

Electric Bicycle

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Abstract: Modern world demands the high technology which can solve the current and future problems. Fossil fuel shortage is the main problem now-a-days. Considering current rate of usage of fossil fuels will let its life up to next five decades only. Undesirable climate change is the red indication for not to use more fossil fuel any more. Best alternative for the automobile fuels to provide the mobility & transportation to peoples is sustainable electrical bike. Future e-bike is the best technical application as a visionary solution for the better world and upcoming generation. E-bike comprises the features like high mobility efficiency, compact, electrically powered, comfortable riding experience and light weight vehicle. E-bike is the most versatile future vehicle considering its advantages.

Keywords: DC Motor, Electric Bike, Pedelecs

1. INTRODUCTION

This paper presents a review in an electric bicycle (e-bike) which is a standard pedal bicycle with an electric motor and a rechargeable battery to assist with propulsion. With power assistance, many barriers to cycling are reduced or overcome, including increasing age, physical limitations, hilly terrain, a lack of time, and a lack of fitness or the perception of fitness that is needed to cycle. While power assistance makes riding easier, riders still gain some physical activity benefits by pedalling. Compared to a conventional bicycle, riding an e-bike requires less physical effort, which makes e bikes attractive to people with a physical limitation or as a rehabilitative tool and e-bikes can provide the extra help to transport items or children. Some studies have reported that e-bike users had higher enjoyment and comfort. A few studies have also reported that some e-bikes can substitute for car journeys or become a replacement on the way to motorization. One promising finding is e bikes may reduce the number of trips taken by cars. Few studies have investigated the barriers to e-bike use. A survey conducted in the U.S. identified significant barriers to e-bike use, including the weight of an e-bike, a fear of theft, road danger, and a fear of insufficient battery power.

2. LITERATURE SURVEY

The chapter reviews about the previously published articles and literatures and by performing an online research for information related, which lays the foundation and basic for the further work.

B Kumar and H Oman [1], by 2007 e-bikes were thought to make up 10 to 20 percent of all two-wheeled vehicles on the streets of many major Chinese cities. A typical unit requires 8 hours to charge the battery, which provides the range of 25 to 30 miles (40 to 48 km), at the speed of around 20 km/h. As of 2017, electric bicycles sales in the United States have slowed. This is due primarily to lower gas prices.



Fig. 2.1 Electric Bicycle

Ian Vince McLoughlin et al. [2], found out that the sustainable and practical personal mobility solutions for campus environments have traditionally revolved around the use of bicycles, or provision of pedestrian facilities. However many campus environments also experience traffic congestion, parking difficulties and pollution from fossil-fuelled vehicles. It appears that pedal power alone has not been sufficient

to supplant the use of petrol and diesel vehicles to date, and therefore it is opportune to investigate both the reasons behind the continual use of environmentally unfriendly transport, and consider potential solutions. This results was obtained from a long study into electric bicycle effectiveness for a large tropical campus, identifying barriers to bicycle use that can be overcome through the availability of public use electric bicycles.

Prabhu Randhir et al. [3], discussed that in today's context 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. So we intend to design a cycle which would run on an alternative source and also reducing human efforts called as Battery Operated Cycle

Kunjan Shinde [4] conducted an experiment regarding the electric bicycle and has given the idea of harnessing the various energy and use it in today's existence of human life. For human being travelling has become vital. In order to sustain in this fast forward world he must travel from place to place. It is very important that time taking for travelling should be less, also it should be economical and easily available. With the fast depleting resources of petrol and diesel, there is need to find intermittent choice.

S I Brand et al. [5], by 2001 the terms e-bike, power bike, pedelec, pedal-assisted, and power-assisted bicycle were commonly used to refer to e-bikes. The terms used were electric motorbike or e-motorbike refer to more powerful models that attain up to 80 km/h (50 mph).

In a parallel hybrid motorized bicycle, such as the aforementioned 1897 invention by Hosea W Libbey, human and motor inputs are mechanically coupled either in the bottom bracket, the rear wheel, or the front wheel, whereas in a mechanical series hybrid cycle, the human and motor inputs are coupled through differential gearing. In an electronic series hybrid cycle, human power is converted into electricity and is fed directly into the motor and mostly additional electricity is supplied from a battery.

Conventional bicycle owning respondents use their bicycles more for recreation and exercise. Also, electric bike owners tend to bike longer distances and take more trips per week. Both electric bike respondents and bicycle respondents stated that improved health was a key factor for cycling, while Millennials and Generation X respondents cycle to save time and improve the environment. Finally, an ordered logit model is proposed for evaluating factors that influence interest in future e-bike ownership. Travel purpose e-bike familiarity, annual household income, and education level are statistically significant factors in the model. These findings begin to provide insight and a profile of potential new markets for e-bikes in the United States.

In 2005 about 10 million electric bikes were produced in China. Strong domestic sales are projected for coming years, raising concerns about the sustainability and potential regulation of this fairly new mode. Policy makers are wrestling with developing policy on electric bikes with little information about who uses them, why they are used, and what factors influence the electric bike travel. In his paper probes these questions by surveying electric bike usage in two large Chinese cities, Kunming and Shanghai. Demographic comparisons are made between the different modes and cities as well as differences in travel patterns.

Electric bike users are found to travel considerably more than bicycle users. Also, most electric bike users would travel by bus if electric bikes were unavailable. This suggests that electric bikes are less of a transitional mode between human-powered bikes and fully blown automobile ownership, and more an affordable, higher quality mobility option to public transport. Electric bike use in China has skyrocketed over the past decade. Despite annexed bicycle infrastructure and a national policy that promotes car growth and ownership, most commuters still rely on two-wheeled transportation.



Fig. 2.2 Electric Bicycle in China

3. COMPONENTS SELECTION

There are several components that are being used in the electric bicycle. The various components used are explained below:

1. DC Motor
2. Battery
3. Controller
4. Frame
5. Platform
6. Chain Drive
7. Sprocket

1. DC Motor

Motor is made up of skilful wrapping of coils on a stator, a rotor for the rotation, and magnets to influence the rotations. The magnets used their work electromagnetically. That means electricity influences this iron to behave like a magnet having both attraction and repulsion characteristics of a magnet into this, thereby helping it to generate the motion accompanying this. The principle in this is to switch the direction of the forces to keep the motor to move continuously, once it is started until the time it is stopped. Fig. 3.2 shows the Brushless DC motor used.



Fig. 3.2 DC motor

The two most common types of hub motors used in electric bicycles are brushed and brushless. There are many possible types of electric motorized bicycles with several technologies available, varying in cost and complexity; direct-drive and geared motor units are both used. Generally for this project 24V DC Motor with 250 W along with 2700 rpm speed is needed. An electric power-assist system may be added to almost any pedal cycle using chain drive, belt drive, hub motors or friction drive. Modern e-bikes all prefer to use "brushless" hub motors, just because they are more durable than its "brushed" counterpart, besides the maintenance cost in them is also very little. Limited in quantity making them expensive comparatively. But in the long run they seem to be lot reliable. Both by the cost and performance.

2. Battery

Battery is the main component in e-bikes. There are many types which have been tested until this time but the popular ones are NiMH, Ni or Lithium-ion Batteries. The battery capacity varies in bicycles. In general the storage energy mostly up to about 400 Watt hour. Battery quality is measured by how many cycles they can be charged, and how much percentage it works still after a fixed duration length, which is measured by comparing with the original capacity at the manufacturing time.

In NiMH batteries, around 400 to 800 cycles of recharging is possible where as in Lithium batteries it can be even 1000 cycles. The charging time essentially depends upon the types of batteries that is used and accordingly it can be 2 to 9 hours. The most trustable battery at this moment is Lithium-ion battery, it is light, that what makes the efficiency of the e-bikes to rise.



Fig. 3.3 Battery

Fig. 3.3 shows the battery used in this project which is of 12V and is kept on series with another same battery. Generally some of the batteries include for this system Nickel Cadmium (Ni-Cd) Sealed Lead Acid (SLA), Nickel-Metal Hydride (NiMH) or Lithium-Ion Polymer (Li ion). For this project generally two 12V battery is required to run the bicycle. E-bikes use rechargeable batteries, electric motors and some form of control.

3. 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. Fig. 3.4 shows the controller used in this project which is of 24V and 350W.



Fig. 3.4 Controller

According to the motor in use the controller function also varies. Brushless motors are popular now a days 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. Those two distinct types of controllers are designed to match either a brushed motor or brushless motor. Brushless motors are becoming more common as the cost of controllers continues to decrease.

4. Frame

The Frame is made up of Mild Steel (MS) along with some additional light weight components. The frame is designed to sustain the weight of the person driving the unit, the weight of load to be conveyed and also to hold the accessories like motor and battery. Also it should be design to bear and overcome the stresses which may arise able to due to different driving and braking torques and impact loading across the obstacles. It is drilled and tapped enough to hold the support plates.

5. Platform

The Platform is designed with robust base so that it can hold the load along with the weight of the driving person uniformly. It is fabricated from Mild Steel at a specific angle in cross section and welded with a sheet of metal of specific thickness. The platform's alignment is kept horizontal irrespective whether it is loaded or unloaded and this is directly bolted and welded to the frame.

6. Chain Drive

A Chain is an array of links held together with each other with the help of steel pins. This type of arrangement makes a chain more enduring, long lasting and better way of transmitting rotary motion from one gear to another. The major advantage of chain drive over traditional gear is that, the chain drive can transmit rotary motion with the help of two gears and a chain over a distance whereas in traditional many gears must be arranged in a mesh in order to transmit motion. Fig. 3.5 shows the connection between the chain drive and the sprocket.

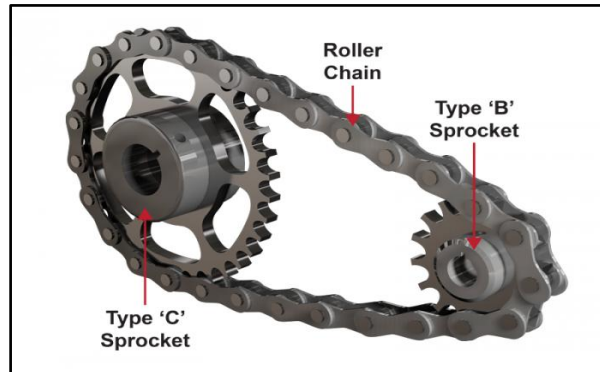


Fig. 3.5 Chain Drive

7. Sprocket

A sprocket or sprocket wheel is a profiled wheel with teeth, or cogs, that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track. For this project we have used Bossed Sprocket.



Fig. 3.6 Different Types of Sprocket

4. 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 off-setting environmental pollution using 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/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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