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Design of Hybrid Electric Vehicle

Prof. Ruhi Uzma Sheikh, Mohammed Irfan Ansari, Akash Kushwaha, Aman Kumar Shende, Mohammad Rashid, Sumit Khobragade

Electrical Department, Anjuman College of Engineering and Technology, Nagpur, Maharashtra, India

ABSTRACT

A 'hybrid electric vehicle' is a vehicle that runs not only on batteries but also on an internal combustion engine that drives the wheels. It has great advantages over the previously used petrol engine that drives the power of petrol only. It also causes air pollution. The objective is to design a hybrid electric vehicle powered by both battery and petrol is to reduce air pollution. by a combination of petrol and electric makes the vehicle dynamic in nature. this gives advantages in fuel economy and environmental impact over conventional vehicles. Hybrid electric vehicles combine an electric BLDC motor, battery, and control system with an internal combustion engine to achieve better fuel economy and reduce toxic emissions. In a Hybrid electric vehicle, the battery alone provides power for low-speed driving conditions where internal combustion engines are less efficient. In long highways, or hill climbing the electric motor provides additional power to assist the engine. Due to this a smaller, more efficient engine to be used. Thus hybrid vehicle is the best option in an urban area with high traffic.

Keywords: Hybrid Electric Vehicle (HEV), Lithium-Ion Battery, Single Chain Arrangement.

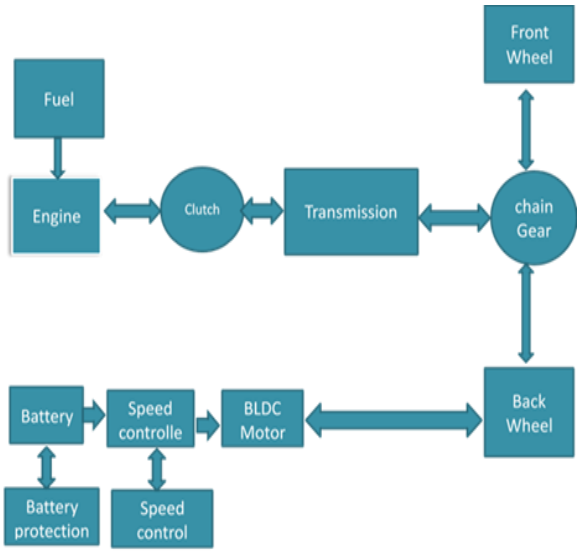
I. INTRODUCTION

One of the primary reasons for the introduction of Electric vehicles into the market is the concern over greenhouse gas emission and their contribution to global warming. National Electric Mobility Mission Plan (NEMMP) 2020. It aims to achieve the national fuel security by promoting Hybrid Electric vehicles in the country. To achieve this there's a target to realize 6-7 million sales of hybrid and electric vehicles within the year 2020. And thus, we can save 2.2-2.5 million tons of liquid fuel which will decrease 1.3-1.5 million-ton tons of carbon dioxide emission. Electric vehicles are powered by batteries that are contained with the vehicle and usually provide an adequate charge for the propulsion of the vehicle through city traffic. The batteries are mounted within the vehicle and are used to propel the motorcycle as an alternative to using an internal combustion engine. The efficiency of an electric vehicle is far greater than all other forms of propulsion currently in use. the electric vehicle is powered by electricity with a rechargeable battery, a BLDC motor, a controller that sends a signal to the motor from the driver's accelerator pedal, and a charging system. These parts of an electric vehicle replace the petrol engine, fuel tank, fuel line, and exhaust system in an existing bike. While the petrol engine is central to the operation of an existing vehicle, it is the rechargeable battery that is central to the operation of an electric vehicle. All-

electric vehicles recharge their batteries by plugging household electrical supply or by the special charging station. The components used in existing battery electric vehicles are motors, motor controller and lithium-ion batteries. Some of the sooner designs of electrical bikes included a way to charge the vehicle using the K.E. generated by the vehicle itself. Electric vehicles are being introduced on the market to completely eliminate the use of IC Engine and make use of the In-wheel motor system on rear wheels for small electric vehicles, the combination structure of each component. The key point of the In-Wheel motor system to be applied in small electric vehicles is the integration capability to meet the requirements such as wheel space, power performance, the strength of components. One drawback to electric bikes is that batteries must be recharged and there are limitations in the range that the battery may propel the motorcycle without recharging. One solution to this recharging problem is to install an alternator of a car to retrieve the unused rotational energy of the wheel to recharge the batteries while still in motion.

II. METHODS AND MATERIAL

BLOCK DIAGRAM



III. LISTS OF COMPONANT

A. Motor Controller
B. Lithium- ion battery
C. Battery charging kit
D. Yamaha crux
E. BLDC Motor

IV. DESIGN PROCEDURE

HYBRID BIKE The name itself depicts that it is urban areas with less pollution. To get this requirement we are doing some minor changes in the normal bike. The changes what we have made is we connect the motor and engine wheel with single chain arrangement. Something different from normal bike. In case of normal bike, it will operate in only one mode i.e., Gasoline mode but in case of hybrid bike it will operate in both Gasoline and electricity mode. Due to this advantage of running in the both the mode there will be less consumption of fuel then there will be a maximum reduction in the pollution.

Fig.I. YAMAHA CRUX (OLD)

Fig 2. Shows the BLDC motor arrangement. Here motor is provided with free wheel which is connected to engine and sprocket chain arrangement in back wheel with single chain arrangement. When bike run on fuel mode the motor freewheels run freely and hence there is no effect on motor. When bike runs on battery the freewheel and motor shaft are inter lock with each other

motor start rotating in that condition engine is in neutral position therefore there is no effect for our project we are procuring an ordinary engine bike of model YAMAH CRUX (OLD). The requirement what we are expecting is getting a speed of 40 KMPH in urban areas with less pollution. To get this requirement we are doing some minor changes in the normal bike. The changes what we have made is we connect the motor and engine wheel with single chain arrangement.

V. CONTROLER

The controller is fitted in the available free space of a normal bike battery. The controller connects the power source to the motor It controls the speed and optimizes energy conversion. Lithium-ion battery with the power ratings of 48v and 12 Ah is used in this project. The reason behind using this type of battery is getting high energy density and self-discharge with the low maintenance. The slot which we have chosen to place the battery is, in the available free space below the seat. The more greater energy density is one of the chief advantages of a Lithium-Ion battery or cell. The much higher power density offered by lithium-ion batteries is a great advantage. One issue with batteries and cells is that they lose their charge over time. This self-discharge can be a major issue. One advantage of lithium-ion cells is that their rate of self-discharge is much lower than that of other rechargeable cells such as NiCad and NiMH forms. Coming to the throttle operation, it is totally based on variable speed resistance. In detail, the speed will be regulated by using the resistance. The throttle placement in a hybrid bike is adjusted to the engine throttle and placed the electric speed throttle on the same handlebar. Due to this arrangement their will reduction in extra fitting of another handle bar. These are the minor changes we have made to fulfil our requirement for the HYBRID ELECTIC BIKE

VI. LITHIUM ION BATTERY

Lithium ion battery with the power ratings of 48v and 26 Ah is used in this project. Here we use old laptop cells for making the battery pack. To get required voltage and current we connect the battery into series and parallel combination. To get 26 amp current we connect 13 cells in parallel and for 48 volt we connect pack of 13 cells in series. Coming to the throttle operation, it is totally based on variable speed resistance. In detail, the speed will be regulated by using the resistance.

Fig 4. LITHIUM-ION BATTERY PACK

The throttle placement in hybrid bike is adjusted the engine throttle and placed the electric speed throttle on the same handle bar. Due to this arrangement their will reduction in extra fitting of another handle bar. These are the minor changes we have made to fulfil us requirement for the HYBRID ELECTIC BIKE

VII. CALCULATION

1 Drag force

2Average speed of vehicle = 40km/h fd= cd * ½ *P* (v*v) A cd= drag coefficient Fd = Drag force (N) cd = Drag coefficient

P = density of fluid (1.2kg/m3 for air) v = flow velocity (m/s) A = frontal area of body (m2)

A= 1.5m (Hight)*0.4m (Width)

A= 0.6m2 now,

Fd = 0.9*1/2*(1.2kg/m3) *(11.11*11.11) *(0.6m2)

= 39.99N

Fd = 40 N

2. Rolling Resistance

Fr = c*w

C = Rolling Resistance coefficient W = m * a c = 0.002 on concrete c = 0.004 on asphalt Fr = 0.004*190*9.81

Fr = 7.45 N

3. power required for motor

P=Fr * v/n

P= power

Ft= Total force n= Efficiency

P= (7.5+40) * 11.11/0.85

P= 530.32 w

4. Torque

Circumference = 2*3.14*(Radios)

= 2*3.14*0.25

= 1.57m

For one Revolution of wheel we will cover the distance of

1.57 m

For 40 km

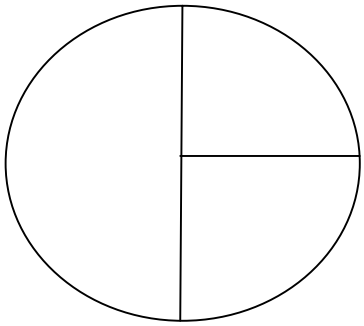
40(km/h) =40000 (km/s)

= 40000/60

= 666.6 (meter/minute)

Wheel RPM = 666.6/1.57

= 424.5 RPM



D= 0.5m

R= 0.25m

C= 2*3.14*r

Motor RPM = gear ratio * wheel RPM

= (Driven/Drive) * 424

= (21/9) * 424

Motor RPM = 1000 rpm

Torque = 9.5488*Power/speed= 9.5488*530/989 Torque= 5.48 N-M maximum Torque (0-40km) in 20 sec

By 1st equation of motion

V=u+at

V = final velocity (m/s) U= initial velocity (m/s) a= acceleration (m/s2)

T= time taken in (s)

V= u+at 11.11= 0+ (a*20) a = 0.55 m/s Force

F=M*a

= 190*0.55

= 104.5 N

Maximum Torque = F*r(radios)

= 190*0.25

= 26.125 N-M

Maximum torque= 26.125N-M

5. **Ampere hour (Ah) Required for Battery**

Battery voltage= 48 volt

Motor Wattage= 500 w

Discharging current = 500 / 48

= 10.11 Amp

6. Power consumption in one Hour 500w * 1 hr = 500whr

But Efficiency of Battery is 84% Therefore,

Power consumption in one hour = 500*1.16

= 580 whr

Now,

(Ah) required = 580/48

= 12.08 Ahr

7.Electricity Consumption for Charging Battery

Charging voltage = 54.6 volt

Charging current = 26 Ah

Power = 54.6*26

= 1419.6 w

Total Energy consume in 4 hours = 1419.6*4

= 5678.4 wh

One unit of electricity = 1000 wh

Total unit consumption = 5678.4/1000

= 5.67 unit

Cost of charging = 5.67* 7

= 39.75 Rs

VIII. CONCLUSION

- using concept of hybrid electric vehicle result in better efficiency and also save lot of fuel in today's fuel deficit world.
- A hybrid gives a solution to all the problem in some extends.
- One can surly concluded that this concept will follow with even better efficiency and conversion rate

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