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Design and Fabrication of an Electric Bike

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Abstract - *The main aim of this project is to give the exact view by bridling the various sources of energy available to mankind. In today's modernized world travelling is very essential for human beings in order to protract in this world. And to do so his travelling should be done in minimum possible way. This project details about the Electric Bike which runs on the battery thereby providing voltage to the motor. This project compromises with design and fabrication of Electric Bike which makes use of Electric energy as the primary source. The electrical power generated which is used to run the bike can give better fuel economy compared to conventional vehicle, better performance and also causes less pollution. To reduce the air pollution and the noise pollution. It provide an ecofriendly vehicle and reduces the usage of fuels.Thus here transmission*
is also used as to control the speed of the vehicle as by increasing and decreasing.The speed can be varied as like gas powered motorcycle.

Key Words: **1.Travelling, 2.Electric bike, 3.Electric energy, 4.Fuel economy, 5.Pollution, 6.Ecofriendly, 7.Transmission**

1. INTRODUCTION

The Electric bike is a bike which is driven with the help of battery which is coupled to electric motor. Energy crisis is one of the major concerns in today's world due to fast depleting resources of petrol, diesel and natural gas. In combination with this, environmental decay is an additional factor which is contributing to the depletion of resources which is an alarming notification. Our project has the solution for this above perilous problems. The system which we innovated is the Electric Bike. This project has various benefits both to the members of the team and also external benefits thereby making awareness of using alternative modes of transport. The Electric Bike which works on the battery that is powered by the motor is the general mode of transport for a local trip. The solar panels can be alternative source for this by adding it to the system. The Electric bike which will be running on battery, the power is supplied by the motor, thereby supplying this power to drive the other gear components. The main purpose of using this E-bike is that it is user friendly, economical and relatively cheap. The efficiency of this system undeniable compared to conventional modes of transport. E-bike comprises the features like high mobility efficiency, compact, electrically powered, comfortable riding experience, light weight vehicle. E-bike is the most versatile future vehicle considering its advantages. Electric motorcycles and scooters are plug-in electric vehicles with two or three wheels. The electricity is stored on board in a rechargeable battery, which drives one or more electric motors.

1.1 Instrumentation and Description

A. Working principle

It works on the principle that the electromotive force of an A.C. motor which receives electrical energy stored in D.C. battery is converted with the help of D.C. to A.C. converter.

B. WORKING

An electric motorcycle works essentially the same way a gas-powered motorcycle works it is propelled by an engine, and that engine requires fuel. The main difference is that the gas fuel in a conventional motorcycle is replaced by either batteries or fuel cells in an electric version. The operating principle of an electric motor is quite similar to that of a gas engine. In both cases motorcycles are powered by mechanical energy, but only in one case are they powered by rechargeable batteries. Electric vehicles run on electricity, that causes a pole into the motor to spin it. It isn't so much a fuel-powered motor but rather a battery that can travel a range of 40 to 100 miles between charges .When the battery is ON the current flows to the motor and the power is transmitted to the rear wheels with the help of chain drive shaft.

1.2 Block Diagram

The diagram shows the parts and the connection between them so it can be easily identified. The parts are as follows:

- Battery
- Motor
- Controller
- Shaft drive
- Throttle
- Charger

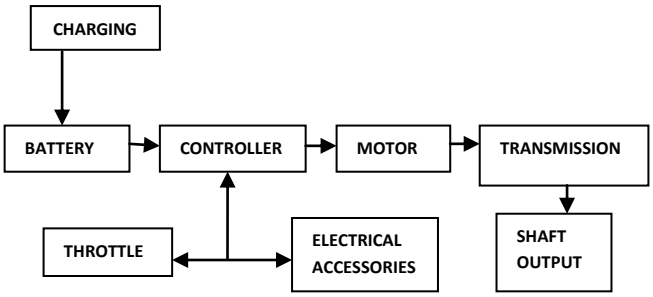

Fig:1 Block diagram

1.3 Components

A. Battery

Lithium batteries are primary batteries that have metallic lithium as an anode. These types of batteries are also referred to as lithium-metal batteries. They stand apart from other batteries in their high charge density (long life) and high cost per unit.

Fig:2 Battery

The three primary functional components of a lithium-ion battery are the positive and negative electrodes and electrolyte. Generally, the negative electrode of a conventional lithium- ion cell is made from carbon. The positive electrode is a metal oxide, and the electrolyte is a lithium salt in an organic solvent.

B. Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills.

This output could either be DCAC-DC transformation or DC-DC conversion, based on the selection of a DC brushed motor. The motor is having 750 watt. Capacity with maximum 1000 rpm. Its specifications are as follows

Fig: 3 DC Motor

- Rated Operating Voltage : 48V
- Rated Power : 750W
- No Load Current : 4.0A
- Rated Torque : 102 kg-cm
- Rated Speed : 400 rpm
- Rated Current : 13.4A
- Efficiency : 80%
- Gear Ratio : 6.1

C. Chain drive

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles.

Fig: 4 Chain Drive

A chain-drive system uses one or more roller chains to transmit power from a differential to the rear axle. This system allowed for a great deal of vertical axle movement (for example, over bumps), and was simpler to design and build than a rigid driveshaft in a workable suspension. Also, it had less unsprung weight at the rear wheels than the Hotchkiss drive, which would have had half the weight of the driveshaft, and differential to carry as well.

2. TRANSMISSION

A transmission is a machine in a power transmission system, which provides controlled application of the power. Often the term transmission refers simply to the gearbox that uses gears and gear trains to provide speed and torque

conversions from a rotating power source to another device. The most common use is in motor vehicles, where the transmission adapts the output of the internal combustion engine to the drive wheels. Often, a transmission has multiple gear ratios (or simply "gears") with the ability to switch between them as speed varies. This switching may be done manually (by the operator) or automatically.

2.1 Manual Transmission

A manual transmission is basically a more powerful version of a bicycle's gear shifter. Even though there's no chain in your car like there is in a bicycle, the engine and transmission have to be temporarily disconnected just like a bicycle chain is temporarily lifted off of the gears when you shift up or down. In your car, pushing the clutch disconnects the engine and transmission. When you adjust the gear shifter, it has the same effect as moving the bicycle chain and moves your car into a new gear. Once you're in a new gear, you can release the clutch and drive on.

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2.2 Automatic Transmission

An automatic transmission is essentially an automatic gear shifter. Instead of manually shifting the gears with a clutch on a manual transmission car or a gear shifter on a bicycle, the automatic transmission does everything for you. . A car with an automatic transmission has a torque converter that senses these changes as you accelerate and shifts you to a higher gear. The same process works in reverse as you slow down. Automatic transmissions are easy to use. However, in the past, some automatic transmissions of this type have had a number of problems; they were complex and expensive, sometimes had reliability problems (which sometimes caused more expenses in repair), have often been less fuel-efficient than their manual counterparts (due to "slippage" in the torque converter), and their shift time was slower than a manual making them uncompetitive for racing. With the advancement of modern automatic transmissions this has changed(which sometimes caused more expenses in repair). The same process works in reverse as you slow down.

3. CONTROLLER

Fig 5: Controller

The mechanism of an electric speed controller varies depending on whether you own an adaptive or purpose-build electric bike. An adaptive bike includes an electric drive system installed on an ordinary bicycle. A purpose-built bike, more expensive than an adaptive bike, provides easier acceleration and affords more features. 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. The analog control systems on this bike are a result of the need for user operation of the motor control elements. A half-twist throttle has been selected as the method for user interface to these elements.

Due to the output level of the throttle being observed as a hall-effect driven DC voltage bias level, the analog circuitry needs to handle the conversion from that voltage level to a duty cycle on output waveform. Additionally, the control circuit needs to function as a mode selection switch. As the user adjusts the half twist throttle, the mode must change at a predefined location that could be made adjustable for the user with the inclusion of various components in future iterations of design. A measurable, though small, amount of hysteresis is necessary in this circuit to prevent ringing from occurring- changing the modes quickly and randomly for a few milliseconds would provide the user with discomfort as the power circuits bounce back and forth between driving and braking. Specifications of the controller are as follows:

- Rated Power : 750W
- Rated Current : 30A
- Under-voltage protection : DC41.5V+-0.5V
- Current Limited : 30A+-0.5A
- Efficiency : >=83%
- Consumption : <1.5W

3.1 Throttle

The throttle mode is similar to how a motorcycle operates. When the throttle is engaged the motor provides power and propels you and the bike forward. The motor power can be increased or decreased by the restriction of current (by use of a throttle), but usually decreased. The term throttle has come to refer, informally, to any mechanism by which the power or speed of an engine or motor is regulated. A few e-bikes have a throttle, which may conjure visions of a motorcycle's twist grip, but in reality is usually just a small electric button. Pressing the throttle works just like depressing the gas pedal on your car no other action is required to accelerate or continue forward

Fig:6 Throttle

3.2 Charger

Fig:7 Charger

The Charger can be used to charge batteries of Bikes and Cars. It has provision to set the charging current to 2A or 4A. The charging time for bike will be 3 to 4 hours and the charging time for car will be 8 to 10 hours. Anyhow if the battery is not fully discharged then the charging time will be lesser. Batteries do not like to be stored in very hot or very cold conditions, or to be subject to conditions of high moisture. They also do not like to be left in a fully discharged state.

If Lithium batteries are left flat for an extended period they may no longer be functional. Store your battery between 15 ℃ (59 ℉) and 25 ℃ (77 ℉) in a dry area. (The conditions found in a normal domestic house). Lithium batteries (and indeed any type of rechargeable battery) do not like to be left discharged. It is good practice to recharge as soon as is reasonably possible after the battery goes flat. We recommend charging after every ride, that way your electric bike is always ready for your next outing. Do not charge at temperatures below 0 ℃ (32 ℉) Switch off the battery before charging. (If the battery has a switch on it). Battery can be charged on or off the bike. Always make sure the battery and charger are on a non- flammable, dry surface away from sources of heat, humidity and flammable materials. Do not cover the battery or charger while charging. Only use the charger supplied. Even if not in use, recharge your battery a minimum of once a month.

4. Motor Power Rating Calculation

The motor power will be selected based on power required to propel the vehicle. This is depends on weight of the vehicle and top speed have to go. To find out the power required to propel the vehicle calculations are done using vehicle dynamics.

4.1 Wheel Speed

Initially we assumed that motor rated speed is 1750rpm from this we can calculate the wheel speed.

$$N_w = \frac{N_m}{GB\ X\ FD}$$

$$N_w = \frac{1750}{1\ X\ 4} = 437 \text{ rpm}$$

4.2 Velocity

From the wheel speed velocity of the bike is calculated

$$V = \frac{\pi\ X\ D\ X\ N_w\ X\ 60}{1000}$$

$$V = \frac{\pi\ X\ 0.5\ X\ 437\ X\ 60}{1000}$$

V=41.21km/hr

S. No	Component	Weight
1.	Vehicle	130 kg
2.	Battery	4 kg
3.	Motor	12 kg
Total		146 kg

Table.1 Weight of the individual components

4.3 Power Required

$$P = \frac{R_t \, X \, V}{3600 \, X \, \eta}$$

$$P = \frac{26.31 \, X \, 41.21}{3600 \, X \, 0.88}$$

P = 0.7 Hp ≈ 1Hp

4.4 Torque @ 750 RPM

$$T = \frac{P \, X \, 60000}{2\pi \, X \, N_m}$$

$$T = \frac{0.342 \, X \, 60000}{2\pi \, X \, 750}$$

T = 4.35 N-m

4.5 Tractive Effort

$$TE = \frac{T \, X \, GB \, X \, FD \, X \, \eta}{r}$$

$$TE = \frac{4.35 \, X \, 1 \, X \, 4 \, X \, 0.9}{0.25}$$

TE = 62.64 N

4.6 Acceleration

F = ma

F = TE-Rt

TE = 62.64 N

R_t = 26.31 N

F = 62.64-26.31 = 36.33 N

m = 146 kg

$$a = \frac{F}{m} = \frac{36.33}{146} = 0.248 \text{ m/s}^2$$

$$a = \frac{V}{t}$$

$$t = \frac{V}{a}$$

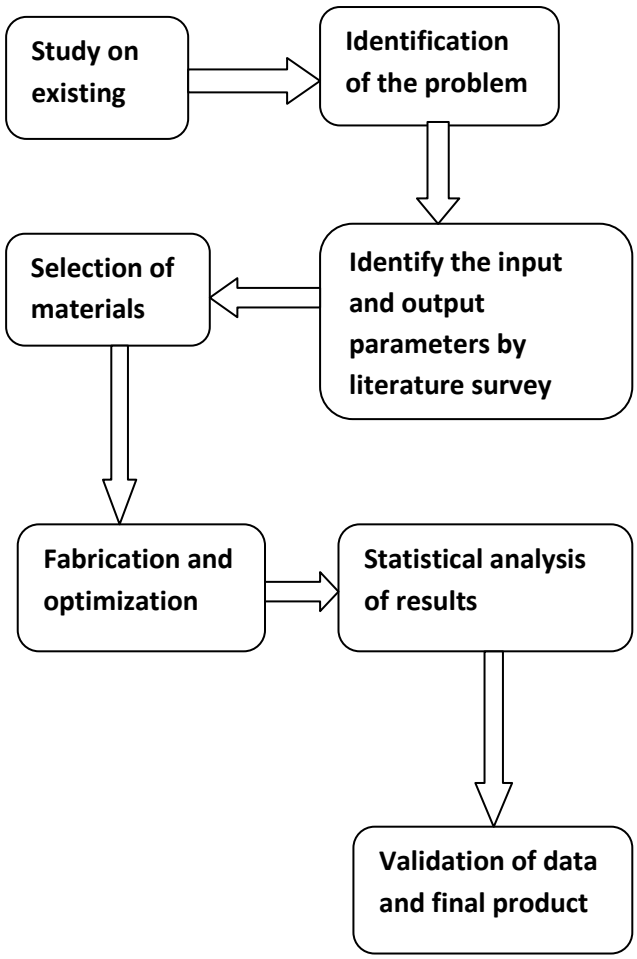
V = 41.21 km/hr

$$= 41.21 X \frac{5}{18}$$

V = 11.4 m/s

$$t = \frac{11.4}{0.248} = 46 \text{ sec}$$

5. METHADOLOGY



6. FABRICATED MODEL OF PROJECT

Fig:8 Bike

Fig: 9 Engine & Transmission

Fig: 10 Modified engine

Fig:11 DC Motor fixed with engine

Fig:12 E-Bike with transmission

7. RESULT

As the future of automobiles will be mostly of electrical and electronics this would help in such way. While the market abounds in motorbikes, electric bikes will soon be the mode of communication for almost every household.Thus the cost of the fuel and the economical affects that are being faced can be reduced .Electric bike is quite eco friendly and itcan bring a huge development to the society in the future here in our project the charging is being the major drawback and the alternate source can be found and it will be rectified as soon as possible.

Advantages

a. Deployable batteries can be taken inside house

b. Cost of the unit is very low.

c. Easy to carry since it is portable.

d. Less energy consumed.

e. High efficiency can be obtained if inverter is used.

f. If using solar panel, free utilization of energy can be done.

8. FUTURE WORK

- The implementation of the project depend upon the amount of time and resource to do the project in an effective manner.
- Alternate source for charging is to be found soon and it also may be implemented.
- Process of increasing the efficiency and power is to be improved and further steps will be taken.

9. CONCLUSION

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 contrived throughout the year.

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, ecofriendly 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. Since it has fewer components it can be easily dismantled to small components, thus requiring less maintenance.

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