Review Paper on "Hybrid Scooter"

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ABSTRACT
A Hybrid electric vehicle is a vehicle which relies not only on batteries but also on an internal combustion engine which drives a generator to provide the electricity and may also drive a wheel. It has great advantages over the previously used gasoline engine that drives the power from gasoline only. It is a major source of air pollution. The objective is to design and fabricate a two-wheeler hybrid electric vehicle powered by both battery and gasoline (PETROL). The combination of both the power makes the vehicle dynamic in nature over conventional automobiles. Hybrid electric vehicles combine an electric motor, battery, and power system with an internal combustion engine to achieve better fuel economy and reduce toxic emissions.
Keywords: Hybrid Electric vehicle, two wheeler, internal combustion engine, electric motor, fuel economy.

1. INTRODUCTION

A hybrid scooter is a type of scooter that combines two power sources to operate: an electric motor and a gasoline engine. The electric motor is powered by a battery that can be charged by plugging the scooter into an electrical outlet, while the gasoline engine provides additional power when the battery runs low or when the scooter is traveling at higher speeds.

Hybrid scooters are designed to be more environmentally friendly and fuel-efficient than traditional gasoline-powered scooters. By using an electric motor and battery, they produce fewer emissions than gasoline engines alone, and they can also save riders money on fuel costs.

Hybrid scooters are becoming increasingly popular as people look for more sustainable and eco-friendly transportation options. They are also ideal for urban areas where traffic congestion and air pollution are major concerns.

Overall, the hybrid scooter is a promising innovation in the world of transportation, offering a combination of convenience, sustainability, and cost savings that make it an attractive option for many riders.

We have used the Honda Activascooter which was runed by conventional gasoline engineto make it into hybrid. A brushless DC Hub motor is connected to the rear wheel of vehicle andLithium-ion battery is used to power the motor. A hybrid conversion kit of the Bijlee bike company is used to convert the vehicle into hybrid.

1.1. Problem Statement:

Despite increasing awareness and demand for eco-friendly transportation options, conventional scooters still rely heavily on fossil fuels and contribute to air pollution. This not only harms the environment but also affects the health of individuals. While electric scooters are a step towards reducing emissions, they suffer from limited range and long charging times. Therefore, there is a need for a more efficient and sustainable mode of transportation that combines the benefits of both electric and fuel-powered scooters. A hybrid scooter could address these issues by offering greater range and faster refuelling times while reducing emissions and promoting environmental sustainability.

1.2. Objectives:

- Environmental sustainability: The primary objective of a hybrid scooter is to reduce emissions and promote environmental sustainability by utilizing both electric and fuel-powered technologies.

- Improved efficiency: A hybrid scooter aims to achieve greater efficiency by utilizing the advantages of both electric and fuel-powered technologies. This includes reducing fuel consumption, increasing range, and improving performance.
- Cost-effectiveness: Hybrid scooters aim to be a cost-effective solution for transportation by reducing the overall cost of ownership, including fuel costs and maintenance costs.
- Convenience and ease of use: Hybrid scooters aim to be convenient and easy to use by providing fast refuelling times and longer range than electric scooters.

2. LITERATURE REVIEW

Bauml and Simic (2008) discussed the importance of vehicle simulations in designing the hybrid electric vehicles. A series hybrid electric vehicle simulation with the simulation language Modelica was developed. They explained the simulation approach. They concluded with some of the simulation results emphasizing the simulation importance.

Zhou and Chang (2008) established powertrain dynamic simulation model of an integrated starter/generator (ISG) hybrid electric vehicle (HEV) using Simulink. The parallel electric assist control strategy (PEACS) was researched and designed. The analysis of dynamics performance and fuel economy of the model was carried out under the FTP drive cycle, which can provide a design reference for the setup of the powertrain test bench. The results show that the fuel consumption can be effectively reduced by using the designed PEACS with the state-of-charge of the battery maintaining in a certain scope.

Kuen-Bao (2008) described the mathematical mod-elling, analysis and simulation of a novel hybrid power train used in a scooter. The primary feature of the proposed hybrid power train is the use of a split power-system that consists of a one degree-of-freedom (dof) planetary gear-train (PGT) and a two-dof PGT to combine the power of two sources, a gasoline engine and an electric motor. Detailed component level models for the hybrid electric scooter are established using the Matlab/Simulink environment. The performance of the proposed hybrid powertrain is studied using the developed model under four driving cycles. The simulation results verify the operational capabilities of the proposed hybrid system.

Daniel (2007) designed, developed and implemented a series hybrid electric vehicle. Though he proposed the architecture as hybrid electric vehicle architecture, he showed that the vehicle runs well in the electric mode and left the hybrid conversion as future expansion. Before developing the hardware part, he did a simulation using PSCAD/EMTDC and validated the simulated results using the hardware he developed.

Emadi et al., (2008) focused more on power electronics as an enabling technology for the development of plug-in hybrid electric vehicles and implementing the advanced electrical architectures to meet the demands for increased electric loads. A brief review of the current trends and future vehicle strategies and the function of power electronic subsystems are described. The requirements of power electronic components and electric motor drives for the successful development of these vehicles are also presented.

Franklin Merlin. R, Martin Jose, present a paper on “Design and Fabrication of Hybrid Scooter”: The aim of this project is to save the fuel and reduce the pollution when vehicle is at low speed. A BLDC hub motor is attached to the front wheel of scootypept. When the vehicle at lower speed act as front wheel drive and at high speed gets switched to rear wheel drive automatically. The controller is designed to implement the switching between IC Engine and Electric motor depending on the power requirement and load conditions.

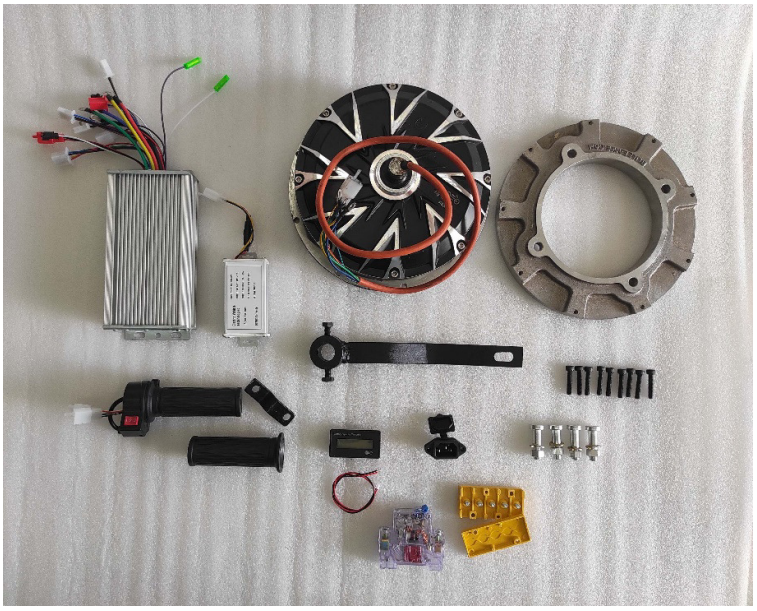
NajmuddinJamadar, SuhaniJamadar, AbhilashaKumbhar, ShitalTanvandkar, ManaliPatil, SourabhZagde, present a paper on “Retrofitting of Existing Scooter into Hybrid Electric Scooter”: The main aim is to increase mobility and to improve performance efficiency of existing vehicles. There are three switching modes are used here. Economy mode (Propulsion using motor only), power drive mode (propulsion using engine only) and hybrid mode. By using economy mode for these in which scooter will start and run on front wheeled electric motor. Hub mounted electric motor works during crawling traffic and does not need

the fuel. In hybrid mode, while starting, to overcome the starting torque, scooter will start on conventional IC Engine. After time delay of 12 seconds, propulsion of wheel is done by using hub motor.

Cuddy and Keith (2007) performed a parallel and series configured hybrid vehicles likely feasible in next decade are defined and evaluated using a flexible Advanced Vehicle Simulator (ADVISOR). Fuel economies of two diesel powered hybrid vehicles are compared to a comparable technology diesel powered internal combustion engine vehicle. The fuel economy of the parallel hybrid defined is 24 percent better than the internal combustion engine vehicle and 4 percent better than the series hybrid.

3. COMPONENTS USED

3.1. Hybrid Conversion kit:



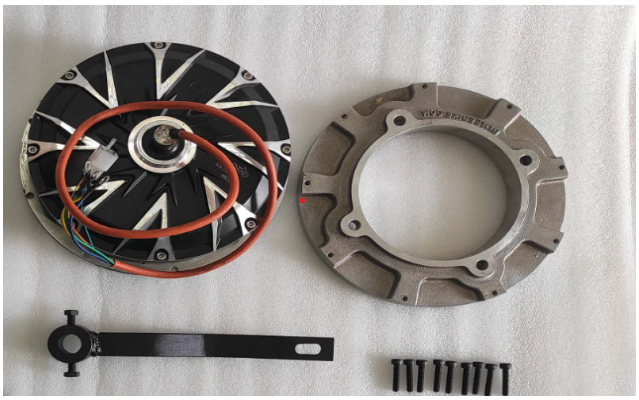
A hybrid conversion kit is used to convert existing petrol engine scooter into a hybrid vehicle. The seller of this hybrid conversion kit is Bijlee Bike Company, Indore, Madhya Pradesh.

This kit consists of following parts:

- 10-inch hub motor 48 v /60 v 1500 Watt
- Sine wave Controller
- Electronic hybrid Throttle
- Hardware components
- DC to DC converter
- MCB
- Battery Level Indicator
- Junction box

COMPONENTS USED

3.1.1. Hub Motor:



Specifications:

- Dimension: 10-inch diameter
- Operating voltage: 60 volts
- Power: 1500watt

COMPONENTS USED

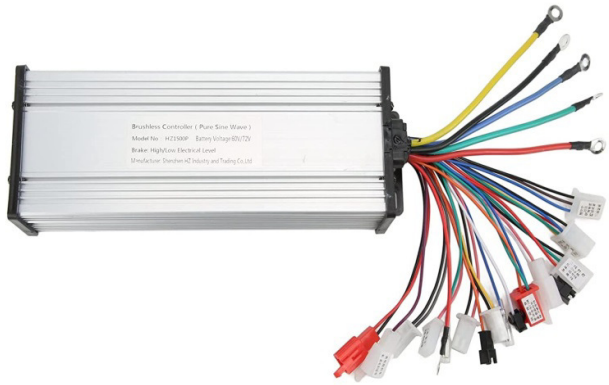
3.1.2. Battery:

Specifications:

- Capacity: 24 Ah
- Voltage: 60 volts
- Type: Lithium-ion
- Brand: Denatsu
- Filled Weight: 8kg

COMPONENTS USED

3.1.3. Sinewave Controller:



Specifications:

- Operating Voltage: 60 volts
- Dimensions: 27 x 17 x 5 cm
- Brand: Bijlee bike

3.1.4. DC-DC Converter:

Specifications:

- Input Voltage: 36V – 64V
- Output voltage: 12V
- Output Current: 10A
- Brand: Emporium

4. CONSTRUCTION

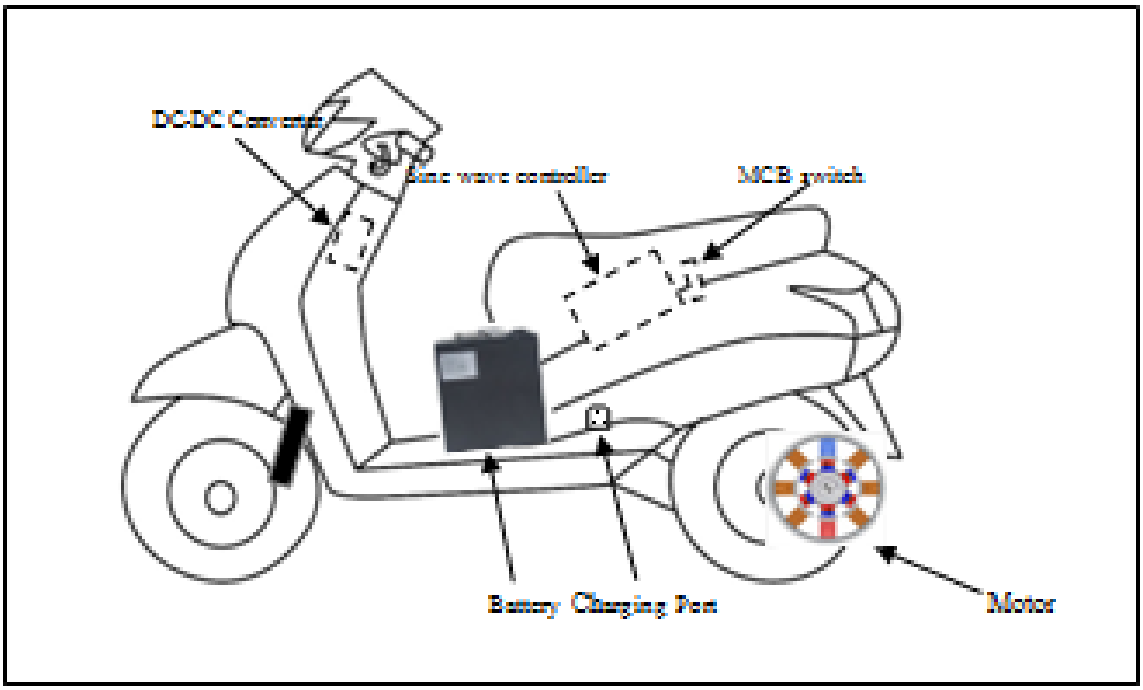


Figure 4.1: Construction

he construction of project is shown in Figure 4.1. It consist of following parts:

- **10-inch BLDC hub motor:**A 1500-watt BLDC Hub motor is connected to the rear wheel of vehicle which propel the vehicle during electric mode. Speed of this motor is an economy level which is 60kmph

- **Li-ion Battery:**A Lithium-ion battery is fitted as shown in above figure. This battery with voltage capacity 51v to 60v and 24 amperes which gives power to the motor and also to the electronic components such as head lamp, indicators, battery level indicator, etc. Battery is kept inside the case of galvanize sheet to protect from water and dust. This case is directly fitted to the chassis of scooter by using fasteners.

- **Sine wave Controller:** A sine wave controller is placed in the boot space of vehicle. It senses the throttle position and control the speed of motor.

- **Electronic hybrid Throttle:** The existing throttle of vehicle is replaced by hybrid throttle. This throttle can control the speed in engine drive mode and electric drive mode.

- **DC to DC converter:**DC-DC converter is fitted in front side below the speedometer. It converts high voltage form battery into low voltage (60v to 12v).

- **MCB:** MCB switch is kept near to the controller which act as main switch of shifting electric drive and protection to the system.

- **Battery Level Indicator:** Battery level indicator is a display which shows the battery percentage and voltage. It is fitted beside to the dashboard and above the start switch.

- **Push-Pull Switch:** This switch if fitted on the inner cover below the ignition switch. This switch is used to shift the mode from engine to electric drive.

- **Charging port:** Charging port is fittedbelow the seat through which battery can be charged.

5. WORKING

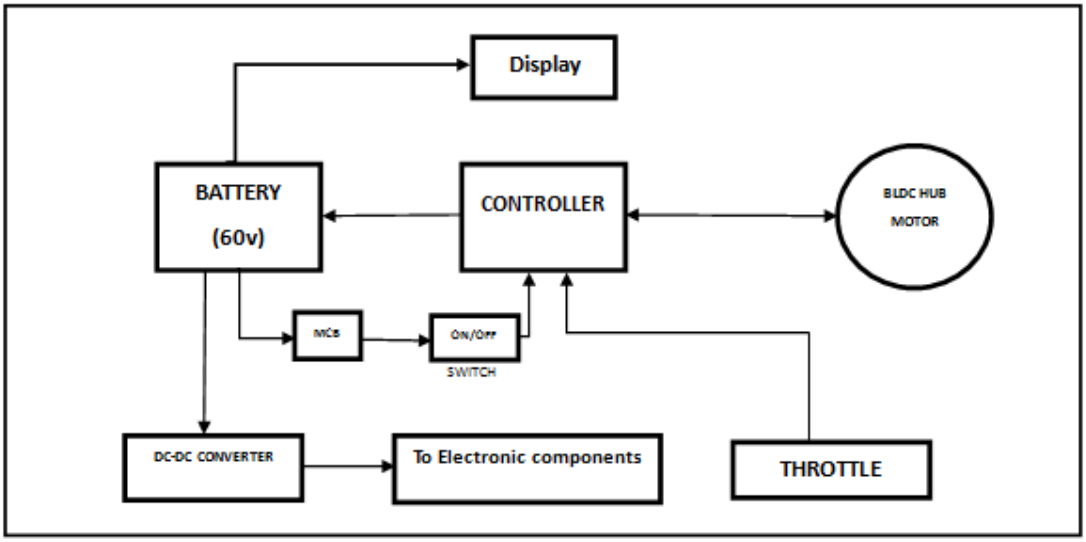


Figure 5.1: Layout

This hybrid scooter consists of following three operating modes:

1. Gasoline mode
2. Electric mode
3. Hybrid mode

1. Gasoline mode: In this mode, the gasoline engine is the only power source for the scooter. The electric motor and battery are turned off, and the scooter runs on gasoline. This mode is typically used when the battery is low, or when the rider needs to travel longer distances.
we can start the scooter on this mode as ordinary scooter by turning on the ignition switch and pressing the start button.
2. Electric mode: In this mode, the scooter runs solely on electric power from the battery and electric motor. The gasoline engine is turned off, and the scooter is powered by the battery. This mode is the most environmentally friendly and fuel-efficient mode of operation.

To run the vehicle on this mode, first we have to on the MCB switch from boot space and pull the toggle switch. The ignition switch should be off during this mode.
When driver rotates the throttle, sine wave controller sense the position of throttle and control the speed of motor by varying the voltage from battery. The capacity of battery with full charge is 60v. A DC-DC Converter converters the high voltage of battery into the low voltage which is required for the other electronic components of vehicle like head lamp, indicators etc. MCB switch protects electric circuit from high voltage and short circuits.
3. Hybrid mode: In this mode, both the electric motor and gasoline engine work together to power the scooter. The electric motor provides additional power to the gasoline engine, which improves fuel efficiency and reduces emissions. This mode is typically used when the rider needs more power or when traveling uphill.
To run the scooter on this hybrid mode, we have to start the vehicle on electric mode by using the procedure mentioned above. After that start the scooter on gasoline mode by switching on the ignition switch and pressing the start button.
On hybrid mode, we gate more torque and power as the IC engine and electric motor both are propel the vehicle simultaneously. The main benefit of this mode is that when we run the vehicle above the speed of 45kmph, the battery starts charging automatically.

CONCLUSION

Hybrid Cars use no energy during idling state; they turn off and use less energy than petrol engines at low speeds. At lower speeds, no smog is emitted maintaining its sustainable advantage. Till lower speed, the car runs on the electric motor and on cruising speed, it runs on IC engine. They offer greater mileage than conventional cars. Noise pollution and emission of CO2 is considerably reduced. But, they are more expensive than conventional cars, are more complex in construction and working than IC engine cars, offer larger repair bills, capacity of batteries is not much advanced.

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