Design and Fabrication of Hybride Two Wheeler

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Abstract— A 'hybrid electric two wheeler' 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 also 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. The combination of both the power makes the vehicle dynamic in nature. It provides its owner with advantages in fuel economy and environmental impact 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. In HEV, the battery alone provides power for low-speed driving conditions where internal combustion engines are least efficient. In accelerating, long highways, or hill climbing the electric motor provides additional power to assist the engine. This allows a smaller, more efficient engine to be used. Besides it also utilizes the concept of regenerative braking for optimized utilization of energy.

Key words: Hybrid, Motor, Engine, Battery, Controller

I. INTRODUCTION

A 'gasoline-electric hybrid vehicle' is an automobile which relies not only on gasoline but also on electric power source. In HEV, the battery alone provides power for low-speed driving conditions. During long highways or hill climbing, the gasoline engine drives the vehicle solely. Hybrid electric vehicles comprise of an electric motor, inverter, battery as electric drive and an internal combustion engine with transmission connected as gasoline based drive. It is to achieve better fuel economy and reduce toxic emissions. 2 It has great advantages over the previously used gasoline engine that is driven solely from gasoline. This hybrid combination makes the vehicle dynamic in nature and provides its owner a better fuel economy and lesser environmental impact over conventional automobiles.

II. CONSTRUCTION

Construction of this bike involves following components:

- Motor
- Controller
- Alternator
- Battery system
- Engine
- Microcontroller

A. BLDC Motor:

Brushless DC electric motor also known as electronically commutated motors are synchronous motor 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. The rotor part of a brushless motor is often a permanent magnet synchronous motor, but can also be a switched reluctance motor, or induction motor. Brushed DC motors develop a maximum torque when stationary, linearly decreasing as velocity increases. Some limitations of brushed motors can be overcome by brushless motors; they include higher efficiency and a lower susceptibility to mechanical wear. These benefits come at the cost of potentially less rugged, more complex, and more expensive control electronics.

Fig. 1: BLDC hub motor

B. Controller:

Controller is a brain of the complete hybrid system. Its function is to receive data from various sensors and provide Electrical power as per the throttle position and angle. It decides the fuel mode that is, to run the motorcycle on petrol or to run it on electrical power. It checks the battery voltage and current value and notifies the user about the charging time**.**

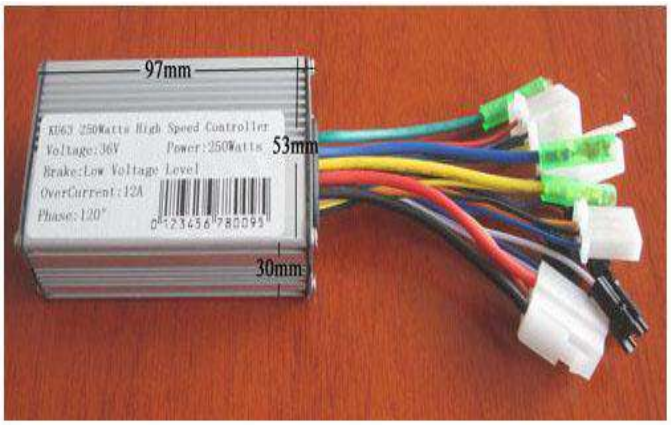

Fig. 2: Hub Motor Controller

C. Alternator

Alternator is an electrical generator that convert mechanical energy to electrical energy in the form of alternating current, for reason of simplicity, most alternator use a rotary magnetic field with stator armature. Any ac electrical generator can be called an alternator.

Fig. 3: Alternator

D. Battery System

Hybrid Electric Vehicle uses battery as one of its power source for vehicle motion during at low power conditions. Batteries are devices that consist of electrochemical cells and provide electrical energy converted from stored chemical energy . Generally batteries are of two types: primary batteries that are disposable and secondary batteries that are rechargeable. Secondary batteries are preferred for vehicles as they can be rechargeable. There are six major rechargeable batteries available today. They are as follows: lead-acid (Placid), nickel-cadmium (NiCad), nickel-metal hydride (NiMH), lithium-ion (Li-ion), lithium polymer (Li-poly), zinc-air.

Fig. 4: Battery

E. Engine

A Petrol engine or Gasoline engine is an internal combustion engine with spark-ignition designed to run on petrol (gasoline) and similar explosive fuels. It differs from a diesel engine in the method of mixing the fuel and air, and in the fact that it uses spark plugs. In a diesel engine, just the air is compressed, and the fuel is injected at the end of the compression stroke. In a petrol engine, the fuel and air are pre-mixed before compression injection. Pre-mixing of fuel and air allows a petrol engine to run at a much higher speed than a diesel, but severely limits their compression, and thus efficiency.

Fig. 5: Cad diagram of engine

F. Microcontroller

Microcontrollers are destined to play an increasingly important role in revolutionizing various industries and influencing our day to day life more strongly than one can imagine. Since its emergence in the early 1980's the microcontroller has been recognized as a general purpose building block for intelligent digital systems. It is finding using diverse area, starting from simple children's toys to highly complex spacecraft. Because of its versatility and many advantages, the application domain has spread in all conceivable directions, making it ubiquitous. As a consequence, it has generate a great deal of interest and enthusiasm among students, teachers and practicing engineers, creating an acute education need for imparting the knowledge of microcontroller based system design and development. It identifies the vital features responsible for their tremendous impact; the acute educational need created by them and provides a glimpse of the major application area.

Fig. 6: Circuit

III. WORKING

Vehicle runs with both electric motor and IC engine. Battery is used to supply the power to electric motor to start and to drive the vehicle up to the speed limit of 30km/hr. When speed limit is exceeded 30km electric motor will disengage from the wheel and IC engine will get started to run the vehicle with the help of sensor. Whenever the speed gets down to 30km/hr electric motor will engage automatically to run the wheel. In both case alternator which is connected to the wheel will re-generate the power ceaselessly so that power will transmitted to battery to maintain the constant power.

A. CAD Diagram

Fig. 7: Transparent Body Frame Isometric view

IV. DESIGN

A. Centrifugal Clutch

A clutch is a machine member used to connect the driving shaft to the driven shaft, so that the driven shaft may be started or stop at a while. A clutch is get provided for interruptible connection between two shafts. Centrifugal clutch is usually used into motor pulley. It consists of number of shoe on the inside of a rim of pulley. The inner surface of the pulley is covered with friction material.

The driving shaft is connected to the shoe through the spring. The spring exerts a radial inward force. The shoes when revolving cause it to exert a radial outward force (centrifugal force). The magnitude of centrifugal force depended on speed at which shoes is revolving. When centrifugal force is less than the spring force, the shoes remain same position. But when centrifugal force is equal to spring force, spring gets expand

1) Design of centrifugal clutch

Given Data:

P= 1119 w

N=2800 Rpm

n=3;

R=42.5mm=0.0425m;

μ=0.28

a) Torque Transmitted

T = P x 60 / 2∏N

= 1119 x 60 / 2∏x 2800 = 3.81Nm

b) MASS OF THE SHOES

M= mass of shoes

w= Angular running speed,

w= 2∏N/60

= 2∏x2800/60 =293.21 rad/sec

w1= 3/4 w

=3/4 x 94.26 = 219.90 rad/sec

Assuming the center of shoes lies at distance 5 mm less than R.

r = 37.5mm = 0.0375m

Centrifugal force acting on each shoe

Pc= m. w.w.r

= m (293.21)2 x 0.0375 =3223.95m N

Force exerted by spring

Ps = m.(w1)2.r

= m (219.90)2 x 0.0375 =1813.35m N

Frictional torque acting on each shoe,

T= μ (Pc- Ps) R x n

3.81=0.28 (3223.95 m-1813.35 m) 0.0.425 x 3

3.81=50.36m

m= 3.81. /50.36 =0.076 kg

c) Size of the Shoe

l= contact length of the shoe

b= Width of shoe

l =ɵ.R=∏/3 R

=∏/3 X 42.5 = 44.50 mm

Area(A) = l.b = 44.5b mm2

p=Intensity of pressure exerted on shoe=0.1N/mm2

F= A .p

= 44.5b X 0.1 = 2.5b.....…….(i)

Net outward radial force

Pc- Ps = 3223.95 m- 1813.35 m

= 1410.6m

= 1410.6x 0.076 = 107.20 N ……..(ii)

From (i) and (ii)

b = 107.20/4.45 = 24.09mm

d) Dimension of spring

Pc= m. w.w.r

=0.076× (293.21)2 x 0.0375 = 241.75 N

Ps= m (w1) 2 r

= 0.076 ×(219.90) 2 x 0.0375 =137.81 N

V. STRESS ANALYSIS OF CHASSIS

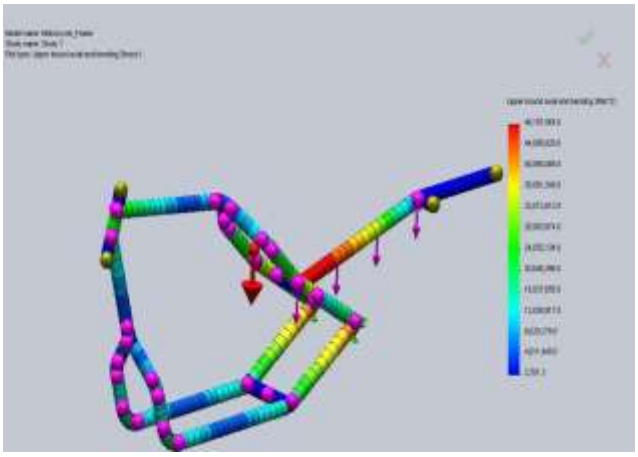

Fig. 8: Stress Analysis of Chassis

A. To Prove Hybrid is more efficient than Conversional Bike

Efficiency is indicated as the ratio of output work to the input energy. Engine efficiency is calculated by various performance parameters, such as Indicated Thermal Efficiency, Brake Thermal Efficiency, Mechanical Efficiency, Volumetric Efficiency, Relative Efficiency etc.

1) Indicated Thermal Efficiency

It is the ratio of energy in the indicated power ip, to the input fuel energy in appropriate units.

Efficiency = ip[kJ/s]/energy in fuel per sec [kJ/s] = ip[kJ/s]/(mass of fuel/s x calorific value of fuel)

2) Brake Thermal Efficiency

Mechanical efficiency is defined as the ratio of brake power (delivered power) to the indicated power (power provided to the piston).

Fp = ip-bp

3) Specific Fuel Consumption

The fuel consumption characteristic of an engine is generally expressed in terms of specific fuel consumption in kilograms of fuel per kilowatt-hour. It reflects how good the engine running or performing is. It is inversely proportional to the thermal efficiency of engine.

Sfc = Fuel consumption per unit time/ Power.

4) Efficiency of Electric Drive

Efficiency = (Output power/Input power) = (T*w/Vdc Idc)

Thus through the expressions efficiency of the vehicle is calculated. The efficiency of IC engine at low speed is very less,i.e, it is less than even 25%. Whereas at this speed the efficiency of battery based drive is almost hundred percent. At high speeds both of them have the same efficiency as both of them are propelled by gasoline energy. Thus from the above discussions it can be concluded that hybrid electric vehicle is more efficient than normal vehicle based on gasoline power source.

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