

DESIGN, ANALYSIS AND FABRICATION OF E-BIKE

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Abstract:- The main aim of this paper is to present the idea of designing E-BIKE with minimum cost as well as should have great efficiency. Electric bike which will be driven with the help of battery and thus provide required voltage to the Brushless DC motor. In this case both the wheels (rear and front) will be driven by BLDC motor. Electric vehicles make use of BLDC motors as the engines. No human effort is required for riding the bike.

Keywords: BLDC motor, Controller, Battery, Bicycle.

1. INTRODUCTION

1.1 LITERATURE REVIEW

[1] In 1993 Kumar, Binod, and H. Oman Electric bicycles powered with today's nickel-metal hydride batteries offer a 100-km range between recharges, and have a potential of 300 km when polymer batteries become available. These vehicles, when implemented by installing power kits on existing bicycles, can offer low-cost, pollution-free transportation for bringing education, health, and communication to remote areas in developing nations. Furthermore, solar-photovoltaic battery charging can avoid fuel cost. A controller for an electric bicycle must supply power that varies from zero to the propulsion-motor's rated peak, at motor speeds corresponding to bicycle speeds from zero to 48 km per hour (30 mph). With direct current propulsion motors, power can be controlled with pulse-width-modulated transistors. AC motors need variable frequency. Requirements for electric bicycle control were postulated and we developed controller configurations.

[2] In 1994 Morchin, William C. The usual battery powered electric bicycle has a conventional bicycle- frame, pedals, cranks, chain and freewheel assembly. Electric-propulsion replaces or supplements muscle power. An electric motor, gear reducer, battery and power controls were added. Average travel William C. Morchin, President Electric Bicycle Company speed compared to pedaled bicycles can be increased the order of 8 to 10 km/h (5 mph). Regenerative braking which in automobiles would capture the potential energy of descending slopes is not required. Bicyclist rarely uses brakes while coasting down paved hills. E-bikes powered with today's nickel-metal hydride batteries give a 100-km range between recharges and have a potential of 300 km when polymer batteries become available. The electric bicycle normally will not require registration, license or operator qualification. Unlike the gasoline powered bicycle it can be used to travel trails reserved for bicycles.

[3] In 1995 Oman, Henry, William C. Morchin, and Frank E. Jamerson. Introduced a paper in which they said, In a human-powered hybrid electric vehicle (HPHEV) the travel distance available from a single battery charge can be lengthened with power from another source, the cyclist's leg muscles. In a battery-powered electric bicycle the propulsion power goes mostly into 18 km per hour (11 miles per hour) this drag represents 200 watts at the tire-to-road interface for a typical cyclist's shape and clothing. Today's usual electric bicycle is propelled by a high-speed dc motor which is powered from a lead-acid battery. The combined efficiency of the motor and its speed overcomes aerodynamic drag. For example, at reducing gears is 50 to 65 percent. In this paper we calculate available travel distances, as a function of speed, grade, and the battery energy-content as measured in watt-hours per kg. We show the effects of battery cost and charge or discharge cycle-life on travel cost in terms of cents per kilometer travelled.

[4] In 2002 Lomonova, E. A. The paper discusses the generic mechanical, electromechanical, electromagnetic, control design and test approaches leading to the system integration, design solutions and physical implementation of electrically assisted bicycle as a result of the co-operative research work done by the Dutch Company - ID Bike and Technical University of Eindhoven.

[5] In 2016 Dumitrache, Florin, Marius Catalin Carp, and Gheorghe Pana said that, The electric vehicles industry is continuously evolving. A such electric vehicle is the electric bicycle (e-bike). Electric bicycles, like another electric vehicles, implement a BLDC motor (Brushless Direct Current Motor). This paper presents a way of designing and using an electronic module for an e-Bike. The paper shows how a low power, 8-bit micro-controller can be used to drive such a motor and also manage other useful functions on an e-Bike.

1.2 SCOPE OF WORK

Transportation makes use of the combustion of fossil fuels to produce energy converted into motion. Pollution is created by unburned hydrocarbons or other elements present in the fuel or air during combustion. Combustion liberates carbon dioxide also, the primary greenhouse gas. The use of fossil fuel used in the transport industries varies widely from region to region and city to city. Various factors can be identified as influencing the amount of emissions relating to the transport sector, and an effective strategy will need to be comprised of all these factors. They include the information about the amount that vehicles are used in a certain country or metropolitan area;

the age of the vehicle and the technology used in it; the limit to which vehicles are accurately maintained; the availability of right fuels and the extent to which they are used properly; and Atmospheric, climatological and topological conditions.

1.3 ADVANTAGES

Electric vehicles use Brushless Direct Current motors as the propulsion method. Due to the fact that the BLDC motors don't have brushes, they present some advantages over the DC brushed motors, from which we remember:

- (1) Longer life span
- (2) Lower EMI (Electromagnetic interference) radiation,
- (3) Noiseless operation,
- (4) Greater torque to motor size ratio.

Due to the geometry of the windings in the motor, the BEMF (back electro-motive force) produced by the motor when in generator mode can be of two types: (1) trapezoidal and (2) sinusoidal. The another thing can be of interest if the driven motor doesn't have Hall position sensors, and facilitates the calculation of the motor's rotor absolute angle.

Global warming is a major concern all around and to save Mother Nature, there are several policies, promises and pledges. With the ever increased emission of green-house gases, there is an increasing fear of pollution. With modern technology and innovation, transportation and communication have undergone a pattern shift.

The most necessary requirements of an electric vehicle are reduced design effort, lower cost, less depreciation, and optimization of the size and weight needed by the traction drive system.

2. OBJECTIVES

Following were the objectives decided for achieving this aim:

- 1) To provide a mode of transport which more user friendly and effortless.
- 2) To provide mode of transport which more convenient and does not effect on the environment.
- 3) To provide mode of transport which can use by all age group of people.
- 4) To provide mode of transport which more clean and energy efficient.

3. METHODS AND MATERIAL

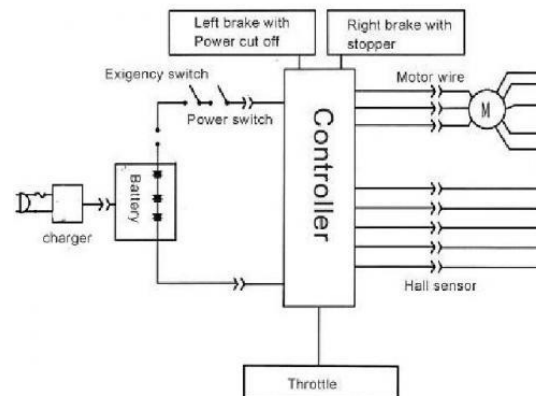


Figure - 1: Block diagram of the designed e-bike electric system



Figure - 2: E-BIKE photo.

The microcontroller receives information about the motor position (rotor angle), via signals generated by three Hall position sensors contained within the motor. Using this data, the microcontroller makes use of a simple commutation table and switches the six power MOSFET transistors which drive the BLDC motor. Internet based literature (images only) suggests that BLDC controllers used in commercial E-Bikes contain linear power supply. This is a main issue regarding power efficiency, due to the luminous power loss as heat in the internal power supply. One of the improvements this design brings is the use of a DC to DC step down converter, which greatly lowers the power consumption of the module and reduces the ambient temperature in the case of the module. The second important issue is that considering the fact that the electronics on an E-Bike must be housed in a water-proof enclosure. The user of the e-Bike receives relevant data (e.g. instantaneous speed, battery state of charging) from the motor controller via Bluetooth protocol and can view the data on a GUI (graphical user interface), i.e. on a smartphone.

By using a Bluetooth transmitter instead of a graphical display, the power consumption is more reduced.

Calculation of Motor Torque

Pedal length: 22cm i.e. 0.22m

Weight of human 60 to 90 KG (weight 1Kg=9.81N) Initial force in range between (15-20 Kg) and running condition very less force

Formula for Torque:

$$T = F * D \text{ (Distance)} \quad T = 20 * 9.81 * 0.22$$

$$= 43.16 \text{ NM (At initial)}$$

We required 43NM Torque at initial but very less for running condition

If we consider W = 15 KG Then, T = 32 NM

BATTERY

The 36-V, 4.8 AH battery is selected with the following performance specification as follows:

To calculate milliamp-hours (mAh) of the battery:

36 V & 350 Watts-hour motor is being used for the E-Bike.

Formula is,

$$\text{Watts-hour (Wh)} \times \frac{1000}{V} = (\text{mAh})$$

$$350 \times \frac{1000}{36} = 9722.22 \text{ mAh}$$

Suitable battery for the motor is of 36 V 4.4 ah

Voltage:	36 V 173 Wh
Maximum continuous discharge current:	9.3 A
Operating temperature:	20C - 60C
Charging time:	1.5hrs
Total Weight:	
Bicycle assembly:	15
Motor:	03x2
Battery & Controller:	1.2
Cyclist:	80
Total weight:	102.2

4. RESULTS AND DISCUSSION

In Simulation Motor takes current 4 to 5 Amperes and maximum speed up to 22 kmph. So According to calculation bike will go 22-25 km in single charge.

5. CONCLUSION

With the increasing use of natural resources of petrol, diesel it is important to shift our way towards alternate resources like the Electric bike and others because it is essential to identify new way of transport. Electric bike is a modification of the existing cycle by implementing electric energy and solar energy if solar panels are provided, that would sum up to increase in energy production.

6. REFERENCES

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