

# Design and Fabrication of Foldable Electric Bicycle

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*Abstract*— There is a diversity of bicycle' models in the market, but all of them have circular wheels. So, the question is, could a concept with elliptical wheels be a good idea? What is the best methodology to evaluate this new and unusual bicycle from the ergonomics point of view? This study aims at answering this challenge. From an ergonomic point of view, we considered important measures to evaluate this new concept of bicycle those related with functional efficiency (fatigue and easiness of use), safety (possibility and fear of falling) and pleasure (emotional reactions). In this context, this work discusses the methodological approach to get these measures. The efficiency of the proposed methodology is discussed, by analysing the results of a pilot study. This analysis showed that the proposed methodology was effective to evaluate a new concept of an innovative product. In the concept of smart cities, quickness is something which everyone craves for. People prefer the fastest means while travelling from one place to another. Generally, while maintaining a trade-off between speed, comfort and cost public transit comes out to be the best solution. But since these vehicles have specific routes and stations, people face difficulty in going to the station from source location and then from the other station to destination. Use of fuel powered vehicles is not recommended due to the depletion of fossil fuels, also these vehicles pose a major threat to the safety to the lives of many. Apart from the noise and air pollution, fuel powered vehicles are quite powerful and thus unsafe if don't used with care. A foldable electric bike may be possible solution to these problems. While serving to the needs for ease and speed, it maintains safety. The major target of this foldable electric bicycle for commercialization. This bike can be sold in cities where people need a solution to travel shorter distance at low price with their luggage.

**Keywords:** Multiphase Flow Digester, Biogas, Slurry Temperature, Dynamic Digestion

## I. INTRODUCTION

People who use public transport, they have to travel from home to bus-stop. And when they come back, they have to travel from bus-stop to home. They either travel by walk or they have to call someone from home to pick them up from bus-stop. They can even go by an auto or taxi, but these are expensive and are not eco-friendly. To eradicate this problem, we designed a foldable electric bicycle which is compact (easy to carry with you), eco-friendly, safe, and economical. A Self Rechargeable Electric Folding bicycle, also known as an e-bike or booster bike, is a bicycle with an integrated electric motor which can be used for propulsion. There is a great variety of e-bikes available worldwide, from e-bikes that only have a small motor to assist the rider's pedal-power to somewhat more powerful e-bikes which tend closer to moped-style functionality it is also self-rechargeable by dynamo and folding for flexibility.

All, however, retain the ability to be pedalled by the rider and are therefore not electric motorcycles E-bikes use rechargeable batteries and the lighter varieties can travel up to 25 to 32 km/h (16 to 20 mph), depending on the laws of the country in which they are sold, while the more high-powered varieties can often do more than 45 km/h (28 mph). We have made this cycle with certain changes which reduces lots of Efforts. It will fold According to joints. It will also self-Recharge with the help of Dynamo which converts Kinetic Energy into Electrical Energy and, we can charge at our Home with Charger. As Bicycle foldable by it we can easily carry with our self anywhere. It's most probably without any Fuel. It is Conventional Energy Source and pollution Free.

## II. LITERATURE REVIEW

A foldable bicycle was patented by Keun. Soo Yun of Seoul in 2011. The objective of this invention is to provide a foldable bicycle in which folding structures are formed in such a way that volume get reduced to high extent. Also, to improve riding comfort through the interaction of weight of human body and weight. Here in this invention, there is one head frame and a lower frame which is in two parts. One end of first lower frame is first formed with head frame at the front end and terminal end with the fastened part. Second lower frame is connected at rear end and other terminal is a fastening part. There is third connecting part which is connecting head frame and the terminal joining both lower frames. With the help of fastening points, bike will get fold in such a way that volume will get remarkably reduced. In 2016, Ford Global Technologies patented a foldable electrical bike which seems to be a combination of three parts, viz. front wheel assembly, rear wheel assembly and frame. The front wheel gets folded into the frame and the whole frame slips into the rear wheel assembly on folding. In this way, the cycle is compacted. But this mechanism is very precise and needs high level of calibration. Then in 2017, a company named Beijing Onemile Technology Co. Ltd. patented a foldable bike which worked on very complex mechanism. It also consisted of a separate foldable frame. This cycle is the most recent patent in the field of foldable bikes.

1) Department of Manufacturing and Materials Engineering, International Islamic University, Malaysia's view on Folding Bicycle Design. The study on the aspects of materials, properties and design of folding bicycle frame was performed. Folding bicycle is an important design in human history; thus, it brings benefits to make life easier than before. The fatigue problem (which might extend the life cycle of the folding bicycle frame) is always considered as main problem regarding the properties of the materials. The relationship between materials properties and design is not straight-forward because the behavior of the material in the finished product could be different from that of the raw material. Additionally, the properties like fatigue

and tensile strength are the important properties for the better performance of the frame. The coated swing hinge in folding bicycle is considered as a better joint technique in the design and carries benefits to the user to fold the bicycle since it overcome the limited lifecycle and moreover is simple and cost effective.

- 2) R.S Jadoun & Sushil Kumar Choudhary Professor, Industrial & Production Engineering, College of Technology, G.B. Pant University of Agriculture & Technology, Pantnagar-263145, INDIA. By it we are focus on "Design and fabrication of dual chargeable bicycle" Topic. We get Idea of Self Chargeable Concept. When the battery is fully charged a speed of 10-15km/hr is obtained. When coming down the hill the charging can be achieved in 1hr. Because of friction driven mechanism wheel wear at a faster rate.
- 3) MD Saquib Gadkari, Khemchand Kolte, Mrunal Jasani, Akash Vichare, Beatrice. Fans are the most used items in India despite the widespread availability of Cooler's and air conditioners. Since the initial capital cost of solar systems is still quite high when it comes to generate power for a domestic use and energy saving and energy generating is a major issue for mankind. This paper presents method of generating power by a ceiling fan. The generated power can be either used or can be stored in a battery for powering some other devices. By it we use Dynamo to Convert Kinetic Energy of Its chain wheel we mesh Gear tooth with small gear by it we Generate Power. It Fan's concept we use in our Project.
- 4) J. Sandhu, A. Edgington, M. Grant, N. Rowe-Gurney Department of Physics and Astronomy, University of Leicester, Leicester. With the help of this paper considers the possibility of power generation, using a bicycle dynamo, to recharge a mobile phone. This concept we are use in our project. But we increase RPM and Get more Efficiency. Analysis part also we consider from this Research Paper.

### III. MATERIALS AND METHODOLOGY

The Electric folding Bicycle is a basic structure made up of iron rods and steel structures. First to make structure stable, and light weight we are going to use iron pipes which can make the chassis strong and carry the load on it and the structure is design by the process of fabrication (Gas Welding) and further we are going to assemble the electric motor in the wheel the controller and throttle. After this we are going to assemble the tires and brakes and all electric kit. After the completion of assembling, we are going to measure the load caring capacity. And all the parts which we required are mentioned below with their specifications.



Fig. 1: Schematic of DC motor.

#### A. DC Motor

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. A DC motor's speed can be controlled over an 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.

#### B. Speed Controller

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 C) Plug: - Functions of Pins and brushless motors. For adaptive e-bikes, a conversion kit is used, and the controller is the core component of that kit.

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 purpose-built electric bike, Hall Effect sensors help detects the location 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 un-driven coil is calculated 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. A purpose-built bike, more expensive than an adaptive bike, provides easier acceleration and affords extra features.



Fig. 2: Speed Controller.

### C. Wheel and Motor Sprocket Assembly

#### 1) Steering

We are going to use the steering similar to that of swivelling rod. This system gives nearly perfect steering. Its working is purely on the movements of linkages. Ball joints to have accurate motion in one plane connect linkages. This type of steering system is a simple mechanism thereby easy to design as well as maintenance will become very easy. This system does not consist of any gearings. It is light in weight. So, it serves our purpose reducing the total weight thus helps in propelling.

#### 2) Chassis Design

We will design the chassis according to the layout of the mechanisms and other parts. We may use any one of carbon fibre material or M.S frames.

#### 3) Braking System

For the braking system we shall be using the braking system used in band brake system consisting of spring-loaded friction- shoe mechanism, which is actuated with the help of hand lever.

#### 4) Seat

A great looking carbon fibre bucket seat shell provides excellent lateral support while allowing the upper body freedom to lean into corners. The raised front portion of the bucket seat shell prevents the rider from sliding down in the seat in rough terrain. A built-in relief rib eliminates uncomfortable pressure on the tailbone region. The reversible seat cushion is made from practically indestructible material and is removable for washing. The adjustable lumbar cushion offers added comfort on those long rides. The seat uses quick nuts for easy removal and is mounted to the frame using rubber isolators to help soak up the bumps.

#### 5) Sprocket

The chain converts rotational power to pulling power, or pulling power to rotational power, by engaging with the sprocket. The sprocket looks like a gear but differs in three important ways:

- 1) Sprockets have many engaging teeth; gears usually have only one or two.
- 2) The teeth of a gear touch and slip against each other; there is basically no slippage in a sprocket.
- 3) The shape of the teeth is different in gears and sprockets.

### IV. SELECTION OF MATERIALS

The proper selection of material for the different part of a machine is the main objective in the fabrication of machine.

For a design engineer it is must that he be familiar with the effect which the manufacturing process and heat treatment have on the properties of materials. The Choice of material for engineering purposes depends upon the following factors

- 1) Availability of the materials.
- 2) Suitability of materials for the working condition in service.
- 3) The cost of materials.
- 4) Physical and chemical properties of material.
- 5) Mechanical properties of material.

The science of the metal is a specialized and although it overflows into realms of knowledge it tends to shut away from the general reader. The knowledge of materials and their properties is of great significance for a design engineer. The machine elements should be made of such a material which has properties suitable for the conditions of operations. In addition to this a design engineer must be familiar with the manufacturing processes and the heat treatments have on the properties of the materials. In designing the various part of the machine, it is necessary to know how the material will function in service. For these certain characteristics or mechanical properties mostly used in mechanical engineering practice are commonly determined from standard tensile tests The selection of the materials depends upon the various types of stresses that are set up during operation. The material selected should withstand it. Another criteria for selection of metal depends upon the type of load because a machine part resist load more easily than a live load and live load more easily than a shock load. Selection of the material depends upon factor of safety which in turn depends upon the following factors.

- 1) Reliabilities of properties
- 2) Reliability of applied load
- 3) The certainty as to exact mode of failure
- 4) The extent of simplifying assumptions
- 5) The extent of localized
- 6) The extent of initial stresses set up during manufacturing
- 7) The extent loss of life if failure occurs
- 8) The extent of loss of property if failure occurs

### V. ELECTRIC KIT INFORMATION

#### A. Motor Specification

48v 250w - 500w BLDC Gearless Hub Motor  
Kit Includes (Motor, Controller (17A), Throttle)

Rated Voltage: 48 V

Rated Power: 250-500W

Efficiency: 83.5%

Weight (kg): 6.2 kg

Colour: silver

Application: Electric Bicycle

Brake Type: DRUM (Double Threaded Disc on Both Sides)

No Load RPM: 404RPM

*Controller Specifications*

Rated Voltage: 48 V

Rated Power: 350W

Rated Ampere: 17 A

Braking: Low Abs

Waveform Type: Square Wave

Weight (kg): 0.23 kg

## B. Battery Specifications

24v to 48v battery required (Lithium-ion battery)



Fig. 3: Electric Components.

## VI. CONCLUSION

This paper has discussed all the aspects of the Foldable Electric Bike in details. It can be concluded that the design of the bicycle as per the initial specifications is successfully carried out. While enhancing the proficiency of team members in technical aspects, this project provided a lot of learning beyond technical skills. It taught to be concentrated towards a goal and to complete it in the given frame of time with the available resources. The team had to deal with a wide variety of people. A major learning is to have a never give up attitude which helped in bringing this project to the end. Any project is a long run team activity which requires a healthy coordination among the team members. A lot of research has been done by the team members in the process, starting from the brainstorming sessions with the faculty to decide the idea of the project, followed by the literature review of various design reports and research papers of different electrical folding bicycles. These documents helped in deciding the parameters of the bicycle with their pros and cons. Also, the market analysis was done with full dedication and research work to check the availability of various parts. Apart from this, the design and fabrication processes helped in brushing the technical knowledge and to obtain a practical application of this knowledge.

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