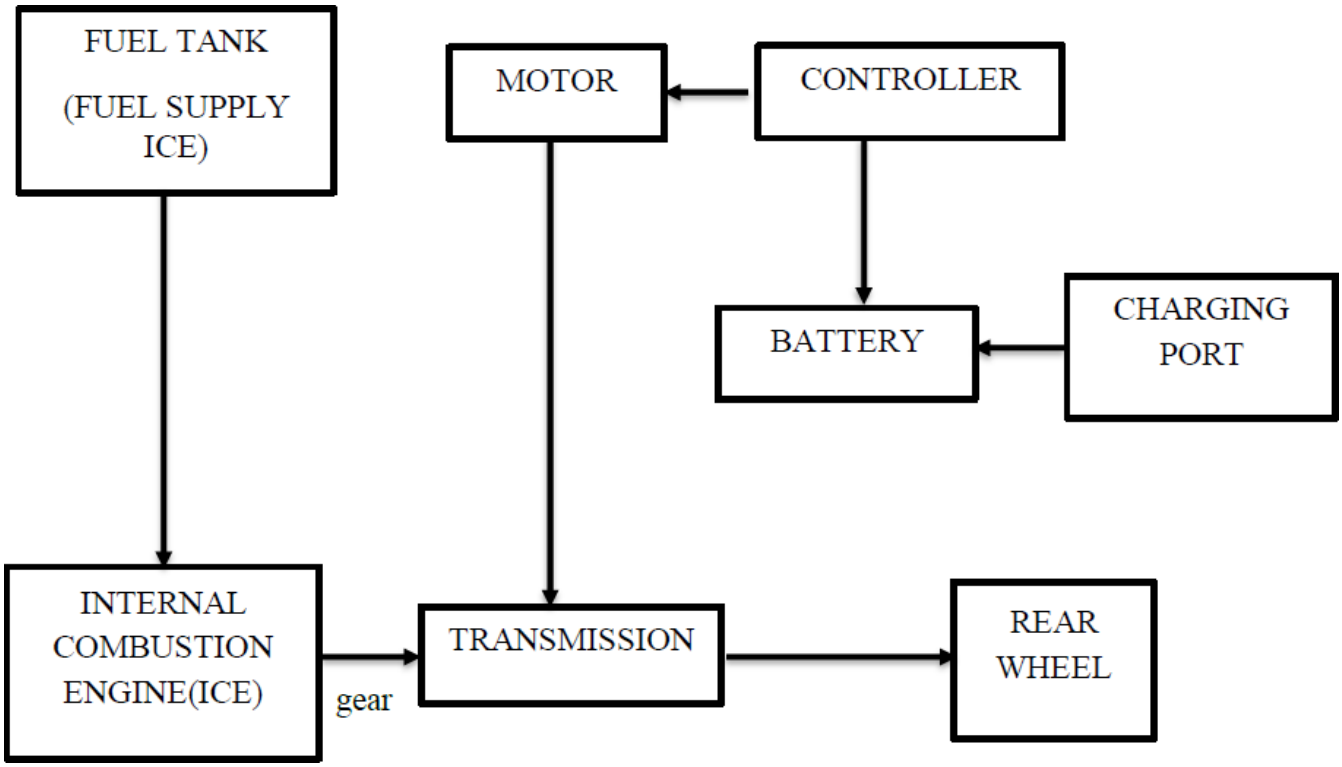

Fig : - Block Diagram of Hybrid Electric Vehicle Powered By Petrol And Battery

The project begins with a detailed requirement analysis to define key performance parameters .

Fuel Tank (Fuel Supply to ICE) : The fuel tank is used to store petrol required for the operation of the internal combustion engine. It is designed to safely hold fuel without leakage and contamination. The tank supplies fuel to the engine through fuel lines with the help of gravity or a fuel pump. Filters are used to remove dust and impurities before fuel enters the engine. Proper venting of the tank maintains pressure balance and ensures smooth fuel flow. The capacity of the fuel tank directly affects the driving range of the vehicle. A reliable fuel supply is essential for continuous and efficient engine operation.

Internal Combustion Engine: The internal combustion engine is the main mechanical power source in petrol mode. A 125 cc, 4-stroke engine is used in this system due to its reliability and good fuel efficiency. The engine operates on four strokes: intake, compression, power, and exhaust. During the power stroke, fuel combustion generates high pressure that pushes the piston downward. This linear piston motion is converted into rotary motion using a crankshaft. The rotational energy produced by the engine is transferred to the gear mechanism. The ICE provides high torque and is suitable for long-distance travel.

Gear Mechanism: The gear mechanism is used to transmit mechanical power from the engine to the transmission system. It helps in changing speed and torque according to driving requirements. Gears reduce engine load during starting and climbing conditions by increasing torque. At higher speeds, gears allow efficient power transfer with reduced fuel consumption. The gear mechanism ensures smooth engagement between engine output and the transmission system. It plays a key role in efficient mechanical power delivery.

BLDC Electric Motor: The Brushless DC (BLDC) motor is used for electric propulsion in electric mode. It operates using electrical energy supplied by the battery pack. The motor has a power rating of 750 W and operates at 48 V, making it suitable for lightweight electric vehicles. BLDC motors offer high efficiency, high torque at low speeds, and low maintenance due to the absence of brushes. The motor assists in smooth acceleration and reduces fuel consumption. It can also work independently or in combination with the petrol engine.

Battery Pack: The battery pack stores electrical energy required to power the electric motor. A 48 V, 28 Ah lithium-ion battery is used due to its high energy density and long cycle life. Lithium-ion batteries are lightweight and offer fast charging capability. The battery supplies DC power to the motor controller during electric mode. Proper battery management ensures safe operation and longer battery life. The battery is a key component for zero-emission electric driving.

Motor Controller: The motor controller acts as the control unit of the electric drive system. It receives electrical energy from the battery and regulates the voltage and current supplied to the BLDC motor. The controller is rated at 48 V and 1000 W to handle high power demand. It controls motor speed, torque, and direction based on rider input. The controller also provides protection against overcurrent, overheating, and short circuits. Efficient motor control improves performance and energy efficiency.

Mode Selector Switch: The mode selector switch allows the rider to select the operating mode of the vehicle. The rider can choose between electric mode and petrol mode. In electric mode, the vehicle runs using battery power and the BLDC motor. In petrol mode, the internal combustion engine drives the vehicle. This switching system provides flexibility and energy optimization. It also helps in conserving fuel and reducing emissions.

Charging Port: The charging port provides an interface to charge the battery from an external power source. It supports a charging current of 5–10 A, ensuring safe and efficient charging. The port is designed with proper insulation and protection. Charging can be done when the vehicle is parked. This feature allows the battery to be recharged using standard electrical supply. Easy charging improves user convenience and vehicle usability.

Transmission System: The transmission system transfers mechanical power from the engine or motor to the rear wheel. It consists of a clutch, chain drive, and gears. The clutch allows smooth engagement and disengagement of power. The chain drive transmits power efficiently with minimal losses. The transmission adjusts torque and speed according to road conditions. It ensures smooth and controlled vehicle movement.

Rear Wheel: The rear wheel receives mechanical power from the transmission system. It converts this power into linear motion, moving the vehicle forward. The rear wheel provides traction and stability during acceleration and braking. Proper power deli very to the rear wheel ensures smooth and safe driving. The wheel design also affects vehicle balance and performance.

RESULT



CONCLUSION

The hybrid electric bike successfully combines the advantages of both petrol and electric power sources, offering a versatile, fuel-efficient, and eco-friendly mode of transportation. By intelligently switching between electric, petrol, or hybrid modes, the bike adapts to different riding conditions, reducing emissions and operational costs. The project demonstrates how integrating modern battery technology with traditional engines can enhance performance and extend vehicle range. Overall, this hybrid system presents a promising solution toward sustainable and cost-effective personal mobility.

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