

The Design and Fabrication of Walking E-Bike

Kartik Ranga¹ Kavindra Singh Khangarot² Sandeep Jhamb³

^{1,2}Student ³Head of Department

^{1,2,3}Department of Mechanical Engineering

^{1,2,3}Arya Institute of Engineering and Technology, Jaipur, India

Abstract— This paper focuses on the transformation of normal bicycle in true treadmill bicycle. A different approach is used to design the walkable e bike. In this the frame of the bike. In which the frame is modified to fit the roller and the belt to make a treadmill in between the front wheel and the rear wheel. This will act as a platform to walk. When the person walks on the treadmill, the roller will rotate and this motion will be transmitted to a sprocket, which is connected at the end of the roller. A Pedal assist sensor is connected at the end roller which senses the speed of roller and tells the controller. The controller then sends the amount of current needed to the motor to adjust the speed of motor. Then the motor rotates the rear wheel with the help of sprocket and chain mechanism and hence the bicycle runs as the person walks on it.

Keywords: Treadmill Bicycle, Pedal Assist Sensor, Motor, Controller

I. INTRODUCTION

The walking a bite is a revolutionary idea of bringing the fitness and transportation together. It completely changes the way transportation works. For short distances the walking E-bike provides a mode of transportation which is good for the environment and also good for the health of person walking on it. Any type of personality can run this bicycle. Whether the person is a fitness freak or business person, anyone can use this bicycle to travel short distances. Also, for those people who work a lot and don't have time to take care of their fitness this walking e bike is a must. It provides fitness while serving its purpose of transportation. This walking E bike is an upgraded version of a conventional treadmill. This bike lets the people connect with nature while running on a treadmill. So, this approach transforms the experience of running on a stationary treadmill into a more dynamic form.

The walking a bike uses a simple approach to acquire this level of transportation. It uses a pedal assist sensor which senses the speed of rotation of treadmill and sends the signal to the controller. This system assists the person walking on the bike and helps to run smoother. The walking ki bike uses the mechanism which is operated with the help of bearings, chains, sprockets, motor shaft and freewheel. The motion from treadmill is converted into rotational motion to drive the rear wheel with the help of this mechanism.

This idea of bringing the treadmill and a conventional bicycle will provide a better lifestyle for this generation and also for the future generation. By bringing the walking and riding feature together it will benefit the people having a busy schedule and don't have time to work out. On the other hand, it is fun to ride anyone can ride the walking E- bike smoothly. This invention will completely change the way transportation works.

II. OBJECTIVE

Walking e bike is a new way of Travelling, with electrically assisted. It requires a very less amount of effort to walk than "A walk in the Garden". This concept combines walking, cycling and electric vehicle in one.

In today's era consumption of fuel is increasing day by day so to control the fuel consumption walking E-bike is the best way. It doesn't require any fuel to run.

In today's generation fitness is most important thing so walking e bike is also helps to achieving. It gives healthy environment to the user.

III. LITERATURE REVIEW

In the research carried out by Kachare Jaydeep he deals with converting a normal or conventional bicycle into a Treadmill Bicycle. In his Research the chassis of the conventional Bicycle is completely removed and a new frame is designed to carry a treadmill inspired mechanism. In his project they introduced a simple yet very fascinating mechanism, when the rider walks on the treadmill belt area the belt moves and which further rotates the rear sprocket and the motion is transferred to the rear wheel. Further the motion is assisted by electric motor with the help of RPM sensors used in the rear sprocket [1].

According to Prabhjot Singh 'Treadmill Bicycle' is a step towards saving our environment by providing a very Eco friendly yet a fun to ride Vehicle. They developed a manual operating Treadmill bicycle which eliminated the need of an Electric Motor for initial Torque [2].

IV. DESIGN CONSIDERATION

Main Components and their selection.

- BLDC Motor
- Lead Acid Battery
- Tread belt
- Main frame
- E-bike kit

A. BLDC Geared Motor –

The treadmill bicycle is powered by a 36V/600W BLDC (Brush less Direct Current) Motor which gives a maximum Torque of 1.8 Nm and maximum Load current of 21.4 Amp., This motor produces the maximum of 480 RPM after reduction. This motor is selected because the maximum torque required to get the bicycle from 0 to 25 km/hr with a total load of 150 KG in 20 Seconds is 1.35 Nm.



Fig. 1: BLDC Motor

B. Lead Acid Battery –

The battery configuration is a series combination of three 12-volt 24 AH Lead acid battery which will be equivalent to 36V 24 AH. This battery will produce the output wattage of 864W which will be more than enough to drive the motor to attain the peak performance.



Fig. 2: Lead Acid battery

C. Tread Belt –

As per the dimensions of the frame 900mm X 390 mm Nylon belt is used as the treadmill belt. This belt is anti-slip which will help the user to walk on it efficiently.



Fig. 3: Nylon Treadmill Belt

D. Main Frame –

The material of the frame is Mild Steel, the frame members are hollow square whose width is calculated by considering the Design parameter and Requirements which comes out to be 50mm with thickness of 5mm. the frame is designed to withstand the impact load of the user who is running on the treadmill area and the weight of all the components attached on it.



Fig. 4: Main Frame / Chassis

E. Rollers –

The total of 2 rotating rollers are used in the treadmill area, they are the Conveyor Rollers made up of Mild steel with 38mm diameter and 400mm length, and 12 stationary rollers are used with same specification as the rotating ones.



Fig. 5: Stainless Steel Rollers

F. E-Bike kit –

The e-bike kit consists of several components which are as follows –

- Control Unit.
- Throttle.
- Brakes
- Pedal Assist sensor.
- Wires for connection.



Fig. 6: E-bike Kit

V. CALCULATIONS

We need force required to pull the bicycle and get the wheel rotation. So,

$$F = m.a \quad (1.1)$$

m = mass of body (bicycle)

a = Acceleration of bicycle

Mass, m

= 150 kg (Mass of Walking E – Bike
+ mass of Average Person Standing on it)

Acceleration,

$$a = \frac{\text{velocity from 0 to } 25 \frac{\text{km}}{\text{hr}}, (v)}{\text{Desired Time taken to reach speed of } 25 \frac{\text{km}}{\text{hr}}, (t)} \quad (1.2)$$

Since, Desired time taken for 0 to 25km/hr, $t = 20 \text{ seconds}$

[Conversion $\rightarrow 25 \text{ Km/hr} = 6.94 \text{ m/sec}$]

$$\text{Therefore, } a = \frac{6.94}{20} \quad (1.3)$$

$$= 0.347 \text{ m/sec}^2$$

$$F = m.a = 150 \times 0.347$$

$$F = 52.05 \text{ kg} \frac{\text{m}}{\text{sec}^2} = 5205 \text{ N} \quad (1.4)$$

Torque required, τ

$$\tau = \text{Force} \times \text{distance from central Axis of Motor shaft}$$

$$\tau = F \times r \quad (1.5)$$

$$r = 26 \text{ mm (sprocket Radius)}$$

$$\tau = 52.05 \times 26 \times 10^{-3} \text{ Nm}$$

$$\tau = 1.35 \text{ Nm} \quad (1.6)$$

The required torque is about 1.35 Nm, so we need a motor with Power 600 W and Maximum Torque ranging from 1.3 Nm to 1.8 Nm

Motor Specification –
Supply Voltage = 36v
Output Power = 600W
Speed= 480 RPM
full Load Current=21.4 Amp.
Output Torque = 1.8 N
Motor Efficiency = 78%

VI. 3D MODEL

The project is designed in SolidWorks and rendered in keyshot.

A. Front view: -



Fig. 7: Front View of the Model

B. Top view: -

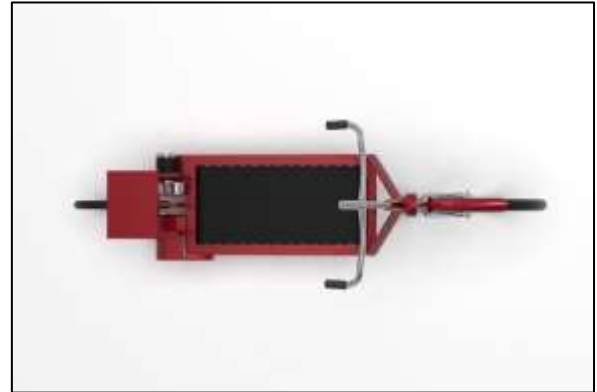


Fig. 8: Top View of the Model

C. Side View: -



Fig. 9: Side View of the Model

D. Isometric View: -



Fig. 10: Isometric View of the Model.

VII. FUTURE SCOPE

The future of the Walking E-bike will be good as people nowadays focusing too much in the fitness and exercise so remain fit and try to make distance with the any sort of diseases. Since walking e-bike has same fating burning process as of regular treadmill present in the gym or home, but walking e-bike make it easier and lets you to exercise outdoor or while you are travelling to your working.

It helps to stay fit and physically active while you are travelling at the same time duration. It can be a good exercise if drive often for a small distance. It comprises with some component that are

Walking E-bike lets you to jog and walking on it as per your speed and age. As its hard-wearing belt that offers a grip which don't let you to slip off or fall off the treadmill.

It also has a feature that helps the people of all the ages that are fit and well balanced to ride the walking e-bike. It's so easy to ride that an inactive person can also ride this e-bike. It comes with immediate apply brake that helps to stop the bike if needed and with that it also comprises with a motor that help to walk on it if u get little bit tired while ride the e-bike.

VIII. APPLICATION

Walking E-bike helps to convert the mechanical energy in to linear motion, from this Walking E-bike we are just trying to convert the walking nature in to a good running speed which can save the energy.

By this prototype we are not only saves the energy resources but also contribute in the electric field which will be going to be our new fuel in the upcoming era.

Some of the point that is present for Walking E-bike.

- 1) Heart healthy- To get a healthy heart we need high cardio, high fat and calorie burn and this can be achieved by this walking E-bike.
- 2) Full body motion- The walking e-bike puts your full body in motion from very first step, and it will not be giving any kind of impact on knees back and shoulders.
- 3) Eco-friendly- As it does not use any kind of fuel so it does not produce any kind of carbon foot prints that to an environment friendly product which is very essential nowadays.
- 4) Economical- Walking E-bike uses the lead acid battery that helps to give 30km per charge at a decent speed.
- 5) Fuel saving- Nowadays people often use vehicle for short trips that makes wastage of fuel, by using e-bike for a short distance work we can easily able to save the fuel at large amount.
- 6) Travelling- Walking e-bike helps to travel over a short distance and also helps to maintain the health. By this you can kill two birds at a time.

IX. CONCLUSION

The Walking E-bike is a bike that helps to achieve a fit body but also helps to travels over shorter distances. It will not only help to reach somewhere but also helps to save time for many people who can't find out time from busy schedule for their health.

The main purpose of walking e-bike is to serves for exercise and travelling and helps to reduce the use of non-renewable energy resources.

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