IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 6, June 2022

DOI: 10.17148/IJIREEICE.2022.10634

ELECTRIC BICYCLE

Mr. KRISHNA KUMAR SINGH[1], Mr. RAJESH KUMAR[2], Mr. SNEHARTHI CHATTARAJ[3], Prof. YOGESH B.MANDAKE[4], Dr. DEEPAK S. BANKAR[5]

[1-4]Bharati Vidyapeeth (Deemed to be University),College of Engineering, Pune

[5]Head Of Department, Bharati Vidyapeeth (Deemed to be University),College of Engineering, Pune

Abstract: The main aim of this review paper is to present the idea of harnessing use it in today's existence of human life and the various energy. Now-a-days there are so many vehicles on road, which hazards our environment and also reduce the consumption of fuel. 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 attract the eye of people towards and fuel consuming vehicles 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. In this paper we design an alternative mode of transport for betterment of social and environment.

keywords: Electric bicycle, Direct current motor (DC motor), controllers, Battery, Battery charger, Throttle, Chain and Sprocket, Key switch etc.

1.INTRODUCTION

The electric bicycle is an electrical-assisted device that is designed to deliver the electromagnetic momentums to a present bicycle therefore relieving the user of producing the energy essential to run the bicycle. It contains a large motor and enough battery power that just needs charging to help in generate greater motoring speed, hill climbing, and provide completely electric transportation free. Electric vehicles more price and more perform poorer than their gasoline counter parts[1]. The aim is that mainly because gasoline cars have promoted from a century of intensive development; electric cars have been virtually overlooked for several years. Even today, gas cars profit from billions of dollars of research every year while electric vehicles receive a small fraction of that quantity of money. The primary principle for the Universities" though air quality alone is not a satisfactory justification to mandate electric bicycles and to support of the electric-powered over the petrol powered has been towards improving air quality. The single biggest advantage of electric bicycle is that it is cost running as it mainly only essentials building cost as running cost would only require the charging of the battery [2]. An Electric bicycle would, however offer other solid benefits that is overlooked in the marketplace. These include the reduction in oil consumption intense that its use would bring about widespread. More less needed of oil because only a tiny proportion of electricity is generated from oil [3]. The major further non-market benefit would greenhouse be low gas emissions.

2. A BRIEF OVERVIEW OF THE ELECTRIC BICYCLE

Bicycles have been around for more than two hundred years now and since then they have been one important and one of the most used means of transportation. Who invented the concept is a very controversial question and can not be known for sure. What is certain is that they evolved a lot since its creation and still have a very important role in today's society. In 2003, more than 1 billion bikes had already been produced worldwide twice as many as the number of automobiles [4]. They not only provide a viable mean of transportation but also a very popular form of recreation. They had been adapted to lots of applications as children toys, general fitness, military and police applications, courier services, bicycle racing and several others [5].

An electric bicycle is a bike with an electric motor integrated used to assist the rider propelling the bike. There are two main types of electrically assisted power cycles. pedelecs and E-bikes, the difference is the way which the motor is actuated. Pedelecs use a PAS, the motor automatically assists the driver as long as he keeps on pedaling and if the driver stops pedaling the motor will stop[6]. The amount of assistance given by the motor is automatically adjusted in accordance with the sensors integrated in the motor, which usually measure the pedeling rate, bike speed or torque applied by the driver. Not all the designs have these three types of sensors, but the recent designs have the three types of sensors working together, which results in a more controlled driving experience and in the improvement on some main characteristics of an EAPC, as the range and comfort. In E-bikes, or as they are commonly referred" power-on-demand" or" twist-and-go" bikes it's used a trigger or throttle which the driver actuates to propel the bike. There are also some designs that present both operating modes.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 6, June 2022

DOI: 10.17148/IJIREEICE.2022.10634

The first known patent for an e-bike was published at 31 December of 1895 by Ogden Bolton Jr.in the United States. It was a simple design ant it used a direct current (DC) brushed hub motor mounted in the rear wheel.[7]
Currently, the main down side of this type of vehicle are the costs inherent to it. Buying an electrically assisted bicycle or converting a common bicycle into an electrical one can reveal to be very expensive, essentially due to two main components, the motor itself and the battery [7]. Despite the market is showing more and more different hypothesis, with different cost rates and power outputs, the concept has always a big investment linked to it, especially in comparison with common bicycles. This is a problem that can only diminish with time and a competitive market between the major brands of the industry. Luckily, and as it will be explained further, the electrically bicycle industry is experiencing a fast evolution with growing designs and innovations. Therefore, it is expected that prices will get lower and more appealing for this type of vehicle, as the main components that enlarge the costs are getting more common and easier to acquire.

3.COMPONENT OF ELECTRIC BICYCLE

3.1 DC MOTOR

A DC motor is one of a class of rotary electrical machines that converts direct current electrical power into mechanical power. The most mutual types rely on the forces created by magnetic fields. Nearly all types of DC motors have specific internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in portion of the motor.
DC motors were the first type commonly used, since they could be powered from present direct-current lighting power distribution systems. [8] A DC motor's speed can be controlled over a extensive range, using either a variable supply voltage or by changing the strength of current in its field windings. Tiny DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for convenient power tools and appliances. Bigger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The arrival of power electronics has made replacement of DC motors with AC motors possible in many applications.

Working Principle

A motor is an electrical machine which translates electrical energy into mechanical energy. The principle of working of a DC motor is that "whenever a current carrying conductor is placed in a magnetic field, it practices a mechanical force.

FIG 1 :- Working of electric DC motor

3.2 CONTROLLER:-

3.2.1 Speed Control Basics

The speed controller of an electric bike is an electronic circuit that not only controls the speed of an electric motor but also serves as a dynamic brake. This controller unit uses power from the battery box and drives it to the motor. Different forms of controllers are used for brushed and brushless motors. For adaptive e-bikes, a conversion kit is used and the controller is the core component of that kit.

3.2.2FUNCTION CONTROL:-

The electric bike speed controller sends signals to the bike's motor in many voltages. These signals detect the direction of a rotor relative to the starter coil. The suitable function of a speed control depends on the employment of various mechanisms. In a Hall effect sensor help detects the location of the rotor and purpose-built electric bike [9]. If your speed controller does not include such sensors and the speed controller on an adaptive bike may not the electromotive force of the un-driven coil is calculate to get the rotor orientation.
The mechanism of an electric speed controller differs depending on whether you own an adaptive or purpose- build electric bike. An adaptive bike includes an electric drive system installed on a normal bicycle [10]. A purpose- more expensive than an adaptive bike, built bike, provides easier acceleration and affords extra features.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 6, June 2022

DOI: 10.17148/IJIREEICE.2022.10634

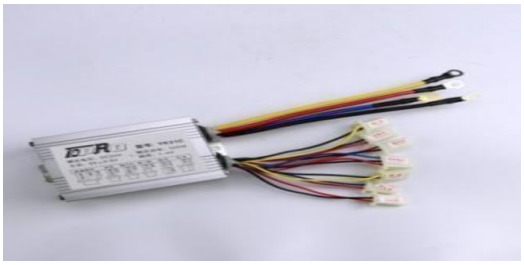

FIG 2:- Controller Devices

3.3 Battery:-

Two lead acid rechargeable batteries of 12v, 9 amp is used in which are connected in parallel position. It basically stores the electrical energy generated and utilize it to run the motor. A battery has a negative terminal called anode and positive terminal called cathode. The terminal marked positive is at the terminal marked negative is source of electrons and when connected to external circuit will flow higher electric potential energy and deliver energy to external device Rechargeable batteries are recharged multiple time.

Fig 3:- Lead Acid Battery

3.4 Battery Charger

The battery charger is a device which is used to put energy into a rechargeable battery by forcing an electric current through it. This charger takes the electric current from the main supply and is connected to a charger plug of a controller which supplies the flow of current to the battery[11]. This wall charger can charge the pack of 2 batteries connected in series in 3-4 hours

Fig 4:- Battery Charger

3.5 Chain and Sprocket

Take the suitable material & no. of teeth according to center distance.

3.6 Throttle:-

The throttle is connected to the controller through wiring whose function is to regulate or control the speed of the motor.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 6, June 2022
DOI: 10.17148/IJIREEICE.2022.10634

Fig 5:- Throttle

4. BLOCK DIAGRAM:-

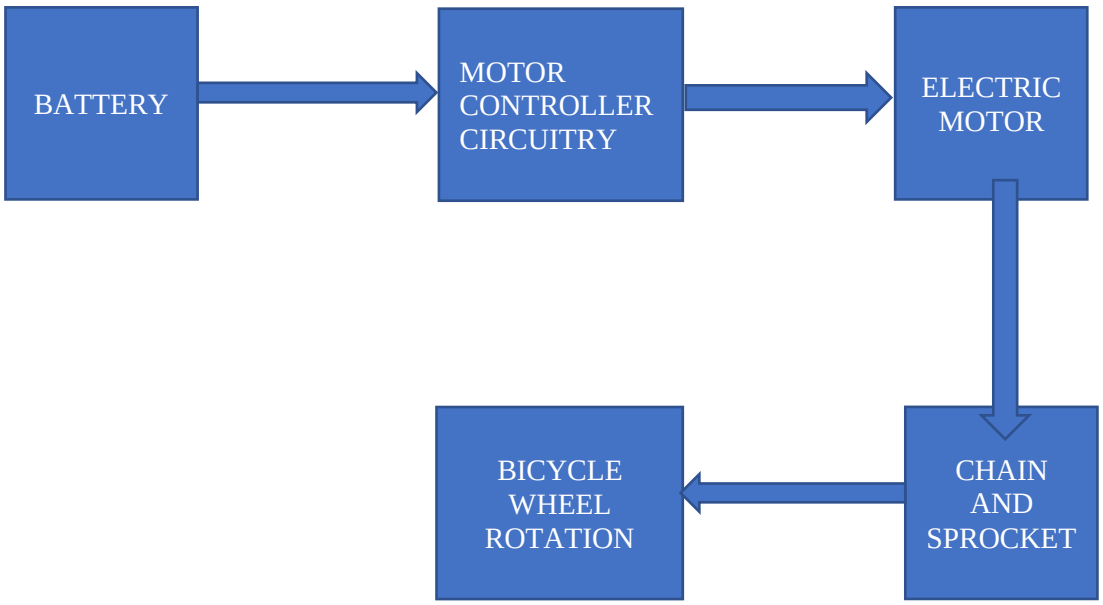

FIG 6 :- Block diagram of the Electric bicycle construction process

5.ADVANTAGES OF ELECTRIC BICYCLE

- Cheaper than the covential vehicles in prolonged usage.
- Environment friendly.
- Vibration and sound free smooth driving.
- Less maintenance than the fuel vehicles.
- No dependency of fuel stations. Can be charge by domestic power sockets.

6. ELECTRIC BICYCLE MANUFACTURERS IN INDIA

[1] Hero LECTRO EHX20
[2] GEEKAY Bikes- ECOBIKE PRO PLUS
[3] E-TRIO ASHVA
[4] NIBE Motors
[5] SWAGTRON

7. SPEED CALCULATION

Given value:
Radius of tire = 33cm or 0.33m
Centre to Centre distance = 56cm

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 6, June 2022
DOI: 10.17148/IJIREEICE.2022.10634

Weight of cycle = 52kg
Weight of passenger = 62kg
Under no load condition:
Motor rpm = 540rpm
Rear wheel rpm = 296rpm
Speed of bicycle
Circumference = 2πr
= 2×3.14×0.33
= 2.0727m
Surface speed = circumference × rpm
= 2.0727×296
= 613.4304m/min
Surface speed (km/h) = 0.6134×60
= 36.8Km/h
Velocity ratio:
V.R. = w2/ w1
Where,
w1 = (2×3.14×N)/ 60
= (2×3.14×540)/60
= 56.52 rad/sec
w2 = 2×3.14×N/ 60
= (2×3.14×296)/60
= 30.98 rad/sec
Therefore,
V.R. = 30.98/56.52
V.R. = 0.520
Torque:
T = (P× 60) (2×3.14× N)
T = (250 × 60) (2 × 3.14 × 296)
T = 24.20Nm.
Under load condition on different inclination:
Surface speed (practically observed) at 0º inclinations
Surface speed = 2πr × rpm
30.53km/h = 2×3.14×0.33×rpm
Rpm= 4.8/(0.00033×60)
rpm = 242
Torque:
T =(P×3.14× 60)/ 2×3.14N
T = (250×3.14× 60)/2 3.14×242
T =29.60Nm.
Surface speed (practically observed) at 15º inclinations
Surface speed = 2×3.14×rpm
22km/h = 2×3.14×0.33×rpm
rpm = 22/ (2×3.14×0.00033×60)
rpm = 176
Torque:
T = (P×60N)
T= (250× 60/(2×3.14×176
T = 40Nm.
Surface speed (practically observed) at 25º inclinations
Surface speed = 2×3.14 r×rpm
14.74km/h = 2×3.14×0.33×rpm
rpm = 14.74/ (2×3.14×0.00033)
rpm = 118
Torque:
T = (P × 60)/ 2×3.14×N
T = (750× 60)/ 2 × 3.14 ×118
T = 60.72Nm.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 6, June 2022

DOI: 10.17148/IJIREEICE.2022.10634

8.DESIGN OF ELECTRIC BICYCLE

Here we have used brushless dc motor with 250-watt power and 450 rpm as rated and 540rpm as practically observed. The motor runs on 24 volts and 15.6amps power source. As for the operating purpose, dc controller is required for the BLDC motor. And this whole needs a battery power source for running the motor. Therefore, here we have used 2 batteries (each of 12volts) connected in series to get the desired output of 24volts.

Fig 7 Electric bicycle

9.IMPLEMENTATION

In this project we had fabricated the bicycle with all electric components. After then, we have used reverse engineering mechanism to calculate speed and torque on different inclination in load condition.

10.TESTING RESULT

Speed of bicycle:- 30km/hr
Battery full charging time 4-5 hr

11.CONCLUSION

After we have completed our research project, we have conducted a lot of results regarding our project. First, we have learned a lot about the local market, compared parts, dimensions, decision making, and finally installation and fabrication. Second, our project works effectively, we had a minor problem with the motor it kept getting heated when working. The problem was due to the extra load on the motor because we were starting the motor while the bicycle is not moving. One of the major challenges that we faced was the battery until finally, we solved that problem as mentioned before.

REFERENCES

[1] Chetan Mahadev, Sumit Mahindraka, Prof. Jayashree Deka, "An Improved & Efficient Electric Bicycle system with the Power of Real-time Information Sharing",2014. [1,2]
[2] D. M. Sousa, P. J. Costa Branco, J. A. Dente, Electric bicycle using batteries and Supercapacitors, 2016 [3,4].
[3] Arun Eldho Alias1, Geo Mathew2, Manu G3, Melvin Thomas4, Praveen V Paul5, Energy Efficient Hybrid Electric Bike with Multi -Transmission System, 2018[5].
[4] A. Hrennikoff. Solution of problems of elasticity by the framework method. Journal of applied mechanics, 1941[6]
[5] Bicycles produced in the world - world meters. http://www.worldometers.info/bicycles/. Ac- cessed: 2016-08-

DOI: 10.17148/IJIREEICE.2022.10634

06[cross ref]

[6] Peter Dubravka, Pavol Rafajdus, Pavol Makys, Adrian Peniak, Valeria Hrabovcova, Lorand Szabo, Mircea Ruba, "Design of Fault Tolerant Control Technique for SRM Drive", 16th European Conference on Power Electronics and Applications, pp. 1-8, 2019[7].

[7] Linus Garrett1,Jack Baker2, Jon Higginbotham, Electric Bicycle and Agricultural Trailer,2013.

[8] Srivatsa Raghunath, Hardware Design Considerations for an Electric bicycle[9].

[9] O. Bolton. Electrical bicycle, 9 1895. URhttp://www.google.com/patents/US552271[crossref]

[10] O. Bolton. Electrical bicycle, 9 1895. URL http://www.google.com/patents/US552271

[11] https://electricbikereview.com,. Accessed: August 2016[10].

[12] https://www.tandfonline.com/doi/full/10.1080/17450101.2021.1897236

[13] Koglin, T., and T. Rye. 2017. "The Marginalisation of Bicycling in Modernist Urban Transport Planning." Journal"

[14] Kaufmann, V. 2011. Rethinking the City: Urban Dynamics and Motility. Lausanne: Routledge[8]

[15] Lopez, A.J.; Astegiano, P.; Gautama, S.; Ochoa, D.; Tampère, C.M.; Beckx, C. Unveiling e-bike potential for commuting trips from GPS traces. ISPRS Int. J. Geo-Inf. 2017, 6, 190. [CrossRef]