E-Bike with Regeneration

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Abstract— India is world's second-largest two-wheeler producer and manufacturer. In terms of two-wheeler production and domestic sales, it ranks third behind Japan and China. In recent years, the Indian two-wheeler industry has experienced phenomenal growth. The two-wheeler industry is about to enter a new age, with the face of auto industry being redefined with the advent of fuel-efficient technology. It is electricity, not petrol, diesel, or any other power, that has sparked a revolution in India's two-wheeler industry. Electric Bikes and scooters are a common mode of personal transportation in developed countries such as America, Japan, and China and the Indian two-wheeler industry has adopted the new model. As aa result, hybrid bikes and scooters have a promising future in the field of personal transportation. This paper investigates the design and construction of an electric bicycle. This paper also discusses electric two-wheeler components such as the battery, charger, BLDC motor, controller and DC-DC converter.

Keywords: Electric vehicles (EVs), Battery, Brushless DC Motor (BLDC), DC-DC converters

I. INTRODUCTION

The bicycle or bike industry is undergoing a transition from human-powered pedal-drive to hybrid drive, which incorporates mechanical pedal-drive with an electric propulsion system. These bicycles are known as electric-bikes or e-bikes because they have an electric motor mounted above the pedals that is driven by an on-board rechargeable battery. As a result, hybrid bikes and scooters have a promising future in the field of personal transportation. This paper also discusses electric two-wheeler components such as the battery, charger, BLDC motor, controller and DC-DC converter.

Electric vehicles have some benefits that traditional internal combustion engine vehicles do not have. EVs are very sensitive and have a lot of torque because electric motors responds quickly. Electric vehicles are frequently more digitally linked than traditional vehicles, with many Electric vehicle charging station allowing charging to controlled through a smartphone app.

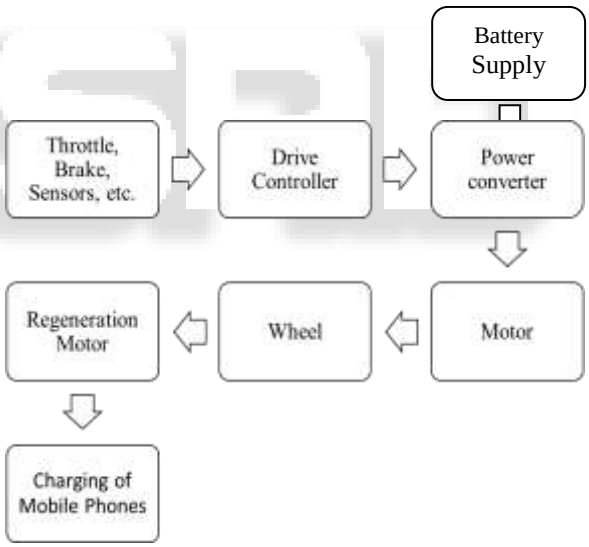
You can plug in your Electric vehicle when you get home, just like a smartphone and it will be ready to use the next morning. Since the electric grid is nearly everywhere, there are a number of charging options: at home, at work, or on road. You will never need too go to gas station again if you charge often. An e-speed bike's and range are determined by the motor's specification and battery power. E-bikes with a maximum power of less than 25km/h are not classified as motorized vehicles in India and are therefore exclusive from the Automotive Research Association of India's transportation regulations (ARAI).

Customers have been drawn to this class of e-bike because they are light and inexpensive. There are conversation kits available that can convert any pedal-drive bike into an e-bike for low cost. Hub motors, brushless motors, brushed motors, crank-drive motors and friction drive motors are all common E-bike motors.

To comply with the ARAI exemption regulations, these motors require DC power for propulsion and are normally rated at 24/36/48 V, 750W. because of their superior energy density capacity, ;lightweight, low maintenance, longer life and high state of charge window, lead acid battery packs are favoured over other battery types for e-bike applications. The normal voltage is 12/24/36/48V, but the power varies depending on the E-bike range.

Between the battery pack and the motor that controls the e-propulsion bike's is a speed controller. Its main task is to measure the rider's throttle response and calculate how much power is required from battery pack to drive the motor. When the rider applies mechanical brakes, the controller cuts the motor for a smoother stop.

II. BLOCK DIAGRAM



III. WORKING OF BLOCK DIAGRAM

Brushless DC motor propels the E-bike forward. With the aid of power converter, this BLDC mtotr is driven from a battery source.

To begin, the Drive controller recieves input signals from the throttle (accelerrator), brake and other sensors. The speed of the motor is controlled by the drive controller. Where slow speeds are required and maximum powe is not required, ahigh resistance is used to reduce the current to a safe level.

To buck up, 12V to 48V DC, a DC-DC power converter is used. Battery provides power to he

Power converter. The power converter provides voltage and current to the motor based on the output signal

from the drive controller. As a result, the motor speed is controlled.

For Regeneration, we attached a 12V DC mtor between the BLDC mtotr and the wheel via the chainwheel for regeneration. When the E-bike is turned on, the 12V DC motor rotates and generates electricity, which is used to charge mobile phones.

IV. MAJOR COMPONENTS USED

A. Brushless DC Motor

Brushless DC Motor (BLDC motor or EC motors), also known as electronically commutated mtotrs (ECM or EC motors) and synchronous DC motors, are motors thatt use direct current (DC) electricity to drive each step of the motor through a closed loop controller. Pulse output is given by the controller.

Brushless motors are normally built in the same way as permanent magnet synchronous motors (PMSMs), but they can also br switched reluctance motorsor induction (asynchronous) motors. They can also be outrunners (the stator is surrounded by the rotor), inrunners (the rotor is surrounded by the stator), or axial and use neodymium magnets (the rotor and stator are flst and parallel).

Brushless motors have a higher power-to-weight ratio, higher rpm, electronic control and need less maintance than brushed motors. Brushless motors are used in a number of applications, including computer peripherals (disc drives and printers), hand-held power tools and vehicles ranging from model planes to automobiles.

B. Battery

An electric vehicle battery (EVB) (also known as tractional battery) is a type of battery that powers the electric motors in a battery electric vehicle (BEV) or hybrid electric vehicle (HEV). These batteries are normally rechargeable (secondary) lithium-ion batteries. These batteries were created with a high ampere-hour (or kilowatt-hour) capacity in mind.

Electric-vehicle batteries are different frim starting, illumination and ignition (SLI) batteries that they are designed to provide power over long period of time. Electric vehicle batteries are distinguished by their high power-t0-weight ratio, specific capacity and energy density; smaller, lighter batteries are favored because they minimize vehicle weight as a result of which it will increase its efficiency. Many new battery systems have lower specific energy than liquid fuel, which has an effect on the vehicles' overall electric range.

Because of their high energy density compared to their weight, lithium-ion and lithium polymer batteries are the most popular battery types in modern electric vehicles. Lead-acid (flooded, deep cycle and valve controlled lead acid), nickel-cadmium, nickel-metal hydride. Generally zinc-air and sodium nickel chloride are among the other forms of rechargeable batteries used in electric vehicles (zebra). We chose Lead Acid battery from among these. The cumulative energy contained is often calculated in kilowatt-hours, with the amount of electricity (i.e. electric charge) measured in ampere hours or coulombs.

C. Drive Controller

The controller acts as a "middleman", ensuring energy balance and flow inside an electric vehicle. It also acts as the vehicle's 'brain', calculating how much energy is required for the vehicle to travel safely on road. When you open the hood, you'll note how large the controller is; it takes up much of the room. The batteries and motor are connected to the controller via heavy wires.

A controller's function in a direct current electric vehicle is fairly straightforward.

Let's assume an EV has 12V batteries connected to each other, each with 12 volts, for total of 144 volts. In a 'controlled' mode, the controller receives 144 volts and delivers it to the motor. When you drive, you must step on the accelerator pedal to make it work and you must remove it when you need to stop the car, effectively acting as an on/off switch ad providing necessary instructions.

D. DC-DC Converter

For DC-DC Converters, there are many topologies to choose form. Buck converters are becoming more common, particularly in battery-powered applications, since the output voltage level can be adjusted in relation to the input voltage. In the different configurations of electric vehicles, DC-DC converters converts HV to 48V, HV to 12V and 48V to 12V.

Low losses, high reliability, low volume and lightweight are the most important design criteria for DC-DC Converters. There are numerous architectures that necessitative various types of semiconductors devices. ST offers power devices such as super-junction MOSFETs with fast switching diodes, IGBTs with co-packed diodes, Sic MOSFETs and low-voltage Trench-Gate MOSFETs, as well as gate drives such as the STGAP1S gapDRIVETM.

The converter's structure is dictated by the load that much be supplied. The step-down DC/DC converter is the subject of this post (Buck Converter). MPPT employs the same converter for a variety of tasks, including controlling the input voltage at the highest power point and load matching for maximum power transfer.

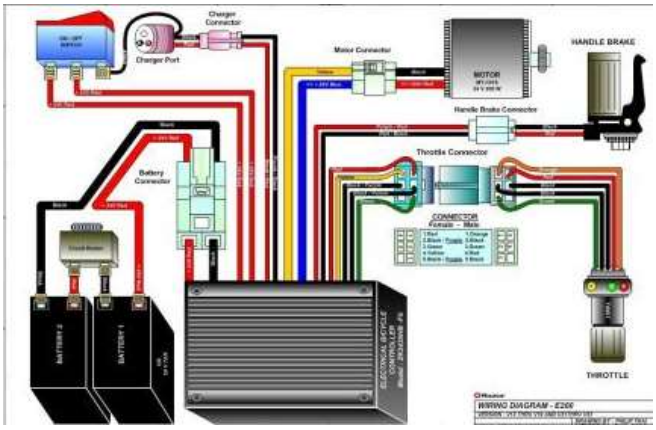
E. 12V DC Motor

A DC motor is of any of many types of electrical machines that transform direct current electrical power. Most of the time, this form of motor is driven by magnetic fields. DC motors, regardless of their type, have an internal mechanism that is either electronic or electromechanical. The direction of current flow in part of the motor is in both cases.

A DC motor's speed is regulated by varying the supply voltage or adjusting the current intensity within its field windings. Larger DC Motors are used in hoists, elevators and electric cars, while smaller DC motors are used in appliances, equipment, toys and automotive mechanism like Electric car seats.

A 12V DC motor is smaller and inexpensive, but it's efficient enough to handle a number of tasks. It's important to partner with the right company because selecting the right DC motor for a particular application can be difficult.

V. CONNECTION DIAGRAM



VI. RESULTS

About 77 % of the electrical energy from the grid is converted into electrical at the wheels by e-bikes. Traditional fuel vehicles convert only about 12-30 % of the energy contained in gasoline to electricity at the wheels. The bike can fly over 50 Kilometers on single charging, with a power consumption of 1200 Watts i.e. 1.2 Units.

VII. CONCLUSION

With so many advantages, owning an e-bike has the ability to boost air quality and reduce greenhouse gas emissions. Future research may apply these models to price changes. The 'alternative basic constants' for gasoline two-wheelers show that the models do not estimate all of the models do not estimate all of the variables that could affect preference.

Many variables differ between vehicle types but are unobserved and these constants are likely to include perception problems. Increased efficiency, lower prices, regulations benefiting E-bikes (or harming gasoline two-wheelers), improved infrastructure and successful marketing can all help to increase E-bike adoption. These are all difficult to achieve, but the benefits can outweigh the drawbacks of other approaches to addressing environmental issues.

VIII. FUTURE SCOPE:

- Regenerative braking can be done to increase efficiency.
- The regenerated Electricity by 12V motor can be used to supply Head lights, Horns, starter switch, etc.
- The regenerated electricity by 12V motor can be used to charge the battery.
- We can add small solar panels on bike to increase efficiency and charge the bike at time of non-availability of charging station.
- The Wireless charging for the vehicle can be implemented using diverse methods to remove the complications for the charging.
- For both motoring and generating modes, the Battery Management System, as well as the Temperature of the SC Bank and Battery combination can be used.
- The observations can be analytic and produced in real time using a variety of methods for continuous data storage.
- Artificial Intelligence Methods- AC, GA, ANN and TLBO can be used to predict the likelihood of SAE cycles at an early stage.

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