FABRICATION OF BELT DRIVEN BICYCLE HYBRID CONCEPT

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Abstract— The Hybrid Bicycle System is a project that incorporates two different ways of charging a lead-acid battery: the 220V AC wall outlet, and solar power; which is used to power an electric hub motor which rides the bicycle. In this electric hybrid bicycle, the rear wheel is meshed with chain driven compact & light weight hub motor. It will be having higher efficiency compared to normal bicycle and smoother drive consisting solar panel at rear side of carriage, which will continuously charge the batteries and will enable substantially longer distance power assist cycling. There are two separate ways of riding the bicycle: manually, and using the variable speed accelerator which operates the motor connected with the battery, with help of controller.

I . INTRODUCTION

The term "hybrid" usually implies that more than one energy source is used to power all or part of a vehicle's propulsion. Solar power is used to provide energy to the batteries and controls other auxiliary functions. Rechargeable batteries are used with long life for charging capacity. DC electric motor is also used in this project to obtain alternate drive apart from mechanical power. The hybrid bicycle is a project that can promote both cleaner technology as well as a negligible dependence on oil. It runs on clean electric power with the ability to recharge the battery 2 separate ways: through the wall charging, and by solar-cell generative power.Here in this project we have used belt drive in place of chain drive, reason behind using the belt is that they provides a very high power transmission efficiency of 98% when maintained properly. However, the conventional chain drive results in 89% power transmission efficiency, which results in loss of input power when compared to that of belt drive.

Here we have used the belt made of alloy of natural rubber, polyester (nylon), cotton. Belt drive offers smoother drive compared to chain drive as well as it reduces the level of noise which is caused by chain drive. The rate of slip is also eliminated in belt drive as the grooves of the pulleys and the belt are in constant mesh, which furtherbolsters the mechanism.

Two lead-acid batteries of 12V 9Ah connected in series, are used to provide power to the motor to propel the vehicle. Moreover, the translation of the vehicle is controlled by a lever which is attached at the handle of the bicycle.

II. DESIGN OF BICYCLE

The complete design of bicycle have been sketched and modified under the guidance of MR.JIGNESH PATEL [Prof. Blue Chip Corp.] in CREO. The lead acid battery is used for storage of energy, since it is cheap, easily available and also it is explosion free. A hub motor is used, which is a conventional type of DC motor. The stator is inside the rotor, the stator is fixed on the axle and the rotor is made to rotate by DC supplied by the battery. This motor provides high torque, which provides higher efficiency to the bicycle compared to normal bicycle. Solar energy is directly converted to electrical energy using photovoltaic cells which work on photoelectric effect. It also gives an alternative method to charge the battery using wall charging. Moreover, the design is capable to bare the load of 140 kg and running at a speed of 20 to 25 km/h.

We have designed the bicycle by considering all the possible ways through which the rider is able to get maximum flexibility for that we have placed all the mechanism used in the bicycle at the rear end of the bicycle. Moreover, the balancing of the engine mechanism placed at the end and that of the rear wheel have also been considered faultlessly.

Fig. 1 CREO Design Model of the cycle viewed from right side

Fig. 2 CREO Design Model of the cycle viewed from left side

III. COMPONENTS USED IN BICYCLE

TABLE 1 : LIST OF COMPONENTS USED

SR NO.	NAME
1)	DC MOTOR
2)	BATTERIES
3)	CONTROLLER
4)	ACCELERATION KIT
5)	BELT WITH PULLEYS
6)	SOLAR PANEl
7)	SOLAR CHARGE CONTROLLER
8)	FLYWHEEL AND CHAIN

IV. COMPARISION AND ANALYSIS

A. As we all know in the normal bicycles only one type of driving method which is through pedal power isavailable whereas on the other hand our concept provides dual mode of riding.

1) Mechanical power (pedal force).
2) Battery mode of driving.

B. In the normal bicycle there are chances that the chain will slip on the application of extra load by the rider which causes huge amount of power loss along with the loss of time as we need to fix the chain to ride the bicycle. Whereas in hybrid concept as belt drive is used, thus misalignment of chain drive is eliminated. Moreover, the maintenance of the bicycle is reduced as lubrication of belt drive is not required.

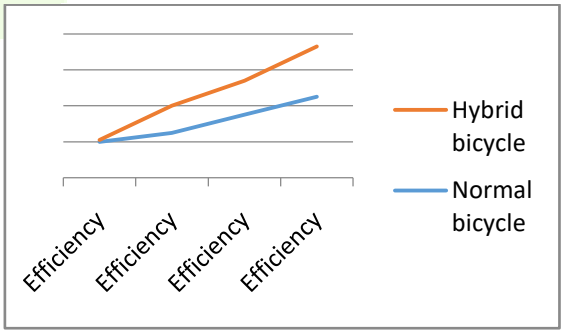

Fig. 3 Relationship between hybrid and normal bicycle regarding their efficiency

V.CALCULATIONS

A. Load carrying capacity: 40 kg(bicycle) + 100 kg(biker) = 140kg

B. Speed Ratio:

$$\text{S. R} = \frac{Teeth\ of\ large\ pulley}{\text{Teeth of small pulley}} = \frac{42}{28} = 1.5$$

C. Pitch Diameter:

For Driving Pulley(A)

$= \frac{Pitch \times No.of\ Teeth}{\pi} = \frac{8 \times 42}{3.14}$ =107 mm

For Driven Pulley(B)

$= \frac{Pitch \times No.of\ Teeth}{\pi} = \frac{8 \times 28}{3.14}$=71 mm

D. Belt Length:

$$l_b = \frac{(d_m \pi)}{2} + \frac{(d_f \pi)}{2} + (2l_{fm}) + \left(\frac{(d_f - d_m)^2}{(4l_{fm})}\right)$$

Where,
d_f = dia of driving pulley = 127 (mm)
d_m = dia of driven pulley = 89 (mm)
π = 3.14
l_{fm} = centre to centre distance of driving and driven in pulley = 508 mm

l_b = length of belt (mm)

$= \frac{(89 \times 3.14)}{2} + \frac{(127 \times 3.14)}{2} + (2 \times 508) + \left(\frac{(127-89)^2}{4 \times 508}\right)$

= 1143 mm

E. Horse power :

H.P $= \frac{350}{746}$ =0.47

F. Torque produced:

P = $\frac{2\pi NT}{60}$

Where,
P= Power of the Motor,
N= Output Rpm of the Motor,
T= Torque Produced

350 = $\frac{2 \times 3.14 \times 350 \times T}{60}$

T = 9.55 N.m

V. FUTURE SCOPE

The hybrid bicycle can be used for regenerative braking by utilizing the same method for energy regeneration on E-Bicycles as on hybrid cars. The main strategy in a hybrid car is to store energy that otherwise would be wasted as heat. When braking a vehicle with regeneration, instead of using regular friction brakes, an electric motor is activated that acts as a generator and supplies power to a battery. In this way, it is possible to store energy when for example stopping at traffic lights. Further also, light weight steel can be used in manufacturing so as to reduce the mass of bicycle, and more efficient motor can be used for increasing bicycles efficiency and speed.

VI. CONCLUSION

This project focuses on providing a cheaper hybrid cycle to the common man. The concept of the project is providing two ways to ride the bicycle:-

1. **Manually**
2. **Battery**

While driving it manually, the rider drives the cycle with the help of the pedals, which rotates the rear wheel with the help of belt that drives the driven pulley attached to the rear wheel. And while driving it through the battery the rider feels relaxed as well can take pleasure and enjoy the ride assuming that he is driving an electric bike. The bicycle also offers one kind of exercise while driving the bicycle manually and when he is tired he can change the mode of driving to hybrid mode by switch and can provide rest to his legs. When the bicycle is kept under sunlight then the solar rays charge the battery through the solar panel. When there is no sunlight, the bicycle can be charged by mains electricity. The hybrid bicycle approach is different, as it works in normal days as well as in cloudy days. We have designed an electric hybrid bike with a minimal amount of additional weight.

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