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Multifunctional Electric Bicycle

P. Madhavi, E. Chakra Harish, L. Sindhu Sri, P. Sai Kiran, B. Sangamesh

EEE department & HITAM College
EEE department & HITAM College
EEE department & HITAM College
EEE department & HITAM College
EEE department & HITAM College

Abstract - — In today's world transportation has become an essential part to travel from one place to another place. We prefer different types of vehicles based on the distance we have to travel. One such vehicle cycle is for short distances to travel and is eco-friendly to nature. To ride cycling effort must be applied by the rider on the pedals to make the cycle move. While riding the cycle in hilly areas extra effort must be applied by the rider while pedaling and it is also difficult to ride the bicycle on steep surfaces. So, the aim of our project is for the smooth movement of bicycles on steep surfaces and easy riding in hilly areas with less human effort. The cycle is integrated with a BLDC motor and rechargeable battery like a Lithium-ion battery. The human can ride the bicycle by pedaling and when he feels tired of pedaling, he can ride the bicycle by accelerating like E-bike without applying any effort to the pedals. Hence this project can also help to attract people's attention towards electric vehicles and reduce the usage of fuel vehicles

Key Words: Electric Vehicle, BLDC Motor, Rechargeable Battery.

1. INTRODUCTION

In this modern world, everyone is preferring electric vehicles [1]. As the cost of petrol and diesel increases rapidly the world is moving to electric vehicles. Electric vehicles are vehicles that use one or two electric motors to run the vehicle. For this motor, the required power is supplied from the battery. For these electric vehicles, there is no need for fuel. These electric vehicles are eco- friendly to nature. Electric vehicles are budget free and have less maintenance cost. Electric vehicles do not emit any gases. These factors attract people to prefer electric vehicles.

Bicycles have many qualities which differ from other vehicles. As we all know for any vehicle there should be registration, insurance, and driving license to drive on the roads. But bicycles do not need registration and a driving license. And bicycles give benefits in health also. Riding the cycle gives us physical exercise.

In the current position, Electric bicycles play an important role because they are economical and environmentally friendly. This electric Bicycle contains a strong electric motor. This electric motor helps to rotate the wheels at high speed. These electric bicycles are a little different from normal bicycles [8]. Normal bicycles run only through pedaling. For normal bicycles person has to put his efforts into pedaling to run the cycle at maximum speed. Electric bicycles are the modified version of normal bicycles. The difference between a normal cycle and an electric cycle is the application of the motor and battery. In electric bicycles, a controller is used to control the motor speed these motoring system makes the ride smooth and more comfortable than the normal bicycles. Electric bicycles are better than normal bicycles because while riding electric bicycles riders can get external power from the motor that makes the ride simple and comfortable. In an electric bicycle, the rider can drive easily when the driver is tired or he is unable to drive forward by pedaling he can stop pedaling and activate the motoring system and drive easily. [10] In hilly areas or steep surfaces these electric bicycles are most efficient than normal cycles. In steep surfaces normal cycles do not give torque and ride becomes difficult in steep surfaces. But with electric bicycles, there is no strain on the driver.

2. HARDWARE SETUP

In this section, the hardware components required for the development of an electric bicycle and their working will be illustrated.

2.1. HUB Motor

A Motor is an electrical machine that converts direct electric power into mechanical power [6]. The hub motor belongs to the family of DC motors. The principle of working of a DC motor is whenever a current-carrying conductor is placed in a magnetic field, it practices a mechanical force. here we are using 350W ,36V hub motor [3[7]] This motor gives high torque of 35Nm and gives a maximum speed of 40KmH. This motor helps to run the vehicle on steep surfaces smoothly. This motor gets a power supply from the battery. This type of DC motor has a specific internal mechanism either electromechanical or electronic to periodically change the direction of current flow in a portion of the motor.

While operating at extremely high speeds, these motors achieve a long trouble-free life as there is no mechanical commutation. These motors have linear motor characteristics with excellent speed and position control. Hub motors give high efficiency.

Fig.2.1. 350W Hub Motor

2.2. Lithium-ion Battery

The template Battery is the main component in electric bicycles. There are many types of batteries but the most usedbatteries are lithium-ion and lead-acid batteries.[7] In this project, we are using 36V 12 A Lithium-ion battery. This battery is a rechargeable battery of 12000mAh. This rechargeable battery consists of power-generated components called cells. There are 40 cells in this battery. Each cell carries 3.6V. These 40 cells are configured as 10 series and 4 parallel configurations. This lithium-ion battery gets charged within 2 to 3 hours of completion. This type of battery has a long life span. They hold their charge very long.

[9] These batteries are lighter compared to other types of batteries. And this battery can handle more charge and discharge cycles. The battery gives electric power to the motor with this powerful motor runs and gives mechanical output this battery also gives power headlight and the horn of4V. This battery can be discharged within 2 hours when it is continuously running. If the charging gets dischargedthe driver can run through pedaling.

Fig.2.2. 36V Lithium-ion Battery

2.3. Controller

The controller is an electronic circuit that controls the speed of the motor. A controller not only controls speed but also works as a dynamic brake.[4] This controller circuit uses power from the battery and drives the controlled power to the motor. The controller sends various signals to the motor about voltage. It is a 350W power and 36V controller. It gets an input power supply from the battery and sends controlled output tothe motor, headlight, and horn of the cycle. This controller is also connected to the brakes for speed and dynamic braking. And it is also connected to the throttle [2]. The PWM (pulse widthmodulation) control is used for spe

Fig.2.3. Controller

2.4. Throttle

A throttle [5] is a device connected to the cycle in the place of the handle, when the throttle is engaged the motor gets power from the battery. Electric bicycle throttle is just like a bike or scooter's handle, it helps the acceleration of the cycle.The throttle is also connected tothe controller.

2.5. Brakes

Brakes [8] decrease the speed of an electric cycle when applied. These brakes are connected to wheels, as the rider applied brakes the speed of the wheels gets reduced.

2.6. Speedometer And Pedal Assist

Speedometer is a guage which measures and displays the instantaneous speed of the cycle.Speedometer measures the time between each wheel using speed sensor attached to the wheels of the cycle and displays the speed.

Fig. 2.6.1. Speedometer

Pedal assist makes the pedaling easier. When you pedal, the sensor monitors each revolution of the pedalsit then sends the signal to the motor how much speed to be ride. Pedal assist makes the riderto ride easily and smoothly and also it increases the speed of the cycle.

Fig.2.6.2. Pedal assist

3. WORKING

The block architecture shown in Fig. 4. illustrates the working of all the hardware components collectively for the functioning of an electric bicycle. The work of our project is explained using these blocks.

a) Motor
b) Battery
c) Controller
d) Battery Charger
e) Throttle
f) Brakes
g) Pedal assist

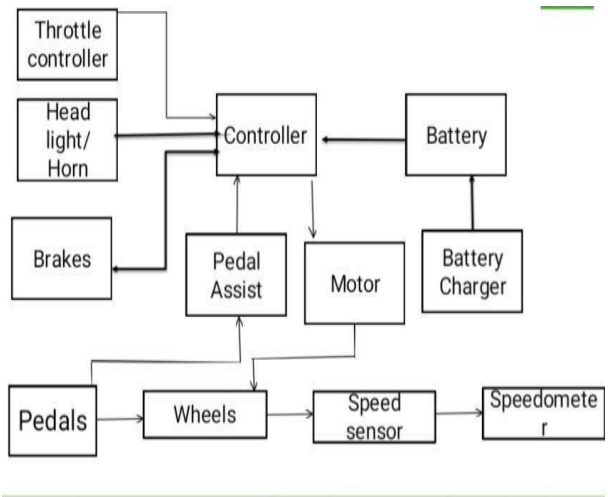

Fig. 3.1. Block diagram of Electric bicycle

When the rider starts the cycle firstly the battery gets charged from the battery charger and then it supplies voltage to the controller. Controller gets power from the battery when the rider engages the throttle the controller supplies controlled output voltage to the motor. With the controlled voltage, the motor starts running making the cycle move forward. And when the rider applies brake then the signal passes to the controller and then which controls the speed of the motor then the speed of the cycle also reduces. From the controller, the controlled output voltage is supplied to the headlight when the switch of the headlight is on and the horn gets a supply of 4V from the controller. In the electric cycle working controller plays an important role, it supplies equal voltage to the components.

when the battery charging gets discharged the driver can run the cycle by pedaling. But this battery will work for two hours continuously, Motor gives a high speed above 35KMh while working and on steep surfaces, it gives better torque of 35Nm.

4. CALCULATIONS

the tire = 32cm or 0.32

Speed = circumference x rpm

Circumference = $2\pi r$

$= 2 \times \pi \times 0.32$

$= 2.010$

Wheel rpm = 256rpm

Speed = 2.010 x 256
= 30 KmH

Torque = p x 60/ $2\pi N$; P = 350 WN

= 225rpm

T = 350 X 60 / 2π x 225

=15Nm

5. EXPERIMENTAL RESULTS

The main aim of this project is to design a bicyclethat gives high speed and torque and whenever the rider goes into steep or hilly areas normal cycles will not give sufficient torque to climb. So, this electric bicycle gives a high speed of 30Kmh and it gives a maximum of 30 Nm of torque, with this torque, the rider can ride the cycle on steep surfaces and hilly areas.

specification	Hero lectro	Moto volt	Hercules
Motor	250W	250W	250W
Battery	36v	36V	36v
speed	35Km	25-30Km	25Km
Torque	25Nm	25Nm	25Nm
Cost	40K	50K	35k

Fig.6.1. Market Analysis

Fig.6.2. Multifunctional Electric Bicycle

From Fig.6.2. we can see the design of the electric bicycle.In the above fig there is a motor that is connected to the rear wheel and the battery is connected to the cycle frame in between two rods, and the controller is connected to the battery and then another wire of controller is connected to brakes, throttle, and motor, headlights, and horn. After designing the cycle [10] the result we got was that the cycle ran with high speed and torque which was wanted and the battery is also running more time and getting a charge quickly. And the maximum weight that cycle can bare is 100 kg. And this weight the charging of the batterydecreases.

6. CONCLUSION

The proposed system is a lightweight electric bicycle, Thiscycle is used for Internal campus moments and it is usedfor various transportation uses, It gives high speed and high torque. This cycle is mainly used on steep surfaces orhilly areas. This cycle runs more effectively than other cycles in hilly areas and this cycle gives physical exerciseto the rider. This can be extended with a dashboard with requires metering equipment and developing a mechanismof cooling system for the battery.

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