SMART ELECTRICAL VEHICLE

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Abstract— The primary objective of the paper is to design a feasible yet highly adaptable E-BICYCLE as number of motor vehicles on the roads whole over the world increases. The world's car usage is booming. Cars are polluting the cities and dumping increases the amounts of carbon dioxide and other climate altering Green house gases into the atmosphere and consuming vast quantities of petroleum. Huge amount of money is being spent on the development of electrical vehicles that may be produced. This paper represents the study of Electrical Bicycle design. The aim of this paper is to design a simple, cost effective model of Electrical Bicycle with intelligent control system. The materials used are most environmentally friendly and cost is very much lower than the existing electric power bike. This can be implemented by connecting an electrical motor, a controller and battery pack, cabling and monitoring instruments.

Key–words: BLDC motor, Controller, Battery system.

I. INTRODUCTION

Nowadays Price of oil keeps on increasing. People want to use electricity instead of oil. To operate transport in China, industry of electric bikes has grown rapidly in these 10 years. The design of electric bikes tends to more environmentally friendly. Electric vehicles make use of BLDC motors as the propulsion method. Due to the fact that the BLDC motors do not have brushes, they have some advantages over the DC brushed motors. From which, we remember: 1.longer life span, 2.lower EMI (Electro Magnetic Interference), radiation, 3.noiseless operation, 4.greater torque to motor size ratio [1]. The internal structure of a BLDC motor is presented in Fig.1. BLDC motors are 3-phase motors, in order to drive properly; a special control circuit must be used. The purpose of the control circuit is to energize the proper winding(s) (Exact winding) at the right moment [2]. This can be achieved by reading information from certain rotor position sensors and generating PWM (Pulse Width Modulation) signals [3]. The maximum speed of the E-Bicycle is 30 to 35 km/h. The charging time takes by the batteries is 2hours and the bicycle runs for 50km.

MERITS OF PRESENT E-BIKE:

A) Good efficiency: IC engines are 40% efficient whereas BLDC (Brushless DC) motors equipped in E-Bicycles are more than 90% efficient in power utilization. These motors are robust in all weather conditions with almost all types of road conditions [4]. B) Eco-friendly: If the electric power required to charge the batteries is derived from Non-conventional sources. Hence Electrical vehicles are environmentally friendly [4].

C) Cheaper and Quieter Journey: Due to good efficiency, electric units required to travel a given distance are compared with power requirement of fossil fuel is too less (for instance, an electric bike called Yo-smart model of E-bicycle has average of 0.08 Paisa/km). Electrical vehicles are quietest of all means of transport [4].

DEMERITS OF PRESENT E-BIKE:

A) Lower speed: E-bicycles don't attend the higher speeds like diesel or petrol powered vehicles [4].

B) Longer Charging time: The batteries require about 2 to 3 hours of charging time. Even if we neglect the scarcity of charging stations, 2–3 hours is pretty long duration [4].

C) Battery issues: Especially lead acid batteries which degrade heavily over time (500-800 charge-discharge cycles). So a bicycle with lead acid batteries will require replacement after about 2 to 3 years. The decomposition of batteries is not eco-friendly. The weight of batteries also adds more than half the weight of the bike [4].

PROPOSED DESIGN:

Based on the detailed analysis of above De-merits, Authors have proposed a modified design of E-bicycle which is shown in the block diagram. The bicycle will have 24 V, 250 Watts BLDC motor, driven by 24 V, 12 ampere hour battery pack and Accelerator, Brakes, Charging indicator, Key. These are driven and connected to 24 V controller in closed loop. The Controller is Heart of the E-bicycle which regulates controlling actions and power through each sub system. Throttle is a potentiometer box which acts as an accelerator.

2. COMPONENTS

2.1 BLDC MOTOR:

BLDC Motors were invented in 19th century. Brushless DC motors were made possible by the development of solid state electronic in 1960s. A Brushless dc motor is also known as electronically commutated motor (ECM or EC motor) and synchronous dc motors. Synchronous motors powered by direct current electricity via an inverter of switching power supply, which produces electricity in the form of alternating current to drive each phase of the motor via a closed loop control. The controller provides pulses of current to the motor windings that control the speed and torque of the motor. The Construction of a Brushless motor system is typically similar to permanent magnet synchronous motor (PMSM), but can also be a Switched Reluctance motor or an induction (Asynchronous) motor. An electric motor develops torque by alternating the polarity of rotating magnets attached to the rotor (The rotating part of the machine), and stationary magnets on the stator which surrounds the rotor. One or both sets of magnets are electromagnets made of a coil of wire wound around an iron core. DC running through the wire, winding creates the magnetic field, providing the power which runs the motor. However, each time the rotor rotates 180 degrees (a half turn), the position of the north and south poles on the rotor are reversed. If the magnetic field of the poles remains same, this would cause a reversal of torque on the rotor each half-turn, and so the average torque would be zero and the rotor would not turn. Therefore, in a DC motor, in order to create torque in one direction, the direction of electric current through the windings must be reversed with every 180 degree turn of the rotor (or turned off during the time that it is in the wrong direction). This reverse the direction of the magnetic field as the rotor turns, so the torque on the rotor is always in same direction.

2.1.1 ADVANTAGES: (of a brushless motor over brushed motor)

High Power to Weight ratio

High Speed

Electronic control

Low Maintenance

2.1.2 APPLICATIONS

Used in computer peripherals

Hand held Power tools

Vehicles ranging from model Air craft to Mobiles

2.1.3 SPECIFICATIONS

Supply Voltage	: 24V DC
Output Power	: 250Watt
Rated Speed	: 2650RPM
No-Load Speed	: 3000RPM
Dimensions	: 7.5*5.3*2.1
Full-Load current	: <= 13.7Amps
No-Load current	: <= 2.2Amps

Fig 1. BLDC Motor

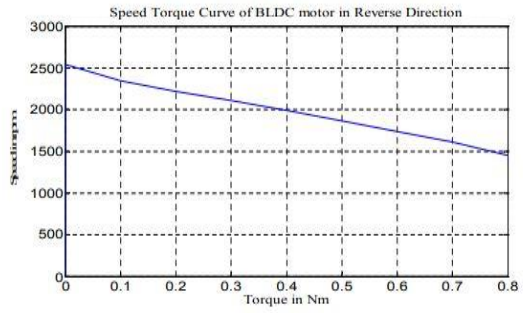


Fig.2 Speed Torque Characteristics of BLDC Motor in Reverse Direction

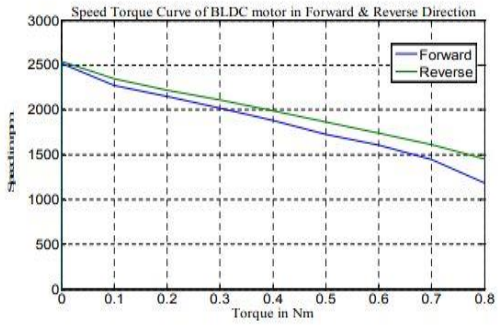


Fig.3 Speed Torque Characteristics of BLDC Motor in Forward and Reverse Direction

2.2 LEAD - ACID BATTERIES:

The lead – acid battery was invented in 1859 by French Physicist Gaston Plante and is the earliest type of rechargeable battery. Despite having very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost make them attractive for use in motor vehicles to provide the high current required by starter motors.

As they are inexpensive compared to newer technologies, lead-acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities. Large format lead-acid designs are widely used for storage in backup power supplies in cell phone towers, high availability settings like hospitals, and stand alone power systems. For these roles, modified versions of the standard cell may be used to improve storage times and reduce maintenance requirements.

In the charged state, the chemical energy of the battery is stored in the potential difference between the pure lead at negative side and the PbO_2 on the positive side, plus the aqueous sulphuric acid. The electrical energy produced by a discharging lead-acid battery can be attributed to the energy released when the strong chemical bonds of water (H_2O) molecules are formed from H^+ ions of the acid and O^{2-} ions of PbO_2. Conversely, during charging the battery acts as a water -splitting device.

Fig.4 Lead Acid battery

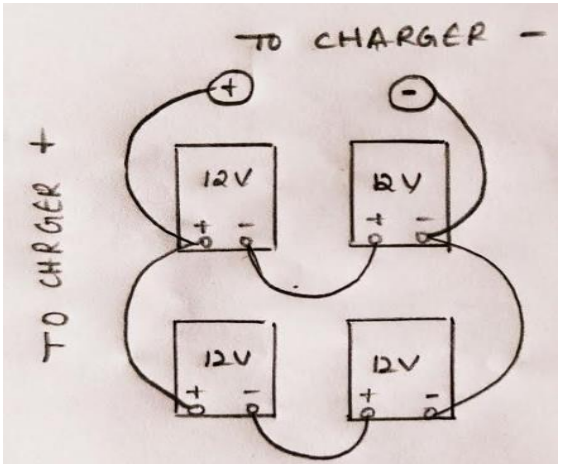


Fig.5 series parallel connection of batteries

2.2.1 ADVANTAGES:

Low cost
Robust. Tolerant to abuse
Lower internal impedance
The worlds most recycled product

2.2.2 APPLICATIONS:

Automotive and traction applications
High current drain applications
UPS(uninterruptible power supplies

2.2.3 BATTERIES SPECIFICATIONS :

Type :Lead Acid
Voltage :12V
Current :7.2AMPH

2.3 CONTROLLER:

An Electronic controller or ESC is an electronic circuit that controls and regulates the speed of an electric motor. It may also provide reversing of the motor and dynamic braking. Miniature electronic speed controls are used in electrically powered radio controlled modules. Full-size electric vehicles also have systems to control the speed of their drive motors. Here, we used 24 V controller.

2.3.1 APPLICATIONS:

Electric bicycles, Electric cars, Electric air craft

Helicopters

Airplanes, Boats

Quad copters

2.3.2 SPECIFICATIONS:

Voltage : 24 V DC

Current Limit : 21 A +/-1

Power : 250 W

Fig.6 controller

3. EXTRA COMPONENTS USED:

Accelerator

Brake Light

Key

Charging indicator.

Odometer

GPS tracker

Fig.6 Components

Fig.7 Acclerator

Fig.8 key

Fig.9 Brakes

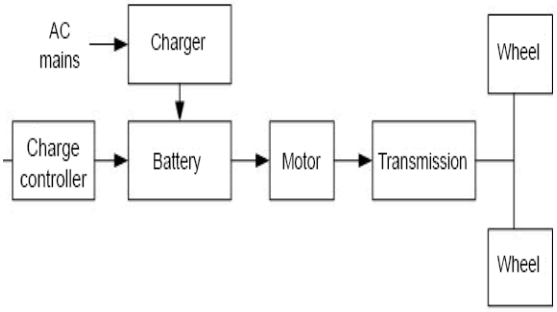
Fig.10 Charger

Fig.11 charge indicator

Fig.12 GPS tracker

Fig.13 odometer

4.BLOCK DIAGRAM:



5.ELECTRIC BYCYCLE:

Fig.14 E-Bycycle

6.TABLE:DESIGNED VS.COMMERCIALSYSTEM

Criteria	Designed System	Commercial System
Maximum speed	33 kmph	35kmph
Motor power	350Watts nominal	250Watts nominal
Assist type	Power on demand & Pedal assist	Power on demand or Pedal assist
battery	Lithium ion	Lead-Acid
Autonomy	20-22km	45-50Km
Total Mass	19-20kg	20Kg
Total cost	20,000/-	10,000/-

CONCLUSION:

In India , 77% of travelers are travelling for a distance less than 10km, a significant percentage of emissions can be reduced daily by shifting use of conventional motorized two wheels to a proposed plug in hybrid electric bicycle.It is observed that 2157 tons of CO_2, 178 tons of NOX and 4 tons of PM can be reduced. In addition,115 tons of HC,14.5 tons of CH_4 and 1.04 tons of SO_2 can be reduced per day. In

addition, the practicability of conversion of the bicycle to proposed plug-in hybrid electric bicycle is discussed in details along with the sizing of electric power train components. 250W of motor and 7.2AH, 12V of battery is sufficient for a distance travelling of 10 km with a maximum speed of 30kmph per hour. The health of millions of commuters can be improved along with the reduction of time of exercise by using the proposed methodology.

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