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# Embedded Based Emission-Free Vehicle with Solar Charging

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***Abstract*—The main aim of this paper is how to design a simple, cost-effective model of electrical bicycle with intelligent control system. A low-cost alternative to an automobile is a bicycle. The system design is based on mechanically coupling a dc motor as the primary power source to drive the bicycle and electrically wiring the motor together with a dc rechargeable battery and efficient transmission from the source to the motor. This paper compromises with design of Electric Bike which makes use of Electric energy as the primary source and solar energy if possible by attaching solar panels. Thus, the proposed system is the cost effective and efficient system satisfying the needs of the modern users.**



***Keywords—electrical bicycle, coupling, transmission, battery***


## I. INTRODUCTION

An e-bikes are bicycles with a battery-powered "assist" that comes via pedalling and, in some cases, a throttle. When you push the pedals on a pedal-assist e-bike, a small motor engages and gives you a boost, so you can zip up hills and cruise over tough terrain without gassing yourself. Called "pedelecs," they feel just like conventional bikes. There are many types of e-bikes available on the market, from small motor-only e-bikes to more powerful e-bikes that are closer to the modern cycle of operation than the human effort of pedal power. Electric bikes are a new and better alternative to urban transportation. These provide all the benefits of a regular cycle: fun exercise, zero elimination, lack of strength to eliminate the most serious shortcomings of cycling. E-bikes use rechargeable batteries and the lighter varieties can travel up to 25 to 32 km/h (16 to 20 mph), depending on the laws of the country in which they are sold, while the more high-powered varieties can often do in excess of 45 km/h (28 mph). There are also cases where E bike is safer than a regular bicycle. There are two main types of E-bike- throttle assist and pedal assist. An E-bike motor works by automatically switching on the (quiet) motor when you pedal or throttle. A pedal-operated E-bike is the most popular option. As you pedal the bike, the motor gets powered, and it works. In comparison, a throttle-assist E-bike is similar to a normal motorbike. It operates as you accelerate the throttle. Electric bicycles are available in many styles, from commuter bikes to full-suspension mountain bikes. The power output of these pedal-operated motors is typically governed by regulations. Mostly, they are available with an output power of around 250 watts. Bikes fitted with a throttle based motor system has slightly different output regulations. It can be available with a maximum power of around 200 watts, while speed remains limited to 25 kmph.

The concept of electric bicycles is far from new with the first known ideas being documented in American patents during the 1890's. One of the first (if not *the* first) designs was thought up by a man named Ogden Bolton Jr. who obtained a patent (US552271 A) in December 1895. Since then, various iterations have come about, the majority of which never caught on in terms of popularity or market success. Reasons for this mainly revolve around the electrical technology needed being big, bulky and expensive and it's not until developments in recent times which have made e-bikes possible. With the introduction of lighter and more compact batteries, components and electronics along with the industry investment to get to a point where the costs are viable both for production and consumer sales, e-bikes have now started to take a significant share of the market.

## II. COMPONENTS OF ELECTRIC BICYCLE

The E-Bicycle has the following components

### *A. BLDC Motor*

The BLDC motor used the rating of 250w.This motor has been fitted into tyre of E-Bicycle. There are different placements for an electric bike motor. Each has its benefits; front hub, rear hub and mid-drive motor.

Fig. 1. BLDC Motor

The specifications are as follows:

Rated voltage: -24v

Rated current: -10.4 amp

Rated power: -250w

Rpm: -300rpm

Design: -Brushless DC hub motor

### *B. Lead acid battery*

The batteries used are lead acid battery. the energy stored in these batteries is used to run the BLDC motor. The battery on an electric bike can be located in varying places on the bike, often dependent on frame type and size. Each battery make, model and type means that they will need to charge for different times. An average charging time is five to six hours.

The specification of battery are as follows:

Battery type: -Lead acid

Rating: - 2x12v, 7amp hr


Fig. 2. Lead acid battery

### *C. Speed controller*

The motor control algorithm employs PI closed-loop control. The power switches are controlled by means of sinusoidal pulse width modulation (PWM). The rotor position feedback hardware elements are Hall sensors. The motor is capable of rotating in both direction and has a speed range from 300rpm to 400rpm. The speed controller of an electric bike is an electronic circuit that not only controls the speed of an electric motor but also serves as a dynamic brake. This controller unit uses power from the battery pack and drives it to the hub motor. Different types of controllers are used for brushed and brushless motors. For adaptive e-bikes, a conversion kit is used and the controller is the main component of that kit.

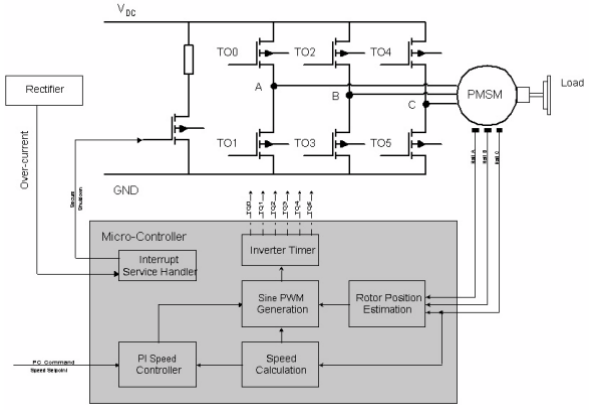


Fig. 3. Block of diagram of speed controller

### *D. Frame of E-Bicycle*

The frame is core structure on which the components as well as batteries are placed, it also provides the base for the rider.

### *E. Solar Panel*

The solar panel is a module consisting of several solar cells that are combined and connected in series and parallel depending on the size and capacity required.

The specification of solar panel are as follows:

Solar Panel 2 unit with capacity 20 Wp

Solar charge controller 24 Volt 2 Ampere

Fig. 4. Solar panel

## III. LITERATURE REVIEW

In 1999, AVL Company proposed a hybrid system that used a 50 carburetted lean-burn two-stroke engine with a 0.75 kW electric motor mounted on the engine crankshaft mainly to provide increased torque during acceleration.[1]

Su-Hau et al (2004) focused on the highly efficient energy usage of the battery energy and proposed an integrated management system for electric motor.[2]

David and Sheng-Chung (2004) proposed new parallel-type hybrid-electric-power system comprises an engine's energy distribution and a torque-integrated mechanism (specifically including an engine, a motor/alternator, a CVT device, and PCM as well as a 3-helical gear set).[3]

Wenguang et al (2005) presented an approach to control powertrain of series hybrid electric vehicles. A formulation of the system equations and controller design procedure were proposed by them. They also proposed a new switching algorithm for the power converter for motor torque and motor flux control.[4]

Daniel (2007) designed, developed and implemented a series hybrid electric vehicle. Though he proposed the architecture as hybrid electric vehicle architecture, he showed that the vehicle runs well in the electric mode and left the hybrid conversion as future expansion.[5]

Lukic et al (2007) tried to develop a driving cycle of the auto rickshaw in a typical large Indian city, in their case, Delhi. First, they considered the existing driving cycles used in India are considered as candidates. Since these data were not applicable, GPS data collected at various times of the day were applied to the analysis. They derived the new driving cycle from the gathered information via GPS data as well as surveys of auto rickshaw drivers in India, which helped to get the entire picture for the driving cycle.[6]

'Investigation of an electric assisted bicycle and determination of performance characteristics'' paper examines and realizes an alternative design for a front wheel hub direct drive, which utilizes a three-phase brushless PM motor.[7]

## IV. WORKING OF THE SYSTEM OF E-BICYCLE

Electric bikes use a motor to assist the movement of the pedals, making riding the bicycle less taxing. Some designs allow the bike to move forward under its own power from the motor while others require your assistance to pedal. The motor is capable of rotating in both directions. The speed controller of an e-bike is used to control the speed of the BLDC motor and all the necessary components are connected to this

controller. The speed controller of an electric bike is an electronic circuit that not only controls the speed of an electric motor but also serves as a dynamic brake. The electric bike speed controller sends signals to the bike's motor hub in various voltages. These signals detect the direction of a rotor relative to the starter coil. The proper function of a speed control depends on the employment of various mechanisms. In a purpose-built electric bike, Hall effect sensors help detect the orientation of the rotor. If your speed controller does not include such sensors and the speed controller on an adaptive bike may not the electromotive force of the undriven coil is calculated to get the rotor orientation.

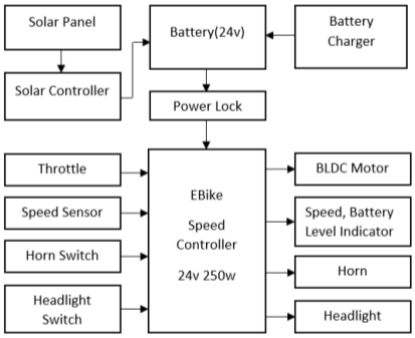


Fig. 5. Block of Electric Bicycle

## V. Mathematical Calculations & Results

As the BLDC motor is being used with 250watt power and 300 rpm with 24 volts and current rating of 10.4 amps. Motor can be reaching a peak current during starting equal to 12 amperes.

P=2*3.14*N*T/60
250=2*3.14*300*T/60
T=7.96 Nm of Torque is Generated.

## VI. Conclusion

This work was developed with the intent to project and build an electrically assisted bicycle adapted to the metropolis environment. It is a concept designed to create a better and versatile alternative to be used as mean of transportation in urban scenarios. With the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the Electric bike and others because it is necessary to identify new way of transport.

Electric bike is a modification of the existing cycle by using electric energy and also solar energy if solar panels are provided, that would sum up to increase in energy production. Since it is energy efficient, electric bike is cheaper and affordable to anyone. It can be used for shorter distances by people of any age. It can be charged with the help of AC adapter if there is an emergency. The Operating cost per/km is very less and with the help of solar panel it can lessen up more. Since it has fewer components, it can be easily dismantled to small components, thus requiring less maintenance.

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