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International
Journal
Of Modern Engineering Research (IJMER)

Design and Development of Hybrid Bike

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ABSTRACT: *A hybrid electric vehicle that 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. This vehicle is powered by both battery and petrol, the combination of both the powers makes the vehicle dynamic in nature. It provides its owners with advantages in fuel economy and environmental impact over conventional automobiles. Hybrid electric vehicles combine electric motor, battery ,and power systems with an internal combustion engine to achieve better fuel economy and reduce toxic emissions.*

Keywords: *Hybrid Electric Vehicle, BLDC Hub Motor, Alternating Current*

Date of Submission: 16-02-2021 Date of acceptance: 02-03-2021

I. INTRODUCTION

The invention of the combustion engine is one of the best inventions of mankind. The conventional vehicles with ICE provide an honest performance and long operating range. However, they need caused and still cause serious problems for poor fuel economy, environment pollution, and human life. Reducing fuel consumption and emissions is one of the most important goals of modern design. Since the fuel prices not only in India but throughout the planet are increasing day by day thus there is an incredible got to look for an alternate to conserve these natural resources. Thus, a hybrid bike is a vehicle that provides that alternative by harnessing electric energy to charge the battery and thus provide required the voltage to run the motor. Thus, hybrid bikes can become a very vital alternative to the fuelled automobile thus its manufacturing is essential.

The hybridization of a conventional combustion engine vehicle with a complicated electric motor drive may greatly enhance the general efficiency and achieve higher fuel with reduced emissions. Considering the urban status in India, a well-organized and fuel-efficient scooter has to be designed and developed. Hybrid Electric Vehicles are the vehicles with more than two energy sources are present. The major challenges for Hybrid Electric Vehicle design are managing multiple energy sources, highly hooked into driving cycles, battery sizing and battery management. owing to the increasing number of automobiles the need for petroleum products is reaching its peak point. An Electric Bike is a low-cost alternative to an automobile. Although the concept of electric bike is not new, it has not been completely explored.

Currently, there has also been a focus on the environment, and it seems that the demand for cleaner alternatives for fuel has become critical. The increasing demand for pollution-free transportation has boosted the utilization of electrical power for transportation thereby reducing the reliance on automobiles.

Then our "hybrid two-wheeler" is an aspect. The goal of this project was to implement the foremost efficient and less polluting vehicle. In our project the Hybrid Electric Vehicle model combines the internal combustion engine of a standard vehicle with the battery and motor of an electric vehicle, leading to twice the fuel economy of a conventional vehicle. We implement this hybrid electric vehicle concept for two wheelers. This paper review focusses on the design and testing of a hybrid electric bike. This paper is challenging with reference to the conversion of the prevailing system to the one that incorporates both petrol engine and electric motor use.

1.1 Electric Mode

Here we are using the BLDC hub motor which is running with help of battery power. Battery is placed within the goods space under the seat. The motor is fixed on the rear wheel of the vehicle and it's controlled through the controlled unit. The hub motor is steadily emerging as a typical drive method a touch like e-bikes, scooters, solar cars, and much of other light electric vehicles. With a hub motor conversion, there is no need for external mounting brackets and drive chains to support a motor and transmission. The direct drive hub motor is about as simple as things get. The motor is strictly fixed as in centre axis of the wheel hub. Now the vehicle rim starts to spin over the axis body for rotation of wheel. the electrical power supply is charged to the battery through the separate charger. Here some losses could also be occurred thanks to mechanical friction. Here we also are having the fuel drive which is including the rear wheel of the vehicle.

1.2 Petrol Mode

In petrol mode, engine will supply power to the rear wheel. When the switch is moved to this position (S1), the microcontroller will sense the position of the switch and transmits signal to the relay, which will energise the ignition coil and operate the starter motor. The rider can control the speed by means of ordinary accelerator handle. In this mode the BLDC motor will be in ideal position at the rear wheel, where its battery connections are cut off by another relay which again controlled by the micro controller. This mode can be activated when we require high power outside the city limits. During this high-power operation engine will run on its own rated rpm, so the fuel consumption is considerably low, also the pollutants coming out of the exhaust is reduced.

1.3 Principle of hybrid bike

The basic design consists of a dc power source battery. The battery is connected to a BLDC hub motor that works on AC. The motor is attached to the rear wheel of the two-wheeler vehicle. As the motor rotates the attached wheel rotates too, thus, leading to vehicle motion. At low speeds, this mode of propulsion is used. The next phase consists of an IC engine that moves the piston continuously. This is connected to the transmission and thus, the vehicle moves. The sprocket of rear wheel is welded to the hub motor and is tighten with bolts to block motion of the sprocket. This causes the vehicle to move in forward direction when the motor rotates by putting gear lever to neutral and when the vehicle is to be run on IC engine then motor is turned OFF and vehicle runs on IC engine.

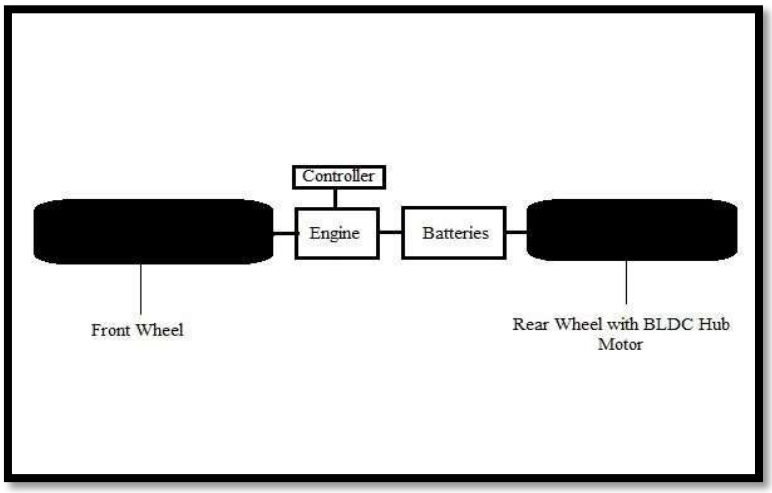

Figure 1: Principle of hybrid bike.

II. COMPONENTS

2.1 IC Engine

An internal combustion engine (ICE) is a heat engine where the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In this project, the Hero Honda CD Deluxe 100 is used. it is run by a 97cc, 4 stroke, single cylinder and air-cooled engine. It produces peak power of 7.5 bhp @ 8000 rpm which is more than sufficient to charge the batteries through the charging circuit. In an internal combustion engine, the expansion of the high-temperature and high-pressure gases produced by combustion applies direct force to some component of the engine. The force is applied typically to pistons, turbine blades, rotor or a nozzle. This force moves the component over a

distance, transforming chemical energy into useful mechanical energy. Single-cylinder engines are simple and compact, and will often deliver the maximum power possible within a given envelope.

Figure 2: IC engine.

2.2 BLDC Hub Motor

A permanent magnet DC Hub motor was considered as ideal for our Hybrid Bike. This motor can deliver adequate torque required for the system. Furthermore, compared to brushless motors, permanent magnet motors are lower in cost and can be easily integrated into the existing bike system.

Figure 3: BLDC hub motor.

Brushless DC motor (BLDC motors, BL motors) also referred to as electronically commutated motors (ECMs, EC motors) are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. during this context, AC, AC , doesn't imply a sinusoidal waveform, but rather a bi-directional current with no restriction on waveform. Additional sensors and electronics control the inverter output amplitude and waveform (and therefore percent of DC bus usage/efficiency) and frequency (i.e. rotor speed).

The rotor a part of a brushless motor is usually a static magnet electric motor , but also can be a switched reluctance motor, or induction motor. Brushless motors could also be described as stepper motors; however, the term stepper motor tends to be used for motors that are designed specifically to be operated during a mode where they're frequently stopped with the rotor during a defined position . This page describes more general brushless motor principles, though there's overlap. BLDC motor may be a closed-loop system electric motor . it's all the characteristics of DC Motor with some added features. A static magnet DC Hub motor was

considered as ideal for our Hybrid Bike. This motor is capable of delivering adequate torque required for the system..

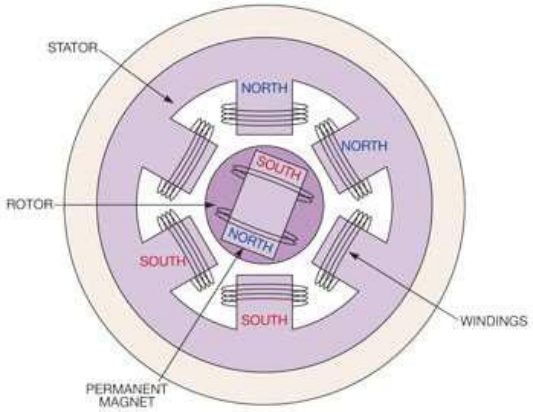

Figure 4: BLDC hub motor have rotor with a permanent magnet containing north and south pole.

Furthermore, compared to brushless motors, permanent magnet motors are lower in cost and can be easily integrated into the existing bike system. Since the speed of the motor is dependent on voltage, the voltage rating of the motor was also crucial. If the voltage rating is high, the motor will produce more power. The appropriate choice of voltage also helps to limit the current drawn by the motor which can limit the heating effects.
It consists of Hub motor having the following specification.

Table I: Specifications of BLDC motor

Hub motor	
Power	2000W
Voltage	72v
Speed Max	70km/hr
Design Brushless	DC Hub Motor
Rated Efficiency	>80%

2.3 Battery

Lead acid batteries are very common in our day-to-day life. It is the most frequently used battery in electronics. Although it has lower energy density than the lithium-ion batteries but since is very safe to use lead acid battery with proper precautions taken. It has many advantages like low cost, frequently available, and is also explosion free thus is the most frequently used battery in solar hybrid bicycles. Current supplied from battery it indicates the flow of energy from the battery and is measured in amperes (or Amps). The higher the current rating the slower the battery will discharge. A battery is rated in ampere-hours (abbreviated Ah) and this is called the current rating. This project revolves around charging and discharging energy within a high voltage battery. Thus, this project demands for a battery with longer running hours, lighter weight with respect to its high output voltage and higher energy density. Among all the available battery types the lead acid batteries are the most suitable ones to be used in solar hybrid bicycles. The primary concern while selecting batteries were cost, durability, energy density, and the number of recharge cycles. Commonly used batteries are sealed lead acid batteries due to their low costs, and reasonably good energy density. After investigating various electric bike designs, we observed that most of them used three 12V batteries with Amp-hr capacities varying between 7 and 20 Amp-hrs.

Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost, makes it attractive for use in motor vehicles to provide the high current required by automobile starter motors. As they are inexpensive compared to newer technologies, lead-acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities.
Specification -

- Six battery of 12 volts each 12 Ah to generate of voltage of 72 v
- Company- Exide

• Quantity – 6
• Type -EP 12-12
• Sealed Lead acid battery

Figure 5: Lead acid battery of 12v

2.4 Motor Controller

A motor controller may be a device or group of devices that serves to control in some predetermined manner the performance of an electrical motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating, or limiting the torque, and protecting against overloads and faults. Motor controllers are often manually, remotely, or automatically operated. They may include only the means for starting and stopping the motor or they'll include other functions. An electric motor controller are often classified by the sort of motor it's to drive like static magnet , servo, series, separately excited, and AC . A motor controller is connected to an influence source like A battery pack or power supply, and control circuitry within the sort of analog or digital input signals

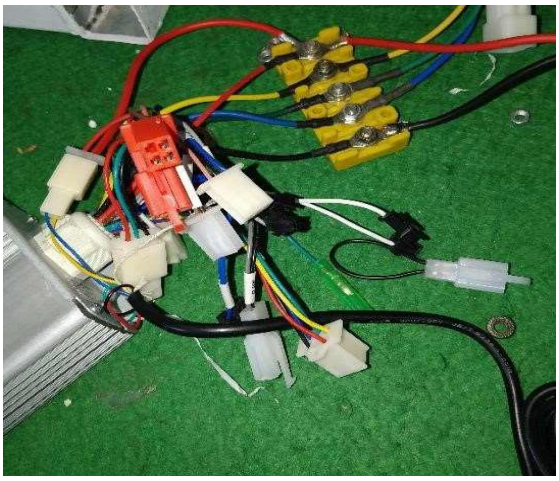

Figure 6: Connecting plugs of motor controller.

2.4 Thumb throttle

In electronic thumb throttle, the throttle works on button to be pushed forward. When it is pushed the thumb button increases the amount of voltage and therefore makes the motor runs faster .
It has basically three sensors namely XYZ
• Sensor – Three position sensor
• Volts – 1-7 volts
• Type – thumb throttle (Switch)

Figure 7: Thumb throttle

III. CALCULATIONS

3.1 Hub Motor Calculation

Motor specification

Rpm = 1000

Volt = 72 V

Power = 2000 W

Power equation

Power = I *V

Where,

V = 72 V

P = 2000 W

I = 500/48 = 27.77 A

To find torque of the motor

P = 2x3.14xNxT/60

T = Px60 / 2x3.14xN

T = 2000*60 / 2*3.14*1000

T = 19.10 N-m

Torque of the wheel hub motor T = 19.10 N-m

3.2 Power Required to Propel the Vehicle

Therefore, initial torque required to propel vehicle will be <19.10.

T =18 N-m

P = 2x3.14xNxT/60

P = 2x3.14x1000x18/60

P = 1884 W

Hence, the power required to propel the vehicle is 1884 W, which is just below our motor specification 2000 W. The design is safe.

3.3 Battery Calculation

To find the current

Watt = 18 W

Volt = 12 V

P = V x I

18 = 12 x I

I = 18/12 = 1.5 Amps

IV. ANALYSIS AND RESULT OF VEHICLE

4.1 Analysis of the vehicle

IC Engine Vehicle

- Vehicle cost (CD Deluxe) - 11000/-
- Fuel cost (1 Lit) – 78.76 /=
- Mileage (1 Lit) - 60 Km/Lit
- Running cost of the vehicle per kilometre - 1.6 /=
- Speed of the vehicle-Max speed 75-85 Km/hr

Battery Vehicle

- Battery cost - 4800 /=
- Fuel cost (1 Full charge Battery) - 8 /=
- Mileage (1 Full charge Battery) – 45(approx50) Km
- Running cost of the vehicle per kilometre - 0.17 /=
- Speed of the vehicle-Max speed 75-80 Km/hr.

4.2 Result

The below table shows the comparison between petrol bike, electric bike and hybrid bike tested under normal conditions. By absorbing the table, we can clearly say that the amount of fuel consumption using the hybrid vehicles will be less.

Table II: Pricing and distance analysis

Sr. No.	Mode	Person Weight kg	Price □	Distance (KM)	Price per unit distance □
1.	Petrol	67	77.89	60	1.29
2.	Battery	67	8.0	50	0.16
3.	Hybrid bike	67	86	110	0.78

The project discloses a hybrid system consisting of an electrical and combustion (IC) based power drives. The rear wheel is being propelled by battery and also powered by electric DC hub motor, i.e., it includes one cylinder, air cooled combustion engine and a BLDC motor based electrical power drive used for hybrid powering of the vehicle. The controller is meant to vary the speed of hub motor. it's great advantages over the previously used internal-combustion engine that's driven solely from gasoline. This hybrid combination makes the vehicle dynamic in nature and provides its owner a far better fuel economy and lesser environmental impact over conventional automobiles.

Figure 8: A complete Hybrid Bike

V. CONCLUSION

HEV is a vehicle that uses two sources of power- petrol and battery. In heavy traffic and inside the city there is no chance for moving fast. At that time, if vehicle is run by IC engine, more fuel is wasted due to variation of acceleration. If the vehicle is run electric hub motor through battery, the consumption of power is reduced. The technology of hybrid petro electric bikes is an emerging field in now a day and the total turn one on these types of vehicles very profitable for the future and solves the issue of natural resources scarcity and is an eco-friendly bike. This type of vehicle is very cost effective for middle-class families. The mileage of the bike is increased from 60 to 90 km for 1 litre of gasoline. For low power application battery drive is used whereas for high power application where power requirement is very high petrol engine is used. Petrol drive is most efficient at high-speed drive. Thus, HEV's mode of operation occurs at their maximum efficiency. But in petrol engine low speed operation is not efficient. Its high-speed mode is only efficient. Therefore, it gives twice the mileage given by a normal vehicle. As this hybrid vehicle emits 50% less emission than normal vehicle it plays an important role for reducing pollution to certain extent without compromising with efficiency. Thus, it is

most efficient in urban areas mainly in high traffic where petrol engines are least efficient as the energy from petrol is being wasted away and creates pollution.

This project on Hybrid Bike is an alternative to automobiles for medium distance travel and focuses on energy conservation. The project focuses on constructing a hybrid bike with a minimal additional weight that is capable of greater efficiency through its use of regenerative motor and various other mechanisms. The implementation of the proposed system is on its way and is yet to be completed. In future we also need to look more into the different mechanisms for decision making and control.

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Shaikh Abdul Muqtadir, et. al. " Design and Development of Hybrid Bike." *International Journal of Modern Engineering Research (IJMER),* vol. 11(01), 2021, pp 16-23.