



Design and Fabrication of Hybrid Electric Bike

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ABSTRACT

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. Now-a-days there are so many vehicles on road, which consumes more fuel and also hazards our environment. It is our responsibility to reduce the consumption of fuel and its hazardous emission products. Taking this into consideration it is our small step towards reducing the use of more fuel consuming vehicles and attract the eye of people towards its alternatives i.e. Electric bicycle. The Electric bicycle is a bike driven with the help of battery which is coupled to electric motor. The Electric bicycle which will be running on lithium ion battery, the power is supplied to the BLDC motor to make the rotation without pedaling. It can be operated as bicycle as well as scooter. The main purpose of using this E-bike is this is user friendly, economical and relatively cheap. Transportation is now greeted as time saving process. So, this is where electric bicycle mainly came into picture. There are many uses of an electric bicycle like it now also being used in Heart rehabilitation centers for patients having heart, lungs problems.

Keywords: Electric Bicycle, Battery, Lithium Ion Battery

1. Introduction

A bicycle, often known as a bike or cycle, is a single-track, human- or motor-powered, pedal-driven vehicle with two wheels coupled to a frame. A cyclist is a person who rides a bicycle. Bicycles were first introduced in Europe in the 19th century, and by the early 21st century, more than 1 billion were in use [1][2][3]. These figures greatly outnumber the overall number of cars produced, as well as the number of different models produced [4][5][6]. In many regions, they are the primary mode of transportation. They also provide a popular form of recreation, and have been adapted for use as children's toys, general fitness, military and police applications, courier services, bicycle racing, and bicycle stunts. Nostalgically, India got its first bicycle in 19th century. Commemorative stamp on asaid games and women empowerment in India.

According to historian "DAVID ARNOLD" around 35000 bicycles were imported by India in 1910. Back to the period of hybrid ebike and health cycling, which is continuously reminding us to keep active and healthy during a pandemic, the basic design and configuration of a typical upright or "safety bicycle" has altered little since the first chain-driven model was built around 1885[7][8][9].

The bicycle's invention has had an enormous effect on society, both in terms of culture and of advancing modern industrial methods. Several components that eventually played a key role in the development of the automobile were initially invented for use in the bicycle, including ball bearings, pneumatic tires, chain-driven sprockets and tension-spoked wheels. [10]. The design of the bicycle was an advance on the velocipede, although the words were used with some degree of overlap for a time. The most popular type of cycling is Utility cycling. It is also a common recreation, a good form of low-impact exercise, and a popular sport. Road bicycle racing is the second most popular spectator sport in the world.

The bicycle has evolved from a quaint recreational item to a cleaner mode of transportation and a small, ultra-light personal mobility device. This is how electric bicycles will be utilised as a pillar in large cities around the world to support individual public transportation. The goal of this project is to determine how worldwide research on the electric bicycle is progressing, and more specifically, around which scientific fields it is clustered, in order to

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identify the major engineering trends. This demonstrates that global research trends toward the electric bicycle are growing, and that it should be regarded a mode of sustainable urban transportation that contributes to energy conservation and sustainability.

To develop a simple vehicle model and simulation for sizing of powertrain components followed by selection of powertrain components. To propose and develop a simple control strategy for the plug-in hybrid electric two-wheeler suitable for city driving conditions. To assess the annual saving of gasoline and reduction of CO₂ emission for the span of next 10 years. To give the maximum travelling by Bicycle of 25-45 km/hr. without peddling of Bicycle. To reduce the air pollution and too keep our region pollution free and to keep the e-Bicycle noise free. To give benefit of having accessible, affordable and sustainable transportation for customers. To give maximum efficiency with a minimum weight of e Bicycle.

2. LITERATURE REVIEW

The hybrid bicycle is a bicycle which is driven with a help of battery which is coupled to electric motor. The navigate research forecast that the world-wide sale of electric cycle and electric bike will reach six million annually starting from 2015 to 2022 and this will total up the rapid increment of the sales is about fifty million. driven by rising fuel price and increasing congested city streets, more consumers are starting to turn two wheeler vehicle, including electric motor cycle and e-bike. Ebike is classified sub classes of motor cycle. Nowadays, there are variety types of bicycle we will find on city streets and parks. The main part of electric bike is main frame, wheels, tires, brake system, battery and charger, motors, charge controller. This type of vehicle are easy to operate

An electric bicycle is a form of electric vehicle that is based on a standard bicycle that has been fitted with an electric motor to assist with propulsion [1]. It is an environmentally friendly and urban mode of transportation with a battery as its power source. Electric bicycles became more popular in the twentieth century as a cost-effective and simple solution to urban transportation difficulties with environmental benefits [2], particularly in densely populated nations like China [3]. To emphasise this point, the fact that over 31 million e-bikes were sold in 2012 [4] suffices.

The primary benefits of riding an electric bicycle are both financial and environmental. The entire cost per kilometre cycled with an electric bicycle (including electricity, purchase, and maintenance) is less than 0.7 cents, compared to \$0.031/km for a gasoline scooter [5], or \$0.62/km for a car. The electric bicycles' batteries may be recharged by plugging them in or pedalling in certain gears.

A typical electric bicycle also takes 6–8 hours to charge the battery [6] and has a range of 35 to 50 kilometres at a speed of roughly 20 kilometres per hour (depending on rider weight) [7]. This means that a single battery charge would be sufficient to get to work, visit friends, and return home on a typical day, as statistics show that about half of a typical urban person's trips and procedures occur within a 15-kilometer radius of his or her home, and thus within the range of these bicycles [3].

From an environmental standpoint, gasoline car consumption in metropolitan areas emits 3.57 g/km of HC (hydrocarbons), 3.15 g/km of CO, 1.82 g/km of CO₂, and 2.29 g/km of NO_x [8]. As a result, the electric bicycle, as an alternative mode of transportation to the car, saves an average of 8.5 litres of fuel every 100 kilometres, avoiding pollution.

The electric bicycle, as a new mode of private transportation, has opened a new era of mobility, particularly in cities, which is beneficial to both countries with big populations and those concerned about the environment. Although electric bicycle research is very young, no one understands where the efforts are currently focused or what the scientific community's primary topics of interest are.

The goal of this paper is to determine how electric bicycle research is progressing around the world, and in particular, around which scientific fields it is centred. Finally, the major trends in this sector may be discovered. Electric bicycles were introduced practically simultaneously with traditional bicycles. Several patents for electric bicycle motors were issued in the 1890s. Ogden Bolton was given a patent (US Patent 552,271, 1895) in the United States in 1895 for a bicycle battery with six brush poles, a DC collector, and a hub motor installed on the back wheel [9].

Hosea W. Libbey of Boston designed an electric bicycle with a double electric motor in 1897 (US Patent 547,441, 1895). In the 1990s, the Giant Lafree e-bikes (electric-assist bicycles) brand used the same design. [10] Heinzmann, a German firm, began mass-producing electric motors for bicycles in 1920. Their first motor was a tandem setup. It continued on to develop motors that included German mail distribution bicycles later on

In the 1930s, Minneapolis-based Lejay Manufacturing files patents for the GoBike, an electric bicycle powered by a Ford T generator attached to the rear wheel. Moulton Consultants Ltd. later developed a twin chain transmission, with one chain coming from the bottom bracket and the other from the electric motor.

Electric bicycles grew in popularity in the 1940s as a result of a shortage of large motorised vehicles as a result of WWII war operations. Several patents for prototypes were granted, but they were overshadowed by the growth and investment in the motorcycle sector, which played a larger role throughout the war. Many engineers who were dedicated to the development of engines for aeroplanes saw a niche and dedicated themselves to the motorcycle industry in postwar Europe and Asia, due to prohibitions on countries like Italy and Japan from building and rebuilding their aeronautical industries, and in the shadows of this development were electric bicycles. which went a bit ignored but nonetheless benefited from the new technologies and innovations in that industry. However, it wasn't until the first oil crisis in 1973 that electric bicycles were marketed, despite their lack of appeal at the time. Electric bicycles played a dominant position in urban transportation in the United States as a clean solution to the oil dilemma. This initial mass-market model, which had a solid steel frame and was difficult to move, was a little rough and hefty compared to contemporary variants. However, when contrasted to the massive and powerful engines of the 1970s, it proved to be extremely adaptable and cost-effective.

This bicycle, like its forerunners, did not hurt the environment or rely on oil market changes. Egon Gelhard, an inventor, created a subtype of electric bicycles in 1982 that used the electric cycle pedal principle, in which the driver is assisted by the engine's electric traction when pedalling. In the 1990s, electric bicycles began to gain popularity. Electric quad bikes are also pricey, heavy to park, and offer minimal benefits above an electric bicycle.

In truth, all of the devices described are expensive, far more so than a conventional bicycle, and the majority of them work on the concept of simply adding a motor power source to a bicycle-type system (or scooter/skateboard/skates). However, it is far from certain that a lack of such power support is the primary reason for Bicycles' lack of widespread adoption on many college

campuses. As a result, simply increasing engine power may not result in a greater acceptance of electric bicycle-style transportation.

3. PROPOSED SYSTEM

Electric bicycle is a vehicle that is called as e bike. It is a bicycle which assist by the electric motor to set the vehicle in motion. The bicycle uses electric dc motor which is receiving power supply from rechargeable batteries. With the help of batteries, the power supply is given to the motor, the bicycle can travel up to 15 to 20 mph, but this range depends on the batteries and the motor power limit which each of the components has their own specifications and limitation. The electric bicycle is not restricted or bend to the motorist vehicle law even though it is powered by motor, it still considered as bicycle which is the identity of Electric bicycle. It is a bicycle which is assist by the electric motor the bicycle is still fixed on it.

The electric bicycle is free from pollution, this is because it using electric source, rather than gasoline. It will not cause pollution to environment, and it will be more similar to a motorcycle. Hence, the using of dc motor that power supply from the batteries is used on the electric bicycle. The electric bicycle is still used pedal to for pedaling, it just adding the motor, batteries, electronic components and throttle for speed. This add up is for assist the rider in certain condition which is when pedaling away up the high slope, more power is needed, so the motor can assist the rider by provide pedaling power to the rider during pedaling up the high slope.

Table-1 Comparison of expenses of vehicle

	Cycle In Rupees	Motorbike	Car
Cost	30,000	50,000	5,00,000
20-25km daily running cost	2	40	150
Monthly running cost	60	1200	4500
Yearly running cost	720	14,400	60,000
Maintenance cost every 3 months	150	3000	5000
Maintenance cost yearly	600	12,000	20,000
Insurance renewal cost	0	2000	5000
Yearly Expenses	1320	28,400	85,000

3.1 Purpose of The Starting System

The starting system's goal is to transform chemical energy stored in the battery into electrical energy, which is then converted into mechanical energy via the starter motor. This mechanical energy is then transferred from the starter motor to the engine flywheel via gears and drives. The engine flywheel begins to rotate after all of this energy has been transferred and converted. The rotation must be fast enough for the engine to create the combustible air-fuel combination needed for starting. It must be maintained for the duration of first combustion until the engine is capable of sustained operation. A starter or cranking motor is utilised to do this.

- Battery
- Ignition Switch
- Starter Motor Assembly
- EWS (if equipped)
- Starter Safety Switch
- Cables and Wiring Harness

Configuration of An Electric Bicycle System

Basic Configuration of an Electric Bicycle System An electric bicycle drive's fundamental configuration comprises of a controller that regulates the power flow from the battery to the electric motor. This power flow works in tandem with the power produced by the rider through the bike's pedals. The rider of an E-bike has the option of totally relying on the motor or pedalling while using the engine (use as a conventional bicycle).

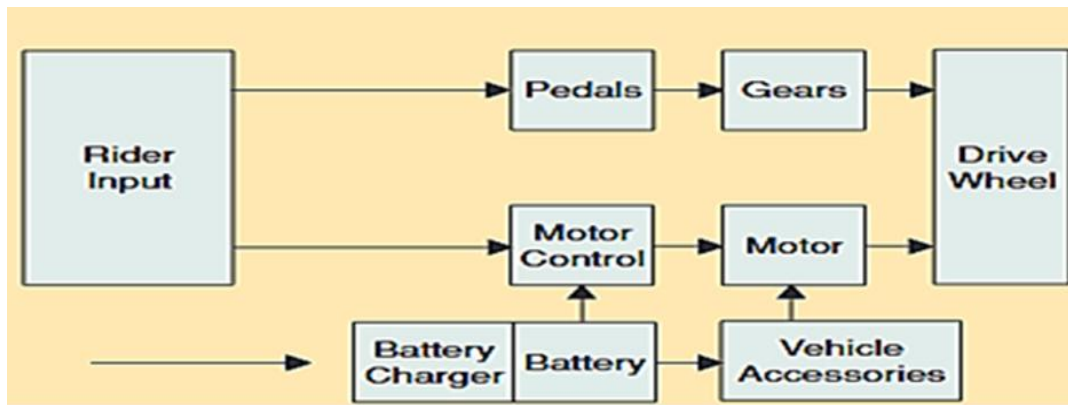


Figure-1 Proposed system

3.2. Starting System Principle of Operation

3.2.1 Electric Starter Motor

Electric current is converted into rotary motion by the Electric Starter Motor. It turns electrical energy into mechanical energy in this way. This rotational force is created by the interaction of two magnetic fields. Magnetic flux lines are produced by the field coils (electromagnetic or permanent) in the housing.

3.2.2 Weight

This is a heavy "bicycle" at 85 pounds, but I consider it more of an ultralight moped. It's also a true "mo-ped" in the sense that you can still pedal it. Plus, if necessary, I can still load it into my pickup or car trunk. Our old Peugeot moped weighed twice as much at 150 pounds and had a similar top speed, but riding it was a joke because the pedals were geared so low that they were only used to start the motor.

3.2.3 Brakes

This bike's original brakes were fine at 12 mph but terrifying at 30 mph. The previous brake mount posts were happily compatible with a new side pull "vee brake" like those found on quality Modern Mountain bikes. Regular bicycles are too light and top heavy to use the front brake as the primary brake, but any motorcyclist will tell you that the front brake does 90% of the work on any heavier two-wheeler. A bike vendor had a vee-brake kit on sale for about \$25, which included a new lever for the handle bar.

3.2.4 Frame
The motor system's extra force and weight are no problem for the components. Mountain bike components are now incredibly sturdy and durable, designed to withstand off-road damage. The wider wheels, in particular, are ideal for the added weight and power.

3.2.5 volt DC motor

A DC motor is a type of rotary electrical equipment that transforms electrical power from direct current to mechanical power. Magnetic fields create forces that are used by the most mutual sorts. Almost all DC motors contain an internal mechanism, either electromechanical or electronic, that changes the direction of current flow in a section of the motor on a regular basis.

3.2.6 Throttle

A throttle is a device that controls fluid flow by restricting or obstructing it. The limiting of inlet gases (through the use of a throttle) can raise or decrease an engine's power, but it is usually decreased. Informally, the term throttle refers to any mechanism that controls the power or speed of an engine, such as a car's accelerator pedal.

3.2.7 Lithium-Ion Battery

A lead acid battery is a type of battery that converts chemical energy into electrical energy using sponge lead and lead peroxide. The lead acid battery is the most prevalent type of battery used in power plants and substations.



Figure-2 Battery

3.2.5 Braking System

It is more convenient to employ the braking system used in band brake systems, which consists of a spring-loaded friction-shoe mechanism that is driven by a hand lever. The goal of this project is to improve the standard bicycle and make it more efficient. Because the electric bicycle is a hybrid, it can run both electrically and pedally, providing the same exercise that individuals get from riding a bicycle. The bicycle's calculated no-load speed is = 20.66 km/hr. =391.69 watts is the required power.



Figure-3 Electric Bicycle

Advantages

- Easy to commute with low fatigue.
- Less maintenance cost.
- Normal Drag/Pedal is possible when power is not in use.
- Deployable batteries – can be taken inside house.
- Cost of the unit is very low.
- Easy to carry since it is portable.

4. Conclusion

The proposed paper, Ebike, is primarily aimed towards converting a gasoline bike to an electric cycle. With the rising consumption of natural resources such as gasoline and diesel, it is vital to shift our focus to other resources such as electric bikes and other modes of transportation. E- vehicles are modified petrol bikes that run on electricity. The most essential features are that it is pollution-free, environmentally friendly, and operates quietly. The most important method for reducing pollution is to use an on-board electric bike. If there is an emergency, it can be charged with the help of a battery. The operating cost per kilometre is really low. It can be charge with the help of battery if there is an emergency. The operating cost per km is very less. It can be concocted at any time of year. The electric bike's most important characteristic is that it does not use fossil fuels, saving billions of dollars in the process. If there is an emergency, it can be charged using an AC converter. The operating cost per km is quite low, and it can be further reduced with the use of solar panels. It can be readily dismantled into little components because it has fewer components, needing less maintenance.

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