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# Digital Electric Bike Controller System

M.Haritha
M.Tech Student, Institute of Aeronautical Engineering College,Dundigal, Hyderabad, Telanaga, India

**Abstract:***The pollution due to cars is actually escalating day by day time hence the dangerous levels in urban areas and cities are actually at unsafe levels because of to use of cars. The application of electric vehicles for short distance traveling will make it possible to decrease the contamination to some degree. The electric bike takes much more time for recharging the electric battery this's not feasible one this's the primary drawback of the current electric bicycle. This electric bicycle uses dc generator for generating power while running, uses solar panel when bicycle is at rest and a charger that operates from main power supply for charging the battery. This electric bicycle uses 24V 250W brushless direct current (BLDC) hub motor and Lithium ion (Li-ion) battery. The use of BLDC hub motor in the bicycle that avoids the complexity and losses while using the permanent magnet direct current (PMDC) motor. The Li-ion battery replaces the sealed maintenance free (SMF) battery which is used in existing electric bicycles. Li-ion batteries are having more advantages as compared to SMF batteries.This paper outlines system requirements to successfully develop and deploy an electric bike, focusing on system architecture, operational concepts, and battery management. Although there is little empirical evidence, electric bike could be feasible, depending on demand and battery management, and can potentially improve the utility of existing bike systems.*

**Keywords**:BLDC motor, controller, solar recharging, dynamo.

## I. INTRODUCTION

In transportation we've created quite a great deal by the assortment of hi-tech cars we've, also the benefits of bike can't be neglected. Bike is common in all of groups because it isnot hard to deal with by its light weight, and don't cost cash to run as it doesn't need gas to run, yet extremely effective in little distant traveling. It's several unique attributes, which makeit even special over some other vehicles, like they don't need registration fees, insurance, or perhaps driving license. Likewise it's much less susceptible to heavy casualties, therefore making it a safertransportation. Besides it's health advantages, just the exact same fashion as in any actual physical exercises.Like this, e-bike on the additional hand is actually an altered variation of the same. In e-bikes thedistinction comes by the application of the motor process, use of the controller to control the motor system, and with battery to Power it. The engine is utilized in order to provide externalenergy to make the drive comfortable. E-bike is much better than the regular bike because rider canget extra power when it's needed, if it's used that way. In this the driver has the choicewhen he's much less of power and not able to drive ahead easily, generally when there looks an uphill and energetic long road, he is able to change on the electric battery, and thereby triggers the motor.

Then motor compensates the necessary power and this way ride gets smoother all of the way.It's up to the driver as as he really wants to change on the energy. He is able to pick engine to propelall of the way for his assistance, or perhaps make use of it when he in fact needs. We will find once again several levelswhich the driver can easily select based upon the problem of the highway, and the quantity of speed that's ideal in riding. Likewise, there's throttle to make driving adjustable, eithercompensating speed for fewer strain, or perhaps get speed for higher strain, this's completely on the option of the riders' power and selection. When we attempt to deal with the ideal feature of e-bike,then we are able to point out that as there's very little strain while using e-bike that we see in normalbike driving uphill, thus it's simple to sum up that when there's much less strain, rider could travela long distance quite simply, there's likewise much less perspiration making user tidier once again, presenting options for broad range users.We need to realize, e-bike has a regular specification to meet, to ensure that it doesn't are available in the exact same category as a motorbike. The standard is actually varied from area to spot, but in Europeespecially Sweden, the existing limit is actually 250W maximum steady energy and fourthy

kg/88 lb.maximum mass with no cap on the peak power1. Whereas in the United States thislimitation is actually 750W. Though the usage of e-bike is actually an unique idea in Europe, but in India andChina it's developing very rapidly, just in China, e-bike at the time has grown by the total amount that it's outnumbering cars by 4 to 1.

## II. RELATED WORK

It's shocking to realize that the experiment carried out to create bike to run on power, was done quite a while ago. The record stated that the very first electric bikes had been alreadyavailable during 1890s [1]. Numerous patents during that time show that.On 19 September 1895, a patent application for an "electrical bicycle" was filed by Ogden Bolton Jr. of Canton Ohio (Patent number: 552271) [2]. The bike ran on 10 volt batteryenergy, in which the engine can draw strength up to hundred amperes. The hub engine was usedplacing in the rear wheel. During that moment gears was nonetheless a mystical idea for thebicycles. Thus, it was produced with no it [3].

On 8 November of the same year, another patent application for an "electric bicycle" wasfiled by Hosea W. Libbey of Boston (Patent number: 596272) [4]. During that time in 1897, Hosea W. Libbey from Boston state invented an electric bike thatran on the double electric motor. The motor having integrated within the hub of the rear wheel. Thismodel has been reused in various latest designs of e-bikes at present times [5].

It was by the year 1898, a belt connecting outer edge of the wheel to the motor patented in thename of Mathew J. Steffens. In the same year, John Schnepf tried a back wheel friction“roller-wheel” style drive electric bicycle. It was in 1969 a modification of the same versionwas done consisting of 4 motors connected in series with the support of clock-wheel gears.Torque sensors and Power controls were developed recently in the 90s. The well-knowncommercial e-bike named ‘Zike’ was the modern e-bike which was launched in 1992, duringthat time hardly any commercial e-bikes were present in the market. Japan experimented inthis and one patent relating to this under the name of Takada Yutky in 1997.

It was from 1993 onwards when well-known Japanese companies involved in producingcommercial e-bikes in huge numbers, it drew other companies’ attentions into this, byestimating the huge market potentials, as a result, the growth towards e-bikes increased by35%, leading to the downfall in the production of regular bicycles.

In 1989, Michael Kutter, the founder of ‘Dolphin E-bikes’ done the first initiation incommercially producing e-bikes in the market. After his attempt, a well-known motorbikecompany from Japan ‘Yamaha’ took the leap in developing commercial e-bikes, producing alarge number of e-bikes in the year 1994, giving the name ‘Power Assist’.

The earlier version of e-bikes or technically low quality e-bikes operated mostly on lesseffective lead acid batteries, which has less sturdiness to give full power to the motor, besidesthey are heavy and bulky, but in newer models there have been mostly selected NiMH,NiCad and Lithium-ion batteries, because they are light, powerful, and dense in theircapacity, giving possibility to drive long and fast, giving maximum durability in terms ofpower and performance.

The words associated with e-bikes which are in the range of bicycles are called by manydifferent names like ‘pedelec’, ‘pedal-assisted’, ‘power-assisted’ and simply ‘power bike’,whereas in bigger powered e-bikes they are termed as (electric motorbike or e-motorbike),having high range in speed and distance, almost can make around 80 km/h.There are usually three variations tested in the design of electric bikes. In the first one i.e. theparallel hybrid motorized bicycle, both human and motor inputs are mechanically coupledand transferred into one of the bicycle wheels. In the second, the mechanical series hybridbicycle, where both human and motor inputs are coupled through differential gearing.

## III. PROPOSED SYSTEM

Our attempt in this project is to add other recharging mechanism which can be used for reducing the dependency over the main supply for recharging the battery. The recharging mechanism uses a solar panel or a DC generator .The solar panel used for charging the battery when the bicycle is at rest and proper sunlight is available. This helps in reducing mains power consumption. The use of DC generator is for recharging the battery while riding is possible only when bicycle is not operated by motor. The DC generator designed and placed such that it does not generate noticeable stress on pedal of the bicycle while riding the bicycle.

The output from these sources is not constant at all time hence it cannot be used for recharging the battery. Constant output voltage can be obtained by using a DC-DC converter. A rectifier is also provided for recharging the battery by using main supply when the other two sources are not become capable of recharging the battery. A 250W BLDC hub motor is used for running the bicycle it is powered by using 24V 15Ah battery. Rider can make choice that the bicycle is completely driven by the motor or not. Bicycle speed is varied by using throttle the maximum speed of 20km/hour. For placing the BLDC hub motor with wheel in the bicycle we have done some alteration in the bicycle.

The BLDC hub motor is fitted with wheel that placed in the front side. Front side is chosen for placing Motor driven wheel is for connecting the DC generator to the back wheel of the bicycle. The protection of battery is another important factor for ensuring the safety for rider from battery explosion and for improving the battery life.

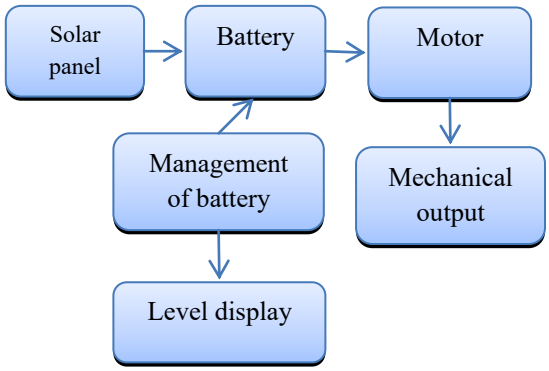


Fig.1Block diagram of Electric bicycle

**A. Brushless DC (BLDC) motors:**Brushless DC (BLDC) motors are synchronous motors consisting of armature windings onthe stator permanent and magnets on the rotor. The stator of a BLDC motor consists ofstacked steel laminations with windings placed in the slots and these stator winding can bearranged in two patterns i.e. a star pattern or delta pattern. The major difference between thetwo patterns is that the star pattern gives high torque at low RPM and the delta pattern giveslow torque at low RPM. There are many advantages of BLDC motor such as better speedversus torque characteristics, high dynamic response, high efficiency, long operating life,noiseless operation, higher speed ranges.


Fig.2 BLDC Motor

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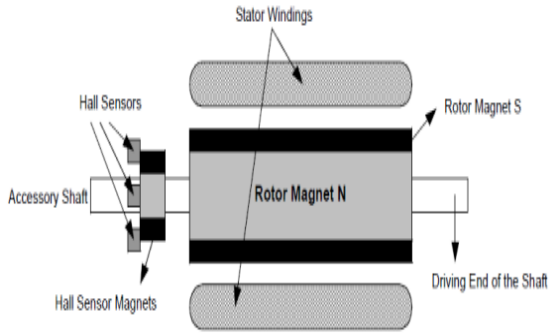


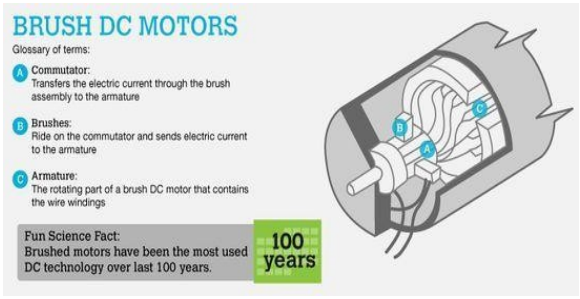

Fig.3 BLDC Motor transverse section

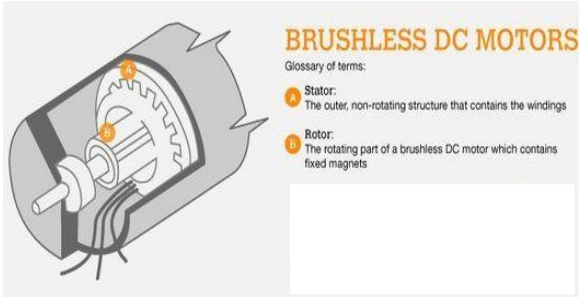
In this Fig.3 shows transverse section of a BLDC motor. The rotor has alternate N and Spermanent magnet s. The Hall sensors are embedded into the stationary part of the motor.Here hall sensors are connected with hall sensor magnet to detect the position of rotor. InBLDC motors the phase windings are distributed in trapezoidal fashion in order to generatethe trapezoidal waveform. The commutation technique generally used is trapezoidalcommutation where only two phases will be conducting at any given point of time.Typically BLDC motors have three phase windings that are wound in star or delta fashionand need a three phase inverter bridge for the electronic commutation. The brushless motorsare generally controlled using a three phase power semiconductor bridge. The motor requiresa rotor position sensor for starting and for providing proper commutation sequence to turn onthe power devices in the inverter bridge.

**Construction and Working Principle**:Brushless DC motors (BLDC) have been a much focused area for numerous motor manufacturers as these motors are increasingly the preferred choice in many applications, especially in the field of motor control technology. BLDC motors are superior to brushed DC motors in many ways, such as ability to operate at high speeds, high efficiency, and better heat dissipation. They are an indispensable part of modern drive technology, most commonly employed for actuating drives, machine tools, electric propulsion, robotics, computer peripherals and also for electrical power generation. With the development of sensor less technology besides digital control, these motors become so effective in terms of total system cost, size and reliability.

**Working Principle and Operation of BLDC Motor:**BLDC motor works on the principle similar to that of a conventional DC motor, i.e., the Lorentz force law which states that whenever a current carrying conductor placed in a magnetic field it experiences a force. As a consequence of reaction force, the magnet will experience an equal and opposite force. In case BLDC motor, the current carrying conductor is stationary while the permanent magnet moves.

When the stator coils are electrically switched by a supply source, it becomes electromagnet and starts producing the uniform field in the air gap. Though the source of supply is DC, switching makes to generate an AC voltage waveform with trapezoidal shape. Due to the force of interaction between electromagnet stator and permanent magnet rotor, the rotor continues to rotate.




**B. Dynamo:** In electric bike process, we make use of a dynamo for the development the electrical power. A dynamo isan electric generator they generate strength with the usage of a commutator. Here in electric bicycledynamo is actually positioned on the front wheel of the bike and dynamo commutator is actually associated with the front wheel of the bike. When the bike is actually running, at this particular problem by the assistance of wheel thecommutator is actually rotating and it creates the power. In dynamo use a rotating coil of wire andmagnetic, so it changes mechanical rotation into an electrical current through Faraday's law of induction. A dynamo is a basic generator which used to turn mechanical motion intoelectrical activity with the assistance of a magnet. It consists of impressive magnet as well as pole on whichcoil has been turned about. The rotating coil slices the series of magnetic force, there by inducingpresent to successfully pass through the wire. The physical power created by the rotation is thusconverted into electric current in the coil.

**C. Solar panel:** Right here we also make use of a solar panel for producing energy. With this bike, we're utilizing the 20W solar panel and it's attached to the 12V battery, consequently what help for charging the battery power. They charge the battery are actually through the usage of a solar panel. The solar panel changes power of sunlight directly into electrical energy through utilization of photovoltaic outcome. The solar panel is electrically attached to the module with a sheet of cup on top to permitted light pass and it protected the semiconductor from the weather. This solar panel is actually attached in series in the module and producing an extra voltage. In solar energy panel photons in the sun hit on solar panel and it absorbed by silicon materials. If sunlight absorbed by silicon afterward electron excited, if the electron is actually excited they dissipate the power and it travels through cellular until it gets to an electron. These electrons are just allowed to move in a single path, then solar energy cell converts solar power into direct current electrical energy.

**D. Lithium-ion batteries:** These are the most suitable in existing technology for electric vehicles because they can deliverhigh output because of having capability to store high power per unit of battery mass, allowing them to be lighter andsmaller than other rechargeable batteries. These features also explain why lithium-ion batteries are already widely usedfor consumer electronics such as cell phones, laptop computers, digital cameras/video cameras, and portableaudio/game players. Other advantages of lithium-ion batteries compared to lead acid and nickel metal hydride batteriesinclude high-energy efficiency, no memory effects, no self discharging and a relatively long cycle life. The electricbicycle uses battery having capacity of 24V 15Ah capacity.

## IV. RESULTS

Fig.4E-bike prototype

Fig.5 E-bike prototype with LCD

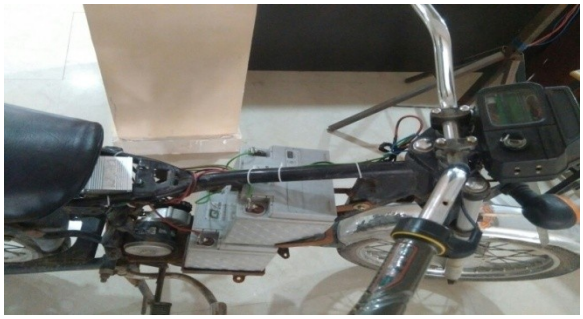


Fig.6 E-bike prototype with batteries

## V. CONCLUSION

The problems related to electric powered bicycles might be resolved by custom designed drives which are most effective during a specified operating cycle. The outcomes of the experiments listed here can certainly serveas a platform to boost electrical bicycle performance in case new drive systems are created around key parameters which will lead to improvement of the system efficiency.In addition, they might be utilized for comparison of existing drives in a systematically, extensive, and specialized means.The most vital feature of the electric bike is that it does not consume fossil fuels thereby saving crores of foreign currencies. The second most important feature is it is pollution free, eco – friendly and noiseless in operation. For offsetting environmental pollution using of on – board Electric Bike is the most viable solution. 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.

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