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The Parallel and Series Configuration for Hybrid Electric Bike

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Abstract - Two-wheelers, which are very inexpensive compared to other forms of transportation, are widely used across India. Hybrid electric vehicles use an electric rear wheel motor, battery, plus control system in conjunction with a conventional internal combustion engine to drastically reduce fuel consumption and harmful pollutants. At low speeds, when combustion engines are at their least efficient, a hybrid electric car may get by on electricity from the battery alone.Though they are also a huge source of pollution, accounting for about 20% of overall pollution (which is 10% greater than automobile pollution) and increasing the demand and supply gap of oil, which was 6 million barrels per day in 2020 and is expected to climb by 14.4 million barrels. All of this may be avoided by simply replacing internal combustion engine cars with pure electric or hybrid electric two-wheelers. Electric motors assist engines accelerate, drive great distances, and climb hills. This allows a smaller, more powerful engine. So, it's excellent for growing cities with considerable traffic. This article addresses the concept of simulating a HEV two-wheeler utilising power split to exchange power between the IC engine and motor and deliver a balanced output to the controller.

Keywords - Hybrid Electric Vehicle (HEV), Hybrid bike, Electrical vehicle, parallel Series.

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INTRODUCTION

Environmental and economic factors promote interest in alternative vehicle technologies. Global oil use, increasing fuel costs, and climate change are reasons. Rising oil consumption has both political and economic consequences. Increasing demand causes higher commodity prices and geopolitical problems for countries that import oil for economic development. Climate change risks increase the necessity of decreasing all GHG emissions. INDIA's transportation sector accounted for 11.8% of total GHG emissions during 2018.

Today, about 80-90% of two-wheelers are powered by IC engines, despite the fact that IC engines only use 25-30% of their power to power the vehicle; the rest is wasted in other processes, resulting in increased petroleum use and pollution. Despite studies and efforts, the cost of petroleum is growing every day due to the present global environment, and supply is limited. The use of an existing IC engine system to add electric car characteristics rather than entirely dismantling the system and creating extra waste is a simple solution to this challenge. A hybrid car combines the benefits of both systems and gives an option that is beneficial and has a lot of scope because to power storage battery used in the system in other nonconventional methods such as solar. This article covers a two-wheeler hybrid electric vehicle system in which a power split is employed to deliver power to the system's uncommon wheel; the power split additionally splits the power based on generator demands. The system is made up of a simulation model of a battery, a DC-DC converter, a motor, a generator, a power split, an IC engine, and a vehicle body.

Considering India's urbanisation, a fuel-efficient motorcycle must be designed. Most of the fuel energy in internal combustion engines is wasted as heat. Electric motors efficiently transform stored energy into propulsion, and electric automobiles don't waste power when coasting. Regenerative braking reuses some braking energy. Regenerative braking recovers one-fifth of wasted energy. Gasoline engines need 15% of their fuel capacity to drive. Fully electric cars are 80% efficient. Electric automobiles failed to gain market share owing to expense and slow speeds. In contrast to petrol automobiles, hybrids can't traverse fewer miles at slower speeds (such as in traffic) effectively. Expanding electric car options might help them win the auto market. As electric car industries turn toward improving vehicle range, powertrain may be utilised. Two wheel hub motors power an electric hybrid system.

FLOW OF WORKING MODEL

Our project has two power sources: primary (IC engine) & secondary (batteries) (Electric Engine). The output of the battery is sent to a DC-Dc converter, which is a chopper that chops the voltage, which is then fed to the motor and other vehicle accessories. The power split is supplied by the secondary source, which is the IC engine (Transmission). Transmission divides electricity into two movements. One motion is sent into the generator, which returns the energy to the DC-DC converter, which charges the battery. Along with the output of the motor, the second output/motion is transmitted to the vehicle body. When the battery reaches a particular level, it may be charged using the power split & generator while working on the IC Engine. The working model of a hybrid electric vehicle is supplied by Graph showing battery charge in Amperes and consists of a battery, a DC-DC converter, a motor, a generator, a power split, and a vehicle body scope. After starting the car, the hour displays a slow outflow.

Daily fossil fuel usage will cause global warming ibid. One day, fossil fuels will diminish or vanish. Thus, electric cars are another alternative, albeit they have their own drawbacks, such as requiring passengers to cease travelling it until battery is completely charged. I wasted time. Therefore, hybrid electric cars are optimal. HEVs combine a gasoline engine, electric motor, and battery to improve fuel efficiency and minimise pollutants.

Series hybridising design with ultracapacitorsmaximises efficiency. A hybrid electric car's battery provides adequate power at low speeds, when combustion engines struggle. The electric motor helps the engine accelerate, stroll, and climb slopes. This allows for a smaller, more efficient engine. Regenerative braking reduces energy consumption. In a HEV, braking energy charges the battery. The car is great for rapidly expanding cities with heavy traffic. Hybrids have regenerative braking.

The graph shows the total power in Kw, which comprises the power of the battery, generator, motor, and IC engine. Design of a Hybrid Electric Vehicle Transmission for Performance Optimization Taking into Account Various Powertrain Component and Configurations. The series, parallel, and series-parallel powertrain configurations are all examples of hybrid powertrain configurations. A powertrain is a collection of equipment used in the power transfer of a vehicle. In a series powertrain, the engine does not deliver propulsion torque to the drive, but rather converts the energy stored of the fuel into mechanical energy, which is then transformed into electrical energy to use a generator and provided to the motor, and so given it to mechanical transmission. This permits the engine speed to be regulated independently of the vehicle speed, allowing for optimal engine speed.

MODELLING WITH DESIGN

Parallel Powertrain- In the this propulsion system, both the turbine and the motor function concurrently and deliver energy to the mechanic computing, which is subsequently transferred to the transmission.

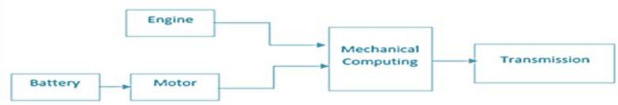


Figure 1: Series configuration of vehicle

Series-Parallel Hybrid powertrain- The engine in this powertrain not only drives the gearbox but also charges the battery.

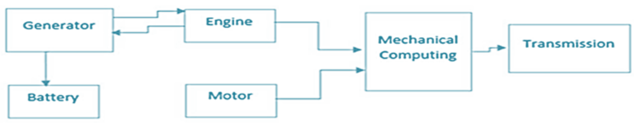


Figure 2: Series parallel configuration of vehicle

The paper goes on to explore the concept of battery simulation and provides several characteristics used in the modelling of the a battery for such an EV that are beneficial for simulation. BATTERY ELECTRIC VEHICLE COMPONENTS are the criteria.

1) Transmission model, which is crucial in providing an output both to the generator and the vehicle body.
2) Electric Motor Model, which features motor speed control & regenerative braking for speed control simulation.
3) The current battery controller model addresses two parameters: SOC and Battery pack, all of which are connected to the battery's lifespan. Additional characteristics include the driver model, driving cycle, and longitudinally vehicle dynamic model.

Hubmotor The motor's static windings are magnetised. The driveline outer component spins the wheel to follow these fields. A brushing motor's brushes distribute energy by contacting the shaft. A brushless motor transmits energy electronically, eliminating physical touch. High-torque technology is more expensive but more efficient and durable than brushing motors. A hub motor is one of three types. In an axial-flux motor, the stators are sandwiched between two magnets. In the inner rotational engine, the rotor resides inside the stator, like in a typical motor. Outer-rotation motor rotors rotate around the stator. Hub motors are still used, although neither is common.

Electric back wheel motors deliver the maximum torque at launching, making them ideal for vehicles. With electric motors, "revving up" is obsolete. Motors don't need a gearbox since the rotor has the most torque at startup. Electric motors don't need shifting, hence a gear-down mechanism may be needed. We started with a wheel driveshaft with a disc brake, but it wasn't enough, so we connected a chain sprocket. Putting a suspension system and chain idler within the same slot requires welding, which might harm the windings. To fix this, we're substituting the brake with such a chain sprocket. Hub motors might provide electric automobiles compactness, quiet operation, and high efficiency. These motors' stators are mounted to the axle, as well as the magnet rotors is in the wheel. The external rotor's cylindrical rotor revolves around with a stator axle. Air gap separates rotor and stator.

METHODOLOGY OF RESEARCH WORK

Brian (2007) created a MATLAB & ADAMS model to compare fuel economy. He used Honda's IMA design, in which an electric motor complements engine torque. He showed how regenerative braking uses the engine as a generator. In the car's power controller, he used a basic algorithm. Cuddy and Keith (2007) used a customisable Advanced Vehicles Simulator to build and analyse hybrid automobiles over the next decade (ADVISOR). Two diesel-powered hybrids are compared to a diesel-powered internal combustion engine. The parallel hybrid's fuel economy is 24% greater than the ICE and 4% greater than the series hybrid.

Force-Acceleration

Acceleration Force (FA) is indeed the force needed to reach maximal speed in a given period.

$$FA = GVW \ X \ Vmax \ / \ (9.81 \ x \ ta)$$

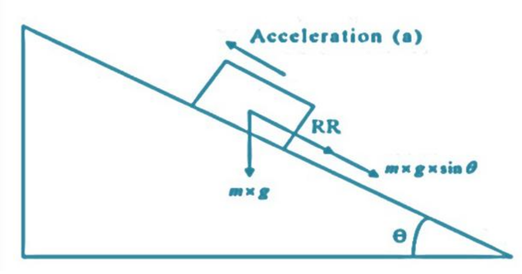
Here,

FA – Acceleration-Force [N]

GVW – Gross-Vehicle-Weight[N]

Vmax– Maximum-speed [m/s]

ta- required timefor maximum acceleration [s]



Methodology: The parameters mentioned in the preceding paragraph, together with their mathematical equations, were entered into MATLAB-Simulink, and the model was created and tested for the vehicle. Technical Information: The following parameters were used as a starting point for the model.

Drivetrain elements	Drivetrain Parameters
Lithium-Iron (2.8V)	Drive Battery
Module and cells	3.201
Relevant Voltage	200 Voltage(V)
Relevant Capacity	27.03kWh and 120 Ah
Weight of the Battery	260 kg
Rate of a Lifetime	5years \ 150,000 km
Motor variety	P.M,A,C (Y.A.S.A-400)
Maximum Output	85Kw
Maximum Torque	350Nm
Transmission of a Single Speed	3.41:1

SOC, Power, Energy, and Current plots showed that battery voltage followed motor current and torque curves. Torque increases battery current. State of charge is the ratio of residual to maximum capacity (SOC).This paper's model explores the concept of step-by-step modelling of and EV employing vector-controlled induction motors, as well as regenerative breaking.

System Architecture: System architecture includes elements such as a battery, motor, gearbox, transmission, and so on. The electricity from the battery is routed into a DC-DC converter, which reduces the voltage and sends it to the motor.

Input and output parameters: The following parameters were considered in this work. The input parameters are shown on the left.

The study went on to explain the concept of broad vehicle movement descriptions, which comprise the following parameters: The Resistance to Rolling Drag caused by aerodynamics Resistance classification Vehicle modelling equation, for example.

NATURE OF SIMULATION MODELS AND RESULTS

This portion of the study deals with the most significant EV computations, such as the calculation of Id, which establishes the relationship between inductance and flux. It also takes care of the current computation along the quadrature axis. This was useful for determining the current flowing through the motor.

HEVs have reduced CO2 emissions and improved fuel economy. The controller drives the HEV. Ultracapacitors provide good regenerative braking. HEVs save money without sacrificing performance. HEVs may use alternate fuels and have excellent environmental performance. This strategy uses popular two-wheeled vehicles. The car might be a real game - changer with competent manufacturing and cost-benefit analysis.

FUTURE RESEARCH

Next, researchers will work to automatically charge batteries without power. To reuse engine exhaust and cooling energy. According to Sankey Diagrams, gas engines transfer just 25% of energy production into meaningful output. Exhaust and coolant lose 40% of energy. Using a Synchronous motor and thermocouples, this wasted energy may be transformed into mechanical energy. Connect a tailpipe to one of the Stirling engine's hot cylinders and leave the cool cylinder open. The Stirling engine uses heat difference. dynamo powers Stirling engine. The Stirling engine charges the battery as it rotates through the dynamo.

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Conflict of Interest: None disclosed

CONCLUSION

HEVs are gas-and-battery-powered cars. Low-power applications employ battery drive, whereas high-power applications use gasoline engines. Gasoline is more efficient at high speeds. Thus, both HEV modes work efficiently. Low-speed gasoline engines are inefficient. Super-fast mode is helpful. It doubles a car's mileage. This hybrid automobile reduces emissions while retaining economy by 50% compared to a regular vehicle. Thus, it's most effective in urban settings, especially high-traffic locations, where gasoline engines are least efficient and pollute. Petroleum is today's principal motor fuel. High-speed electric cars are inefficient. The plan uses both vehicles' efficiency by combining them. Popular two-wheeled vehicles employ this technology. This vehicle's manufacturing and cost-benefit analysis might make it a breakthrough.

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