DESIGN AND FABRICATION OF ELECTRIC BICYCLE

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Abstract

The bicycle has gone from being associate old-intentional recreational product of a less polluting suggests that of transport and a compact, ultra-light personal quality tool. In today's world, the pollution is increasing terribly fast and impromptu owing to the serious usage of fuels, thanks to that air is contaminating at a high rate that ends up in a varied severe diseases. and therefore the price of fossil fuels is additionally increasing day by day in addition as government policy is additionally try and minimize of region pollution in encompassing. So, electrical bicycles are used because the pillars that support individual conveyance in massive cities. electrical bicycle could be a bicycle with associate integrated motor that's used for propulsion. It's additionally known as as *E*-bike or booster bike. This bike is constructed up with BLDC motor, controller, reversible batteries and a throttle. The technology provides you the additional oomph you would like to hide miles of distance with very little effort.

I. Introduction

The e-bike may be a human electrical hybrid vehicle. Basically, associate *e*-bike may be a variety of electrical vehicle supported a conventional bicycle

to that an electrical motor has been adscititious to assist propel it. It's associate ecological and concrete suggests that of transport and its supply of energy may be a battery. within the twentieth century, electrical bicycles began to play a crucial role as a result of they were associate economic and easy possibility for urban transport issues and had environmental benefits, particularly in extremely inhabited countries like china to focus on this truth, it's enough to point that over thirty one million *e*-bikes were oversubscribed in 2012 the most benefits of electrical bicycles square measure each economical and environmental. The batteries of the electrical bicycles are often recharge by connecting them to a plug or once monger in some gears. Additionally, a typical e-bike desires 4-6 hours to charge the battery and encompasses a vary of travel of 25-35 klick at a speed of concerning 30-35 km/hour (depending on riders weight) this suggests that, with one battery charge, it might to enough to travel to figure, visit friends and come home on a standard day, since statistics show that concerning half the journeys and procedure of a standard urban person square measure applied at intervals a distance of fifteen kms from his/her house, thus at intervals the reach of this bicycle.

II. Literature

(i) Wenhua Du, Dawei Zhang, Xingy Zhao (2009)

Based on multi-body dynamics theory and vibration theory, the dynamic performance of electrical bicycle is simulated. Firstly, a two- dimensional mathematical model for the motion of a driver-electric bicycle coupled system was developed. The motive force model is established and also the electrical bicycle model is made by virtual prototyping technology mistreatment the computer code. Secondly, associate degree experiment check is taken to validate the feasibleness of the model. Finally, the influence of the mass and installation location of battery to ride comfort was mentioned. The result shows that the ride comfort is healthier because the mass of battery increased. Once the mass of battery is lower, the installation location will very little influence to ride comfort, however because it is greater, the influence is exceptional. Thought each the values of weighted accelerations RMS at the seat and hand, to the paradigm electrical bicycle, battery put in

beneath the seat-tube has the higher ride comfort.

(ii) Alan A. Parker (2006)

There is a necessity to alter Australia to survive the anticipated depletion of the world's standard oil reserves (cheap oil) between 2010 and 2020. victimization bicycles, electrical PAB sand E-bikes, rather than several 'drive alone automobile journeys' is one in all several measures needed to conserve oil in traveler transport. dynamic the Australian and states road rules to encourage inexperienced merchandise just like the electrical PABs can cut back automobile and oil dependence and gas emissions by tiny however vital quantity. Legislation permitting a most power output of three hundred watts for the ready bodied is needed and to reinforce the quality of the old the lame and also the disabled a most power output of 600 watts is needed.

(iii) Sen Lin, Min He, Yonglu Tan, Mingwei He (2008)

This paper surveys the in-operation speeds of e-bicycles and bicycles on nonmotorized lanes on eight avenues in Kunming, China. A comparison study of the in operation speed and its distribution between e-bicycles and bicycles is given. Applied mathematics analysis indicates that the mean in operation speed of e-bicycles is twenty one.86 km/h, which is 7.05 km/h quicker, or 47.6% higher, than that of bicycles. The influence of riders' gender and age on in operation speed distribution is additionally mentioned. This paper presents a subjective analysis of safety from the riders' perspective by measure 552 e-bicycle riders and 232 bicycle riders.

(iv) Xiang Liu, Mian Li, Chengbin Ma, Min Xu (2012)

Torque is one in every of the foremost necessary management factors for a vehicle's motion. Compared with burning engine, electrical motors will have a lot of correct force feedback. In electrical vehicles, direct force management of the magnet electric motor has been studied. However, thanks to non-ideal back electromotive force} phenomenon, direct force management of brushless DC motors has not been wide used. During this paper, a replacement technique victimization kriging to calculate back electromotive force during a period on-line fashion is conferred. Kriging prediction is employed to approximate the rear electromotive force of the

motor supported data from sampled points. With motor speed and rotor position as inputs, kriging predicts back electromotive force because the output that's accustomed calculate the motor force with 3 section currents victimization this novel technique, motor force may be accurately calculated and implement in small management units of vehicles, even once facing extraordinarily high/low temperature and aging conditions.

(v) Vidyadhar Gulhane, Mr. Tarambale, YP Nerkar (2006)

There square measure some common problems associated with electrical vehicle technology. These embrace choice of batteries, choice of electrical motors for specific capability vehicles, style of controllers, style of battery chargers with specific applications to electrical vehicles, development of testing facility for testing of electrical motors, controllers and battery chargers. This paper emphasizes basic details concerning characteristics of varied motors and controllers used for battery operated electrical vehicles.

(vi) V. Thiyagaranjan, V. Sekar (2012)

A dynamic model of the vehicle has been realised, and therefore the characteristics of the european are individuated. A basic electrical bicycle runs on a BLDC motor, is powered by batteries and controlled from an eu. The BLDC motor for the electrical bicycle is of the quality 3 section tetragon kind, usually rated at some hundred watts and therefore the battery voltage is typically 36V or 48V counting on the circuit current.

(vii) Dainis Berjoza, Inara Jurgena (2014)

A research should be conducted so as to settle on a correct charging device, to optimally load the electrical wiring network likewise on opt for power and alternative parameters for energy devices so as to confirm the charging method. The current analysis involves 5 varied electrical bicycles. The analysis additionally involves battery systems with a complete voltage of twenty four V, 36 V, forty eight V and sixty V. For the analysis, each a knowledge assortment system and electric battery discharging system were developed.

III. Components of *e*-Bicycle

1. Motor. There square measure totally different placements for an electrical bike motor, every has its own benefits; front hub, rear hub and mid-drive motor the most perform of the motor is to manage force. The additional advanced the electrical motor, the additional force it offers. The additional force you've got the additional power you'll get out of the bike.

Figure 1. Motor.

2. Battery. The battery on an electric bike can be located in varying places on the bike, which depends on frame. Each battery makes, model and type mean that they will need to charge for different times, an average charging time is 6-8 hours. Charging your battery is easy, just like a mobile phone you plug it into the wall. As we are using 48v 750w motor to run the cycle, we are required to supply a voltage of 48v, a rated current of 15.6A and to make the e-bike run more efficiently for a long duration of time, we have connected 4 batteries (each 12v) and with a capacity of 18ah in series to get the supply enough power to run the motor.

Figure 2. Battery.

3. Controller. The speed controller of an electrical bike is Associate in Nursing electronic circuit. This controller unit uses power from the battery pack and drives it to the motor. Differing types of controllers area unit used for brushed and brushless motors. For adaptive e-bikes, a conversion kit is employed and therefore the controller is that the main part of that kit. the electrical bike speed controller sends signals to the bike's motor in varied voltages. These signals sight the direction of a rotor relative to the starter coil. the correct perform of a speed management depends on the use of assorted mechanisms.

Figure 3. Controller.

4. Throttle. The throttle is connected to the controller through wiring whose function is to regulate or control the speed of the motor.

Figure 4. Throttle.

5. Battery charger. The battery charger is a device which is used to put energy into a rechargeable battery by forcing an electric current through it. This charger takes the electric current from the main supply and is connected to a charger plug of a controller which supplies the flow of current to the battery. This wall charger can charge the pack of 4 batteries connected in series in 5-7 hours.

Figure 5. Wall Charger.

6. key switch. Key switch is the component which channels the power flow from battery to motor, when ON condition.

Figure 6. Key switch.

IV. Design of e-Bicycle

Here we have used brushless dc motor with 750watt power and 450rpm as rated and 540rpm as practically observed. The motor runs on 48volts and 15.6amps power source. As for the operating purpose, dc controller is required for the BLDC motor. And this whole needs a battery power source for running the motor. Therefore, here we have used 4 batteries (each of 12volts) connected in series to get the desired output of 48volts.
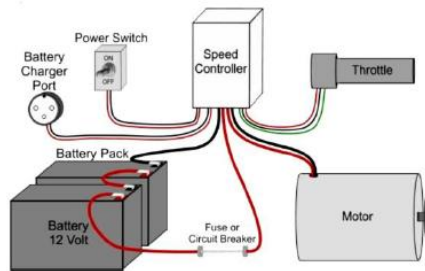

Figure 7. Electric Bicycle.

Implementation. In this project we had fabricated the bicycle with all electric components. After then, we have used reverse engineering mechanism to calculate speed and torque on different inclination in load

condition.

Figure 8. Circuit representation.

V. Calculation

Speed calculation-

Given value:

Radius of tire = 33cm or 0.33m

Centre to Centre distance = 56cm

Weight of cycle = 52kg

Weight of passenger = 62kg

Under no load condition:

Motor rpm = 540rpm

Rear wheel rpm = 296rpm

Speed of bicycle:

Circumference = 2πr

$\qquad$ = 2×3.14×0.33

$\qquad$ = 2.0727m

Surface speed = circumference × rpm

$\qquad$ = 2.0727×296

$\qquad$ = 613.4304m/min

Surface speed (km/min) = 613.4304/1000

$$= 0.6134 \text{Km/min}$$

Surface speed (km/h) = 0.6134×60

$$= 36.8 \text{Km/h}$$

Velocity ratio:

V.R. = w_2/w_1

Where,

$w_1 = 2\pi N/60$

$\quad = (2 \times 3.14 \times 540)/60$

$\quad = 56.52$ rad/sec

$w_2 = 2\pi N/60$

$\quad = (2 \times 3.14 \times 296)/60$

$\quad = 30.98$ rad/sec

Therefore,

V.R. = 30.98/56.52

V.R. = 0.520

Torque:

$$T = (P \times 60)/(2 \times \pi \times N)$$

$$T = (750 \times 60)/(2 \times 3.14 \times 296)$$

$$T = 24.20 Nm.$$

Under load condition on different inclination:

Surface speed (practically observed) at 0^0 inclinations

Surface speed = $2\pi r \times$ rpm

30.53km/h = 2×3.14×0.33×rpm

rpm = 4.8/ (0.00033×60)

rpm = 242

Torque:

$$T = (P \times 60)/2\pi N$$

$$T = (750 \times 60)/2 \times 3.14 \times 242$$

$$T = 29.60 Nm.$$

Surface speed (practically observed) at 15^0 inclinations

Surface speed = 2πr×rpm

22km/h = 2×3.14×0.33×rpm

rpm = 22/ (2×3.14×0.00033×60)

rpm = 176

Torque:

$$T = (P \times 60)/2\pi N$$

$$T = (750 \times 60)/2 \times 3.14 \times 176$$

$$T = 40 Nm.$$

Surface speed (practically observed) at 25^0 inclinations

Surface speed = 2πr×rpm

14.74km/h = 2×3.14×0.33×rpm

rpm = 14.74/ (2×3.14×0.00033)

rpm = 118

Torque:

$$T = (P \times 60)/2\pi N$$

$$T = (750 \times 60)/2 \times 3.14 \times 118$$

$$T = 60.72 Nm.$$

VI. Conclusion

After we have completed our research project, we have conducted a lot of results regarding our project. First, we have learned a lot about the local market, compared parts, dimensions, decision making, and finally installation and fabrication. Second, our project works effectively, we had a minor problem with the motor it kept getting heated when working. The problem was due to the extra load on the motor because we were starting the motor while the bicycle is not moving. One of the major challenges that we faced was the battery until finally, we solved that problem as mentioned before.

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