DESIGN AND DEVELOPMENT OF SELF POWER REGENERATIVE ELECTRIC-BIKE

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ABSTRACT

An Electric Bike uses an electric motor for the purpose of moving. There are many varieties of electric bikes.Brushed and brushless are the two important types of motors used in these bikes. An electric power assist system is also added to these bikes to make them more functional.Batteries used in this vehicle are lithium-ion batteries, nickel-cadmium batteries or any other. The parameters of the battery vary according to the voltage and capacity required for the vehicle. The type of controllers depends upon the motors used in the vehicle. The design of the bike is also very important. One of the most interesting designs is the folding bike. In this research, a traction system useful for an autonomous Electric Vehicle of individual use is described. The developed system is constituted in a first approach by two different power sources: one is constituted by batteries or by fuel cells and the other by super capacitors. According to the obtained results, a control strategy that allows an effective management of the stored energy in the system regarding the vehicle's optimal functioning and increasing its autonomy is also presented and discussed.In this research work design self-power generating electrical bike was developed. This design overcomes all the drawback of e- bike. Self-power generating electrical bike is nothing but the self-power generating bike that generate own power by using some arrangement of equipment and drive the bike without any external energy.

Key words:*Electric bike, Self-power, Regenerative, Energy storage, Electric power*

INTRODUCTION

Now a day's bike or vehicle is very important in our fast life for traveling and this is also play very important role in growth of economy but main drawback this bike and vehicle is produce pollution in environment because of burning fuel. For this reason increases global warming and also storage of fuel is limited. Due to that now day need of eco-friendly technology for traveling. E-bike (electrical bicycle) this is nothing but one example of eco-friendly technology.In the resentful scenario, e-bike use has gradually increased in America, Europe and particularly Chinese transport. Eleven per cent of e-bikes have been used in Germany for one day [1]. The uses of lightweight materials like carbon fiber and aircraft standard aluminum have greatly reduced weight [2].A year-long investigation into electric bike adequacy for an enormous tropical grounds, recognizing boundaries to bike utilize that can be defeated through the accessibility of open utilize electric bikes [3]. Electrically determined vehicles utilizes the battery as a wellspring of vitality which gives capacity to the engine which thusly give force to wheels [4]. The general effectiveness of the bicycle will be improved by taking a shot at the boundaries talked about before [5]. E-bike doesn't devour important petroleum derivatives consequently sparing umber of unfamiliar monetary forms. It is ecofriendly and contamination free, as it doesn't have any emanations [6]. Execution and ecological investigation of an inventive e-bicycle by methods for a unique model furnished with a reasonable control for the administration of the helped drive of the e-bicycle [7]. Investigation of financially accessible steel tube sets on the firmness attributes of bike outlines [8]. E-motorbike includes highlights like man-made consciousness, silent activity, low vehicle running cost, light weight vehicles [9]. Improvement of electric bike execution is accomplished if new drive frameworks are structured around key boundaries [10]. The regenerative braking system (RBS) is a proficient framework to diminish vehicle emanation and fuel utilization [11]. In an electrical bike, the framework happens because of the regenerative force managing to forestall a DC-interface over-voltage condition [12]. The ordinary mode with two-wheel drive can be utilized for battery power recovery and for self-adjusting [13]. Regenerative slowing down alludes to a cycle in which a segment of the motor vitality of the bicycle is put away for a present moment by the capacity framework [14]. An upgraded regenerative slowing down methodology for two-wheeled vehicles is depicted [15]. The evaluated separation is one of the key components to restrict the advancement of electric vehicle (EV) [16]. The

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exploratory test apparatus can mimic the safe force of a foreordained track and it intends to test and to advance the control procedure accessible on the electronic control unit [17]. Another electric stopping mechanism is proposed for a brushless DC (BLDC) engine driven electric vehicle (EV). This new slowing mechanism is created by joining different regenerative strategies and stopping [18].Some of these bikes have a rechargeable battery. This makes it easy to power the bike whenever you want. They make use of stored electrical energy in some or the other form. Due to this form of energy, the bikes have more power and speed. These bikes are more convenient than regular ones.

The world's car usage is booming. Cars are polluting the world's cities, dumping increasing amounts of carbon dioxide and other climate-altering greenhouse gasses into the atmosphere, and consuming vast quantities of petroleum. The alarming reality is that the automobile usage is growing at a much faster rate than the human population, with saturation nowhere in sight. If present trends continue, over 3 billion vehicles could be in operation by the year 2050, exceeding 20 cars per 100 people. Even then, world car ownership rates would fall far short of current U.S. rates of 70 cars per 100 people. Nowadays, the price of oil keeps on increasing. People want to use electricity instead of oil to operate transport. In China, the industry of electric bikes has grown rapidly in these 10 years. The design of electric bikes trends to more environmentally friendly. In this project, a electric powered bike was designed. The materials used are more environmentally friendly and the cost is much lower than the existing electric powered bike. The maximum speed of the bike is 35km/ hr. The charging time by using electricity is 6-8 hours. We have analyzed the market for of electric bikes to understand the needs of its citizens. The target customers want to have an electric bike with a light weight and don't need to recharge frequently. They also care about the safety of the bike.Project Background A method of upgrades a conventional electric powered bike that is powered by an electric motor which gets its supply from Dynamo connected to the Motor. The Dynamo must be mounted and installed at the bike without compromising riding comfort ability. The method employs an electric motor that are easily connected and separated for ease of transport.

METHODOLOGY

This research work is the way of using the outgoing power and producing both from rotation of Motor and Rear wheel. This project consists of a rechargeable battery pack which powers a light weighted motor unit. The Self charged electric bike approach is different. It works inany situation while the bike is in running condition.A Regenerative electric bike is an electric vehicle powered by completely or significantly by direct Mechanical energy. The 350w Dynamo is connected with the motor shaft by chain drive.While the motor is running the dynamo which is connected to it then it rotates and generates power as it reaches it is maximum of 2750rpm.Then it directly connected to the battery with supplying constant voltage. Rechargeable battery is used with long life for charging. An electric motor converts electrical energy into mechanical energy. Most electric motors operate through the interaction of magnetic fields and current-carrying conductors to generate force.

ELECTRIC BIKE DESIGN

It used high quality parts. You can get a turn-key electric motor kit, or a readymade e- bike for, but of course the motors and batteries Weight at 40kgs.

Brakes - The old brakes on this bike were okay for 35kmph. Brake Type Front and rear is Mechanical Expanding Shoe Type.

Frame – The parts can take the additional power and weight of the engine framework. The more extensive wheels particularly are greatly improved for the extra weight and force. Likewise, a steel outline is simpler to weld or braze engine and battery mounts onto. Avoid aluminum except if you can calculate an approach to jolt or clip everything on without welding. Welding onto an aluminum edge will probably demolish the hardening and seriously debilitate it. It's very hard to weld on slender aluminum. The curious calculation of the edge configuration really makes an ideal spot for the engine. We need to weld an engine mount onto the base casing close to the middle stand. The chain just clears the haggle and it was basic to get the engine firmly mounted. With such a ground-breaking engine, the engine mount must be solid, and it's truly entirely critical to have a great time bearing engine. The engine mount is removable from the edge with three Allen head screws. We have a Circular segment welding to which we can

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make a mellow steel plate slice into needed to mount the engine on it. The plate is welding with the bicycle body outline and the engine is put on it. The batteries likewise have a strong welded-on mount with a screw-down top holding rail. The batteries are hefty and need a decent strong mount with stun cushioning. For Batteries a strong casing is welded and it is set over the engine by welding it the two sides.

Figure 1. Electric bike working model

Figure 2. Rear Wheel Setup**Figure 3.**Battery and Motor Setup

PARTS OF THE ELECTRIC BIKE

The parts of an electrical bike has been explained below those are

1. D.C. Electric motor
2. Battery
3. A speed controller or motor controller
4. DC Generator
5. Throttle

DC ELECTRICMOTOR

An electric engine changes over electrical vitality into mechanical vitality. A 750W brush less sort DC engine is utilized in electric bicycle. A brushless DC electric engine (BLDC engine or BL engine), otherwise called electronically commutated engine are coordinated engine fueled by DC power by means of an inverter or exchanging power gracefully which delivers an air conditioner electric flow to drive each period of the engine through a shut circle regulator. The regulator gives beats of current to the engine windings that control the speed and force of the engine. Electrical gear frequently has at any rate one engine used to pivot or dislodge an article from its underlying position. There are an assortment of engine types accessible like enlistment engines, servomotors, DC engines (brushed and brushless), and so on. To be utilized relying on the application necessities. Most new structures are slanted towards Brushless DC Engines. BLDC engines are better than brushed DC engines from multiple points of view, for example, capacity to work at high speeds, high proficiency, and better warmth dispersal. They are an essential piece of current drive innovation, most normally utilized for inciting drives, machine apparatuses, electric impetus, apply autonomy, PC peripherals and furthermore for electrical force age. With the improvement of sensor-less innovation other than advanced control, these engines have gotten successful regarding absolute framework cost, size and unwavering quality. A brushless DC engine is a changeless magnet simultaneous electric engine which is driven by direct flow (DC) power and it achieves electronically controlled correspondence framework (correspondence is the way toward creating force in the engine by changing stage flows through it at proper occasions) rather than a precisely.

CONSTRUCTION OF DC ELECTRIC MOTOR

BLDC motors have many similarities to AC induction motors and brushed DC motors in terms of construction and working principles respectively. Like all other motors, BLDC motors also have a rotor and a stator. BLDC motors can be constructed in different physical configurations. Depending on the stator windings, these can be configured as single-phase, two-phase and three-phase motors. However, three-phase BLDC motors with permanent magnet rotor are most commonly used.

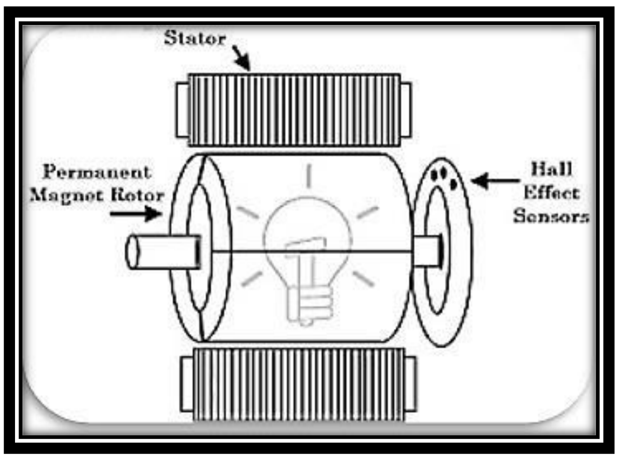

Figure 4.DC Brushless Motor

STATOR

Stator of a BLDC engine comprised of stacked steel overlays to convey the windings. These windings are set in spaces which are pivotally sliced along the internal fringe to the stator. These windings can be organized in either star (Y) or Delta (Δ). The significant contrast between the two examples is that the Y designs gives high force at low RPM and the Δ designs gives low force at low RPM. This is on the grounds that in the Δ arrangement, half of the voltage is applied over the winding that isn't driven, consequently expanding misfortunes and, thusly, effectiveness and force. Most BLDC engines have three stage star associated stator. Each winding is developed with various interconnected curls, where at least one loops are put in each opening. So as to frame a considerably number of posts, every one of these windings is disseminated over the stator fringe. The stator must be picked with the right evaluating od the voltage relying upon the force flexibly ability. For mechanical technology, car and little inciting applications, 48 V or less voltage BLDC engines are liked.

Figure 5. Stator

ROTOR

BLDC motor incorporates a permanent magnet in the rotor. The number of poles in the rotor can vary from 2 to 8 pole pairs with alternate south and north poles depending on the application requirement. In order to achieve maximum torque in the motor, the flux density of the material should be high. A proper magnetic material for the rotor is needed to produce required magnetic field density. The rotor can be constructed with different core configurations such as the circular core with permanent magnet on the periphery, circular core with rectangular magnets, etc.

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Vol-11 Issue-01 2021

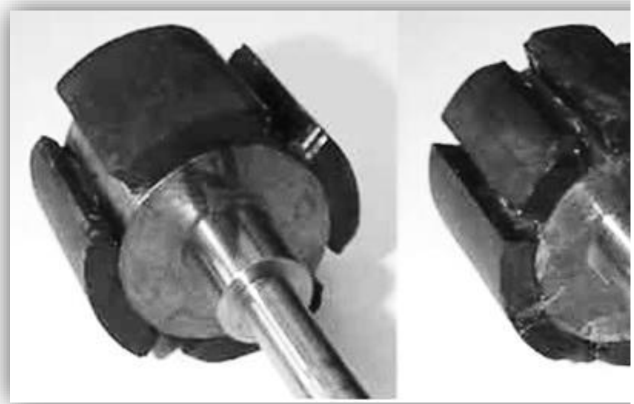

Figure 6.4 pole 8 pole permanent magnet Rotor

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.Consider the figure below in which motor stator is excited based on different switching states. With the switching of windings as High and Low signals, corresponding winding energized as North and South poles. The permanent magnet rotor with North and Soth poles align with stator poles causing motor to rotate.Observe that motor produces torque because of the development of attraction force (when North-South or South-North alignment) and repulsion forces (when North- North or South-South alignment). By this way motor moves in a clockwise direction.

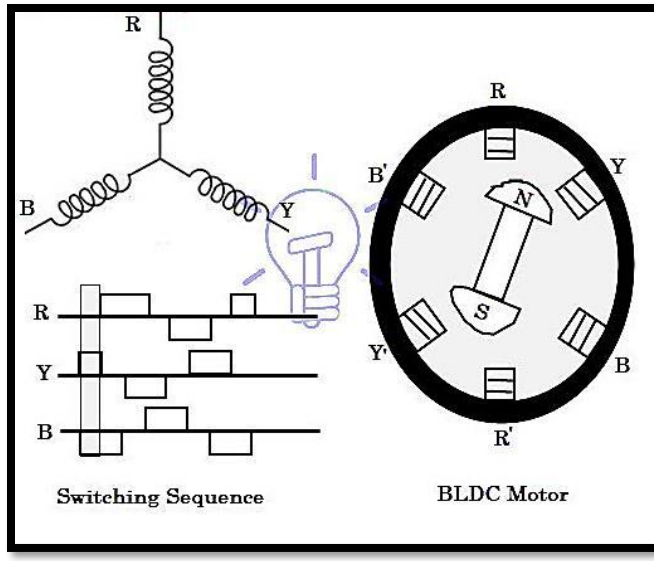

Figure 7. Switching Sequence of DC BLDC Motor

Here, one might get a question that how we know which stator coil should be energized and when to do. This is because the motor continuous rotation depends on the switching sequence aroung the coils. As discussed above that Hall sensors give shaft position feedback to the electronic controller unit.Based on this signal from sensor, the controller decides particular coils to energize. Hall-effect sensors generate Low and High level signals whenever rotor poles pass near to it. These signals determine the position of the shaft.

MOTOR CALCULATIONS

BIKE SPECIFICATIONS

Wheel Base = 1285mm

Length * Width * Height = 2016mm * 740mm * 1055mm

Suspension front = 125mm fork travel,

TelescopicKerb weight = 180 Kg

Suspension Rear = 100mm rear wheel travel

Teeth on rear wheel (TR) = 48

Teeth on drive motor (Td) = 15

$$Gear\ Rato = \frac{T_R}{T_d} = \frac{48}{15} = 3.2$$

SELECTION OF MOTOR

1. Weight of the vehicle (N) = Mass * g= 170 * 9.81= 1667.7 N
2. Vehicle speed (v) = 33Km/hr.
3. Wheel radius (r) = 25cm

1. ROLLING RESISTANCEFORCE

Rolling Resistance Force (F_{rr}) = f* m * g

Where,

f= coefficient of rolling resistance = 0.02

$$F_{rr} = 0.02 \times 1667.7 = 33.35\ N$$

2. AERODYNAMIC DRAG FORCE

Aerodynamic Drag Force (F_{ad}) = 1/2 * Cd * ρ * Ac/s * V^2

Where,

Cd = Drag coefficient (Cd = 0.5)

$A_{c/s}$ = Frontal cross sectional area

ρ = Air flow density (ρ = 1.225 Kg/m^3)

$$F_{ad} = \frac{1}{2} \times 0.5 \times 0.74 \times 1.055 \times 1.225 \times (9.17)^2 = 20.08\ N$$

3. GRADIENT RESISTANCE FORCE

Gradient resistance force (Fhr) = f * mg* sin θ

Where,

f = coefficient of rolling resistance

θ = inclination angle

Total resistance force = Frr + Fad + Fhr

F_{tot} = 33.35 + 20.08 + 5.79 =59.22 N

Torque required for wheel (T_w) in Nm

Tw = F_{tot} * r = 59.22 * 0.25 = 14.8 Nm

T_W 1 = 14.8 Nm

Torque required for motor in Nm

$$T_m = \frac{T_W}{\eta \times G} = \frac{14.8}{0.8 \times 3.2} = 5.78\ Nm$$

Rpm for wheel = (Vehicle speed)/ (2*Π * radius of wheel)= 550/ (2*Π *0.25) = 350.32 rpm

Rpm for motor = Gear ratio * rpm of wheel= 3.2 *350.32 = 1121 rpm

Power required for motor (P) = Torque * (2*Π* N)/60= 5.78 * (2*Π* 1121)/60 = 678.17 Watts

Power (P) = 678.17 Watts

BRUSHLESS DC MOTOR DRIVE

As described above that the electronic controller circuit energizes appropriate motor winding by turning transistor or other solid state switches to rotate the motor continuously.The figure below shows the simple BLDC motor drive circuit which consists of MOSFETBridge (also called as Inverter Bridge), electronic controller, hall effect sensor and BLDC motor.Here, Hall-effect sensors are used for position and speed feedback. The electronic controller can be a microcontroller unit or microprocessor or Digital Signal Processor (DSP) or A Field-Programmable Gate Array (FPGA) unit or any other controller. This controller receives these signals, processes them and sends the control signals to the MOSFET drive circuit.In addition to the switching for a rated speed of the motor, additional electroniccircuitry changes the motor speed based on required application. These speed control units are generally implemented with Proportional–Integral–Derivative (PID) controller to have precise control. It is also possible to produce four-quadrant operation from the motor whilst maintaining good efficiency throughout the speed variations using modern drives

TORQUE AND EFFICIENCY

For the study of electric motors, torque is very important term. By definition, torqueisthe tendency of the force to rotate an object about its axis.

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Vol-11 Issue-01 2021

Torque (Newton-meters) = Force (Newton) * Distance (meters)

Thus, to increase the torque, either force has to be increased. Which requires stronger magnets or more current or distance must be increased for which bigger magnets will be required. Efficiency is critical for motor design because it determines the amount of power consumed. A higher efficiency motor will also require less material to generate the required torque.

$$\text{Efficiency} = \frac{Output\ Power}{Input\ Power}\ \%$$

Where,

Output Power = Torque * Angular Velocity

And Input Power = Voltage * Current

Having understood the above provided equation, it becomes important to understand the speed vs. Torque curve.

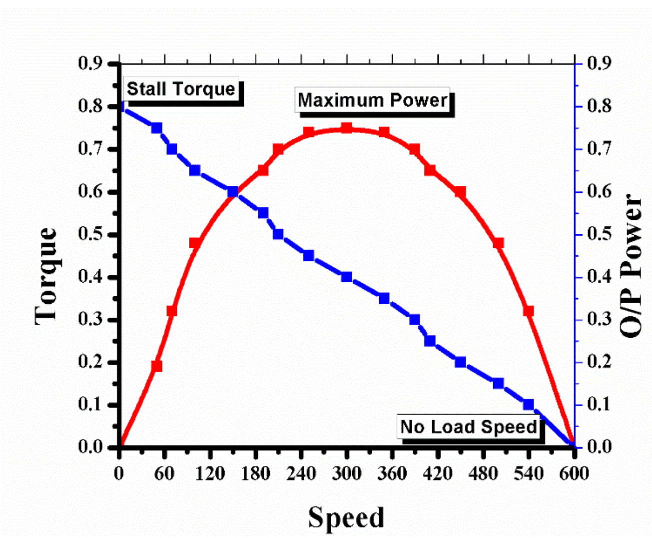

Figure 8. Speed-Torque-Power Curve

From the graph: -With an increase in speed, the torque reduces (considering the input power is constant).A Maximum power can be delivered when the speed is half of the "no load" speedand torque is half of the stall torque. Specifications of BLDC motor has been given below figure.9

Table 1.BLDC Motor Specifications

Rated operating voltage	**48V**
Rated Power	**750watts**
No Load Current	**4Amps**
Rated Torque	**77 kg-cm**
Rated speed	**450 rpm**
Rated current	**13.4 A**
Efficiency	**80 %**
Gear ratio	**1:6**

BATTERIES USED IN E-BIKE

In this work EV's construction up to now involved many mechanical aspects involving transmissions, gear ratios, geometry, and other design considerations. Here, it reviews the electrochemical actions that turn chemical energy into electrical energy. In essence, your batteries are your fuel tank. The goal of your fuel tank (batteries) is to achieve the greatest storage possible in a limited space, giving your EV as much range as possible.While battery development and advancements are an ongoing process, for this EV conversion, I will assume that lead-acid batteries will be the battery of choice. Considering this conversion and the limited space available, it is option for advanced battery technology to cram more power in a smaller space. The batteries may represent the largest replacement-cost item and possibly your largest initial- expense item depending on the number and type of battery you use. The cost of batteries for your EV should be half to one-quarter what a normal EV conversion might cost depending on the size of conversion. Considering this cost savings, you might be able to spend a little more money on advanced batteries. Remember, the batteries are the heart of your EV, one of three very important areas that are crucial in your EV build.

BATTERY CALCULATIONS

Motor Specifications: Power =750W and Voltage=48V

Battery Specifications: Voltage = 12V, Capacity =26Ah and Quantity =4

ENERGY CALCULATIONS

$$Energy\ consumed\ by\ motor\ in\ 3\ hr.$$
$$= Power \times Time = 750 \times 3$$
$$= 2250Wh$$

$$Energy\ stored\ in\ battery = Capacity \times Voltage$$
$$= 26 \times 48 = 1248\ Wh$$

$$Discharging\ Time(with\ power\ loss)$$
$$= \frac{Capacity \times Voltage}{Power\ Load} = \frac{26 \times 48}{750}$$
$$= 1.66\ hrs.$$

$$Discharge\ time\ (with\ power\ loss\ of\ about\ 25\%)$$
$$= \frac{Capacity \times Voltage}{Power\ Load} = \frac{1.66 \times 75}{100}$$
$$= 1.248\ hrs.$$

CHARGING TIME REQUIRED FOR BATTERY

$$Charging\ time\ of\ battery\ (\ without\ any\ power\ losses)$$
$$= \frac{Battery\ Ah}{Charging\ current} = \frac{26\ Ah}{13\ A} = 2\ hrs.$$

$$Charging\ time\ of\ battery\ (with\ power\ loss\ of\ about\ 25\%)$$
$$= \frac{Battery\ Ah}{Charging\ current} = \frac{2 \times 75}{100} = 1.5 hrs.$$

$$Charging\ time\ required\ for\ 26Ah\ battery\ with\ 25\%\ power\ loss$$
$$= \frac{26\ Ah \times 25}{100} = 6.5\ Ah$$

Battery rating would be 26Ah + 6.5Ah = 32.5 Ah

$$Required\ charging\ current\ for\ time\ of\ battery$$
$$= \frac{32.5\ Ah}{13\ A} = 2.5\ hrs.$$

$$Battery\ Life = \frac{Battery\ Capacity\ \times Run\ time\ \%}{Load\ Current}$$
$$= \frac{26\ Ah \times 0.7}{13\ A} = 1.4\ hrs.$$

LEAD ACID BATTERIES

In the lead acid cells the negative plates have a spongy lead as their active material, whilst the positive plates have an active material of lead dioxide. The plates are immersed in an electrolyte of dilute sulfuric acid. The sulfuric acid combines with the lead and the lead oxide to produce lead sulfate and water, electrical energy being released during the process.The overall reaction is:

$$Pb + PbO_2 + 2H_2SO_4 \leftrightarrow 2PbSO_4 + 2H_2O$$

The reactions on each electrode of the battery are shown in Fig. 2. In the upper part of the diagram the battery is discharging. Both electrode reactions result in the formation of lead sulfate. The electrolyte gradually loses the sulfuric acid, and becomes more dilute.When being charged, the electrodes revert to lead and lead dioxide. The electrolyte also recovers its sulfuric acid, and the concentration rises.The lead acid battery is the most commonly used rechargeable battery in anything but the smallest of systems. The main reasons for this are that the main constituents (lead, sulfuric acid, a plastic container) are not expensive, that it performs reliably, and that it has a comparatively high voltage of about 2V per cell. The overall characteristics of the battery are given in Table2.A good estimate of the internal resistance of a lead acid battery is thus:

$$R = No.of\ Cells \times \frac{0.022}{C_{10}}\ Ohms$$

Table 2. Lead Acid Battery Parameters

Specific Energy	**20-30 Whkg^{-1} Depending on usage**
Energy Density	**54-95 WhL^{-1}**
Specific Power	**~ 250 WKg^{-1} Before Efficiency falls very gently**
Nominal Cell Voltage	**2 V**
Amp hour Efficiency	**~ 80% Varies with rate of discharge & temperature**
Internal Resistance	**Extremely Low, ~ 0.22_Per cell for 1 Amp hour cell**
Commercially Available	**Readily available for several manufacturers**
Operating Temperature	**Ambient, Poor performance in extreme cold**

Self-Discharge	~ 2% Per day but see the text below
Number of Life Cycles	Up to 800 to 80 %Capacity
Recharge Time	8 h (But 90% recharge in 1 h is possible)

THE LITHIUM ION BATTERY

The lithium ion battery was introduced in the early 1990s and it uses a lithited transition metal intercalation oxide for the positive electrode and lithiated carbon for the negative electrode. The electrolyte is either a liquid organic solution or a solid polymer. Electrical energy is obtained from the combination of the lithium carbon and the lithium metal oxide to form carbon and lithium metal oxide.The overall chemical reaction for the battery is:

$$C_6Li_x + M_yO_z \leftrightarrow 6C + Li_xM_yO_z$$

The essential features of the battery are shown in Table 3. An important point about lithium ion batteries is that accurate control of voltage is needed when charging lithium cells. If it is slightly too high it can damage the battery, and if too low the battery will be insufficiently charged. Suitable commercial chargers are being developed along with the battery.

Table 3. Lithium ion Battery Parameters

Specific Energy	90 Whkg^{-1}
Energy Density	153 WhL^{-1}
Specific Power	300WKg^{-1}
Nominal Cell Voltage	3.5 V
Amp hour Efficiency	Very Good
Internal Resistance	Very Low
Commercially Available	Only in very small cells not suitable for electric vehicles
Operating Temperature	Ambient
Self-Discharge	Very Low ~ 10 % Per moth
Number of Life Cycles	> 1000
Recharge Time	2 – 3 h

STATE OF CHARGE

State of charge (SOC) is the amount of energy left in a battery compared with the energy it had when it was fully charged. This gives the user an indication of how much longer a battery will continue to perform before it needs recharging. Battery voltage, internal resistance, and amount of sulfuric acid combined with the plates at any one time are all indicators of how much energy is in a battery at any given time. Frequently, this is given as a percentage of its fully charged value; for example, “75 percent” means that 75 percent of the battery’s energy is still available and 25 percent has been used. Traditionally, the specific gravity of the electrolyte was measured using a hydrometer, the device used to measure specific gravity. As the battery discharges, its active electrolyte, sulfuric acid, is consumed,and the concentration of the sulfuric acid in water is reduced. With reduction of the sulfuric acid, the specific gravity becomes less. It was common practice with flooded lead-acid batteries to use a hydrometer. The hydrometer worked fairly well, but with some inaccuracy and ability to contaminate battery cells. With the latest sealed batteries and new battery chemistry, measurements are no longer done this way. The below given figure 9 shows that Glass tube hydrometer measuring specific gravity in a battery cell.

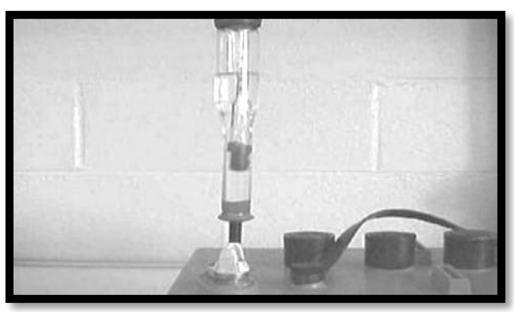

Figure 9. Glass tube hydrometer

A SPEED CONTROLLER OR MOTOR CONTROLLER

There are mainly two types of controllers which are designed to be effective on two types of motor, one is brushed, and another is brushless. According to the motor in use the controller function also varies. Brushless motors are popular nowadays because of high efficiency and durability, and it is also supported by the reduced cost factors, whereas brushed motors because of less complex controller mechanism, is still in use fairly.

CONTROLLERS USED IN BRUSHLESS MOTORS

There are various sensors used to check and control the speed movements. To do this quite efficiently, Hall sensor is used. The reason is also that e-bike requires strong initial torque to complement the low powered motor; this mechanism to control with safe the speed, the sensor has special functions to monitor the speed accurately. Various electronic controllers provide real time data input to the controller to 34react according to the situation. Usually the measuring values by the sensor are the ongoing force, and the present speed of the vehicle. The controllers work with closed-loop speed control mechanism for precise speed control, by adjusting the speed and also over-voltage surge, over-current input, or other levels of protections. Controller uses PWM (pulse width modulation) to adjust the power input to motor. In some e-bikes regenerative braking system brings additional role of power generation and management from the controller. In short, it has to maintain safety. The main specifications used in this e-bike controller are given below table 4.

Table 4.E – Bike controller specifications

Voltage	DC 48V
Under Pressure	42V±1
Current Limit	24A ±1
Level Brake	Low
Turn The Voltage	1-4.2V
Phase Angle	120 degrees
Power	750W

DC GENERATOR

The most and main important component in design of self-power generating bike is dc generator because power generator is done by this generator. Generator is nothing but the machine that convert mechanical power into electrical power. It is based on the principle of production of dynamically (motionally)induced e.m.f (electromotive force).whenever a conductor cuts magnetic flux, dynamically induced e.m.f. is produce in it according to faraday's laws of electromagnetic induction. in this design I have use dc generator because dc generator having advantages over ac generator such as no conversion of supply is required from ac to dc there for it may be chap and design having low Weight. The below figure 10 shows that the DC Generator used in the e-bike

Figure 10.DC Generator

PMDC MOTOR (PERMANENT MAGNET DC MOTOR)

ISSN: 2278-4632
Vol-11 Issue-01 2021

Figure 11.PMDC Generator

Permanent magnet DC brushed motors (PMDC motors) consist of permanent magnets, located in the stator, and windings, located in the rotor. The ends of the winding coils are connected to commutator segments that make slipping contact with the stationary brushes. Brushes are connected to DC voltage supply across motor terminals. Change of direction of rotation can be achieved by reversal of voltage polarity. The current flow through the coils creates magnetic poles in the rotor that interact with permanent magnet poles. In order to keep the torque generation in same direction, the current flow must be reversed when the rotor north pole passes the stator south pole. For this the slipping contacts are segmented. This segmented slip ring is called commutator.

THROTTLE

A throttle was needed to provide a user interface to the moter. The thottle needed to be rugged and bike mountable. This throttle uses the Hall - effect sensor, insted of the variable resistor sometimes found in electric throttles. Twisting the throttle varies the strength of the mangetic field adjecent to the sensor, which sends a corresponding voltage.By using the Hall- effect sensor, the throttle is more rugged and reliable as there are no moving electrical components, in contrast to the variable resistor which can wear over time.

Figure 12. Throttle

MANUFACTURING THE BIKE WITH LI-ION BATTERY

The below table shows that the estimation cost for manufacturing of the e-bike with lithium ion battery, This cost of the e-bike may be varies with different batteries, the cost estimation of the e-bike generally depends up on the parts which are used in the e-bike, in this research we have mentioned the cost of the individual parts of the electric-bike. Individual parts which are used in the e-bike are given below those are:

Frame manufacturing

Battery, motor and generator

Battery charger

Miscellaneous parts

CONCLUSION

It is clearly seen that the electrical bike gives a clean and more economical solution to the energy crisis. People use bikes and fuelled vehicles for even travelling short distances without making use of bicycles and other non – fuelled vehicles. Most number of people from the list have been those which think riding a cycle is equivalent to providing extra effort for cycling. In order to avoid this electric assistance has been provided to the cycle that will ease the user to ride the unit with the help of a motor. Even the hardship of climbing slopes and riding on rough terrains has been reduced. All these aspects are available keeping in mind the factor of pollution being affected at all. The factors that our prototype design of bike provides to the raider are:

1. Simplified riding with minimal effort on flat as well as gradients.

2. Easiness of riding on rough terrains.

FUTURE SCOPE

By becoming an e-bike owner in 2019 you place yourself at the forefront of a transportation movement that's revolutionizing cycling, especially as it becomes increasingly important for Americans to find affordable, quick, easy, and convenient ways to get around. With a huge jump in e-bike ownership in the last 7 years and plenty of room to grow, the U.S. electric bike market will continue to expand quickly. Some analysts predict that within 10-15 years, U.S. will become one of the largest electric bike markets in the world, with millions of e-bikes sold each year.One of the key reasons for the rapid growth in ebike use is improved technology—as batteries and motors have become more efficient, durable, and lightweight, electric bikes have become increasingly viable vehicles for everyday travel. These improvements are also what make now such an opportune moment to become an ebike owner. With today's super-efficient, lightweight components, an electric bike can empower you to travel conveniently and affordably, all while having a good time.

REFERENCES

[1] K. Schleinitz , T. Petzoldt , L. Franke-Bartholdt , J. Krems , T. Gehlert, The German Naturalistic Cycling Study – Comparing cycling speed of riders of different e-bikes and conventional bicycles, ScienceDirect-Ekseveir July- 2015

[2] AjinkyaParab, AnkitKamath, SatwantSinghRajpurohit, ZeeshanMulla , Urban Electric Bike , IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 02, 2015 ISSN (online): 2321-0613

[3] Ian Vince McLoughlin, KomangNarendra, Leong HaiKoh, QuangHuy Nguyen, BharathSeshadri, Wei Zeng, Chang Yao , Campus Mobility for the Future: The Electric Bicycle , Journal of Transportation Technologies, 2012, 2, 1-12

[4] R.S Jadoun , Sushil Kumar Choudhary , Design And Fabrication Of Dual Chargeable Bicycle,InnovativeSystems Design and Engineering, www.iiste.org ISSN2222-1727 (Paper) ISSN 2222-2871 (Online) Vol.5, No.8, 2014

[5] Rahul Sindhwani , Punj L. Singh , AnjumBadar , AnkurRathi , Design Of Electric Bike With Higher Efficiency , International Journal of Advance Research and Innovation Volume 2, Issue 1 (2014) 247-251 ISSN 2347 - 3258

[6] M. ReddiSankar, T. Pushpaveni, V. BhanuPrakash Reddy, Design and Development of Solar Assisted Bicycle , International Journal of Scientific and Research Publications, Volume 3, Issue 3, March 2013 ISSN 2250-3153

[7] CarmelinaAbagnale, Massimo Cardone , A dynamic model for the performance and environmental analysis of an innovative e-bike, ScienceDirect Energy Procedia 81 (2015) 618 – 627

[8] Derek Covill, Alex Blayden, Daniel Coren , Parametric finite element analysis of steel bicycle frames: the influence of tube selection on frame stiffness , ScienceDirect

[9] Akshay, N. Khonde, Aditya R. Ughade, Kapil D. Warghane, Rajat R. Vidhale Students, Performance Evaluation of Electric Bicycles, IARJSET ISSN (Online) 2393-8021 ISSN (Print)2394-1588 International Advanced Research Journal in Science, Engineering and Technology, Agni-Pankh 16-Jawaharlal Darda Institute of Engineering and Technology, Yavatmal-Vol. 4, Special Issue 3, January 2017

[10] Electric Bicycles: A performance evaluation by Annette Muetze& Ying C. Tan

[11] Kumaresan.N, Barathkumar.M, Praveen.M, Ramachandran.s, Fabrication of e-bike with regenerative braking system , IRJET ISSN (Online) 2395-0026 ISSN (Print)2395-0072 International Research Journal of Engineering and Technology, Volume: 06, Issu: 03, March 2019

[12] N. Somchaiwong and W. Ponglangka, "Regenerative Power Control for Electric Bicycle," 2006 SICE-ICASE International Joint Conference, Busan, 2006, pp. 4362-4365, doi: 10.1109/SICE.2006.314654.

[13] MopideviYaswanth, KunduruPhaniTeja, K Sri Sindhu, development of smart & regenerative electric bike, IRJET, ISSN (online): 2395-0056, ISSN (Print): 2395-0072, Volume: 07 Issue: 03, Mar 2020

[14] Mr. Mragank Sharma, AnshulVerma, GauravTiwari, Sunny Singh, MohdNadeem, Design and Fabrication of Regenerative Electric Bik, IJESC, ISSN 2321 3361, Volume 6 Issue No. 5, DOI 10.4010/2016.1265

[15] Juan Jesús Castillo Aguila, Javier Pérez Fernández, Juan María Velasco García and Juan Antonio Cabrera Carrillo, Regenerative Intelligent Brake Control for Electric Motorcycles, MDPI, Energies 2017, 10, 1648; doi:10.3390/en10101648 www.mdpi

[16] CHEN Jia-Xin, JIANG Jian-Zhong, WANG Xin- Yao, Research of Energy Regeneration Technology in Electric Vehicle, Journal of Shanghai University (English Edition), 2003, 7(2) : 173-177, Article ID: 1007-6417(2003)02-0173-05

[17] C. Abagnalea, M. Cardoneb, P. Iodicea, R. Marialtoc, S. Stranoa, M. Terzoa, G. Vorraro, Design and Development of an Innovative E-Bike, Energy

ISSN: 2278-4632
Vol-11 Issue-01 2021

Procedia 101 (2016) 774 – 781, ATI2016, 14-16 September 2016, Turin, Italy

[18] A. Joseph Godfrey, V. Sankaranarayanan, A new electric braking system with energy regeneration for a BLDC motor driven electric vehicle, Engineering Science and Technology, an International Journal, 21 (2018) 704–713