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RETROFITTED HYBRID ELECTRIC BIKE

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ABSTRACT

At the mention of global warming, the first thing that comes to mind is an increasing number of vehicles in traffic, as well as exhaust gasses these vehicles emit. To control the emissions caused by gasoline vehicles, we aim to offer a cost-effective and more environmentally friendly way to travel. So, this project describes a modified procedure for a conversion of a specific IC engine vehicle into an electric-powered vehicle. In this project, instead of making a normal electric vehicle, we are converting the existing traditional petrol vehicle into an electric vehicle by using the concept of retrofitting. We are using the chassis of the traditional vehicle and with the help of the BLDC Hub motor, battery set, and controller we are using the set of batteries as an energy source.

KEYWORDS: Electrical Vehicles, IC Engine, Retrofitting, Chassis, BLDC Hub Motor, Controller And Batteries.

1. INTRODUCTION

As we all know the IC engine of the vehicle is getting old, the efficiency of the engine is reduced with respect to time, and due to this engine started to emit CO2 gas into the atmosphere in a high amount and harms the environment. After some time, the engine is not able to work and it will be dead. Due to the useless IC engine, the vehicle is going to be scrapped. So, we can use the chassis of the vehicle and be used for the electric vehicle just by replacing the engine with a motor with the concept of retrofitting. Retrofitting is basically the conversion of a petrol vehicle into an electric vehicle. And the BLDC (Brushless DC motor) is going to be used as a replacement to the conventional IC (Internal combustion engine) with this we can get continuous torque without any external gearbox. And the main reason is that it will not harm the environment. Retrofitting is the concept of the addition of new Technology or features to the older system to improve efficiency, add more functionalities, or be compatible with the latest environmental demand. By retrofitting the vehicle becomes pollution-free, gearless, and noiseless. This process involves changing the original engine and other related components and a new alternative energy source to be transplanted into the existing vehicle body. Instead of replacing a vehicle, retrofitting involves reducing emissions from older engines. Retrofitting also helps curb vehicular pollution by allowing the use of chassis of old vehicles that go to scrap for recycling and also reduces recycling efforts.

2. METHODOLOGY

In this project, instead of making a normal electric vehicle, we are converting the existing traditional petrol vehicle into an electric vehicle by using the concept of retrofitting. We are using the chassis of the traditional vehicle and with the help of the BLDC Hub motor, battery set, and controller we are using the set of batteries as an energy source. The vehicle consists of an electric battery for energy storage, an electric motor, and a controller. The battery is normally recharged from mains electricity via a plug and a battery charging unit that can either be carried onboard or fitted at the charging point. The controller will normally control the power supplied to the motor, and hence the vehicle speed, in forward and reverse. This is normally known as a 2- quadrant controller, forwards and backward.

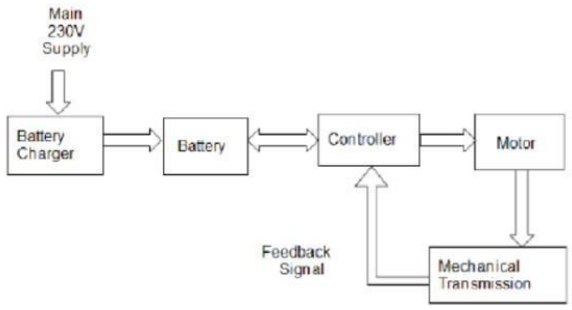

Fig no. 2.1 Methodology Block Diagram.

External Charging Circuit: The external charging circuit contains a charger. The main purpose of an external charging circuit is to charge the batteries. The charger provides a direct current of 3 amp for charging.

DC/DC: The DC-to-DC converter takes 48V supply from the batteries and supply to it to the external 12v load.

DC/AC: This DC to AC converter converts the 48V DC voltage into 48V AC voltage and this AC supply is provided to BLDC hub Motor. As we all know BLDC motor is an AC motor so this converter is used. This circuit is also inbuilt into the controller.

Motor: Here we use a 48V BLDC hub motor instead of an IC engine. The main purpose of the BLDC hub motor is to give acceleration to the mechanical transmission. The shaft of the BLDC hub motor is inbuilt into the rear wheel of a vehicle. As the motor starts the shaft of the motor starts to rotate and due to this the wheel of a vehicle also starts to rotate. As we accelerate the speed of the motor the speed of the vehicle automatically increases.

Mechanical Transmission: Here mechanical transmission means the complete assembly of the vehicle which includes the chassis, wheels, mechanical brakes of the vehicle, speedometer, battery indicator, etc.

Battery: Batteries are the source of energy. Batteries store the energy in the form of charge and supply it to the motor whenever it needs. Batteries not only supply to the motor but also supplies to the speedometer, Battery Indicator. A battery stores the Charge in DC quantity and then gives it to the DC-to-DC converter.

3. OBJECTIVES

The following objectives are to be achieved at the end of the project.

1. Comparison between petrol vehicle and electrical vehicle.

2. Conversion of petrol vehicle into electrical Vehicle by replacing the IC engine to the BLDC motor using a retrofitting concept.

3. To check the performance of the electrical vehicle. 4. Modify the retrofit Electric vehicle for goods carrier.

4. COMPONENTS & SPECIFICATION

I. BLDC HUB MOTOR

We use a 48V BLDC hub motor instead of an IC engine. The main purpose of the BLDC hub motor is to give acceleration to the mechanical transmission. The shaft of the BLDC hub motor is inbuilt into the rear wheel of a vehicle. As the motor starts the shaft of the motor starts to rotate and due to this the wheel of a vehicle also starts to rotate. As we accelerate the speed of the motor the speed of the vehicle automatically increases.

Voltage	48 Volt
Rated Current	17 Amp
No Load RPM	500 rpm
Power	850 Watt

Fig no. 4.1 BLDC Hub Motor.

II. CONTROLLER

A controller is the heart of an electrical vehicle and it simply helps in driving a motor. The controller transforms the battery's direct current into alternating current and regulates the energy flow from the battery. Unlike the carburetor, the controller will also reverse the motor rotation (so the vehicle can go in reverse), Modern controllers adjust speed and acceleration by an electronic

process called pulse width modulation. Switching devices such as silicon-controlled rectifiers rapidly interrupt (turn on and turn off) the electricity flow to the motor. High power (high speed and/or acceleration) is achieved when the intervals are short. Low power occurs when the intervals are longer.

- Controller Rating: - 48V, 28Amp

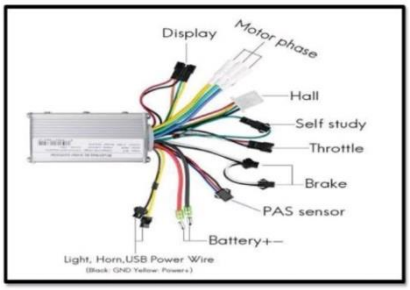

Fig no. 4.2 Controller.

III. LEAD ACID BATTERY

In this project, we are using lead-acid batteries. There are four batteries of 12v each (48v).

- Supply Voltage - 12 Volt.
- Current Rating - 27 Ah.
- Weight - 7 Kg.

Fig no. 4.3 Lead Acid Battery.

IV. BATTERY CHARGER

The battery gets drained after running a distance of 30-35 km and it does require a recharge. For charging a charger is required. It converts AC into DC. It consists of a step-down transformer, rectifier, and filtering circuit to supply constant voltage.

Specification of selected charger.

Input Voltage - AC 170V-300V 47-63Hz

Input Current - 1.0A Max.

Output Voltage - DC 59V Output Current: - 3.0A.

Fig no. 4.4 Battery Charger.

V. SPEED THROTTLE

The throttle is fitted on the right handlebar on the e-bike and it is connected to the controller. A throttle allows driving an e-bike from zero to rated speed. The throttle converts the DC voltage received from the battery to alternating voltage as per the shift in the position. This alternating voltage and variable frequency drive the BLDC motor at a different speed. It uses the hall-effect type sensor.

Fig no. 4.5 Speed Throttle.

5. CALCULATION

Table 1: Ratings of components

Make – TVS
Model: Scooty pep +
Maximum Power: 3.5BHP
Displacement: 87.8cc
MaximumTorque:5.8Nm@4000rpm

Number of gears: Automatic
Net Weight: 79.50KG
Fuel Tank Capacity: 3.5liters
Motor Ratings:
Motor Type: Brushless DC motor
Power: 746 Watts
Voltage: 48Volts
Rated Current: 15.54A
Wheel Motor diameter- 12inches=12*2.5=30cm
Controller Ratings:
Voltage: 48V
Current: 5-6 Ampere
Battery Ratings:
Battery Type: Lead acid Battery
Voltage: 12 V
Ampere hour rating: 9
Tested Parameters:
Speed (RPM) = 900Ampere
No load current=3Ampere
Full load current=13.20Ampere

Table 2: Calculations

For BLDC Motor
$Torque = \frac{(power \times 60)}{(2 \times v \times speed)}$
$=\frac{(746 \times 60)}{(2 \times 3.14 \times 900)}$
=7.91N-m
$Efficiency = \frac{\text{output power} \times 100}{Input\ power}$
$\frac{48 \times 13.20 \times 100}{48 \times 15.54}$
= 85%
Speed in kmph = D × RPM × 0.001885
= 30 * 900 * 0.001885
Battery Km/charge
Rating of battery: 12V, 9Ah
No of batteries used: 4
Let average current drawn: 6A
$In\ one\ charge\ it\ can\ complete =$ 50.89 × 6=75Kms

Table 3: Calculations for saving.

Assumptions:
Price of petrol/ liter= 78Rs.
Price of Electricity / Unit= 5Rs.
Price of Electricity / Unit= 5Rs.
Annual driving distance= 12000Km
Duration of ownership= 3 years
Price of battery pack= 8000Rs.
3 years driving distance= 36000Km

6. RESULT

1. Top speed of 40 KMph was achieved on a level road.

2. The range of the bike is 30-35 Km after full charge.

3. Battery charging takes around 6 hours for the full charge.

Fig no. 6.1 Actual Project

7. CONCLUSION

1. As compared to IC engine vehicle, running cost of our E-bike is almost 1/10th.

2. Electric vehicles are a cheap source of transport and affordable to anyone. The motor used in this bike has high efficiency and the battery bank has less weight with high speed. These bikes are environmentally friendly, need less maintenance, and can also be assembled into small components.

3. The operating cost per/km is very less and with the help of solar panels, it can lessen more.

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