

DESIGNING A THREE-WHEELED BIKE FOR ROUGH TERRAIN NAVIGATION

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ABSTRACT:

This paper aims to Design and Fabricate a 3-wheeled Electric bike with double suspension for rough terrain as well as high-speed riding. An electric bicycle is a tool that is produced from a combination of a bike as a means of transportation which is added with an electric component as its driving force. An electric bicycle (e-bike) is a motorized bicycle with an integrated electric motor used to assist propulsion. Many kinds of e-bikes are available worldwide, but they generally fall into two broad categories: bikes that assist the rider's pedal power and bikes that add a throttle. E-bikes use rechargeable batteries and typically are motor-

powered, high-powered varieties can often travel more than 60 km/h. The basic principle of 3 Wheel E-Bike is that the electromotive force of an D.C. motor receives electrical energy stored in a D.C. battery. Our e-bike is designed using a unique innovative 3-wheel design where the front 2 wheels are connected in a separate frame and the bike handle and body rest on the mechanism through a unique suspension joint linkages setting. Our E-bike can attain a max speed of up to 80 km/h and mileage of up to 70 km.

Keywords: 3-wheeled

Electric bike, D.C. motor, rechargeable batteries

INTRODUCTION

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. An Electric Bike or Scooter is a battery operated vehicle that is very economical with low maintenance cost and zero pollution. Electric two wheelers use the electrical technology of rechargeable battery that converts the electrical energy into mechanical energy. The battery of an EV can be charged easily using a power connection. 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.

1.1. Project Overview

The progress of automobiles for transportation has

been intimately associated with the progress of civilization. The automobile of today is the result of the accumulation of many years of pioneering research and development. In the modern trend, automobiles have certain disadvantages such as fuel cost relative to mileage, pollution, less efficiency, poor balancing and inability to move over rough terrain. We are introducing an advanced rough terrain 3-wheel E-bike project incorporating an innovation within in the vehicle.

Basic Working

A 3-wheel e-bike typically consists of a battery, an electric motor, a controller, and three wheels. The battery powers the electric motor, which propels the bike forward. The controller is responsible for regulating the speed and power of the motor. To operate a 3-wheel e-bike, the rider needs to switch on the key to start the motor. Once the motor is on, the rider can adjust the speed and power using the controller.

Problem Statement

The main goal is to design a 3 wheel e-bike which can use renewable energy as a power source and provide additional stability to the rider over rough terrain. The devastating problem on both biotic and abiotic components of our home (i.e. pollution) can be reduced by using e-bike as the major mode of transportation in the urban area as well as tough terrains. A natural gift like fossil fuels, wood, etc. which are limited in amount can be saved from crisis and extinction. For people, due to its more efficiency and less harmful impacts, rough terrain 3-wheel e-bike might be a good decision for the intermediate future. So, this project can practically demonstrate the effect of this variation to people.

LITERATURE SURVEY

H. T. Kim have discussed about the ergonomic design of a 3-wheel e-bike for the elderly population.

J. S. Kim have discussed about the presents the design and development of a 3-wheel e-bike for urban use. The study found that the e-bike was

suitable for short-distance travel in urban areas and had a low carbon footprint.

S.

Y. Kim has discussed about the performance analysis of a 3-wheel e-bike for urban transportation. The study found that the e-bike was a viable mode of transportation for short-distance travel in urban areas.

R. G. McKee has discussed about the design and performance factors of electric 3-wheel bikes, including battery life, motor power, and stability.

P. Ferrara has discussed about the study to evaluate the use of 3-wheel e-bikes as a sustainable mobility solution in urban areas.

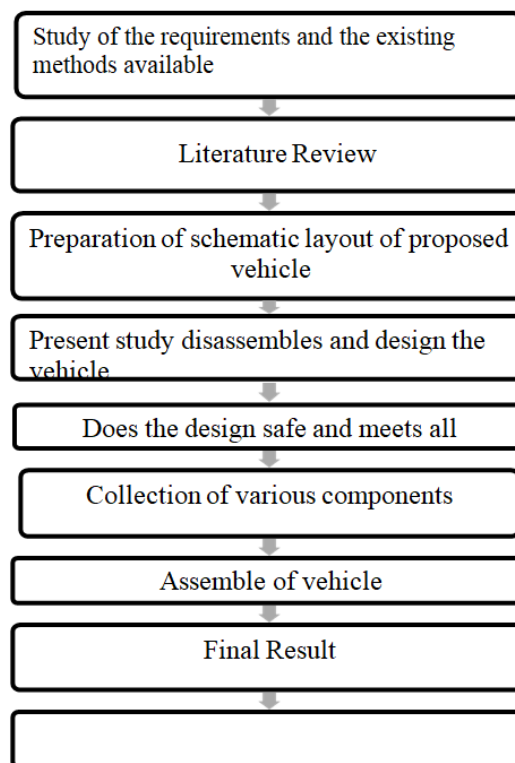
METHODOLOGY
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3.1 Introduction with Work Flow Chart

The methodology could be a method for implementation and developing the project. With the goal of prosperity of the project is looking on how ever the plans are conducted to realize the result.



3.2 Project Planning

The below figure is a schematic representation of basic design of the system. The below diagram shows the flow of control in the systems and the display of various components present in the system. The system consists of a chain drive motor that is driven by the 48V li-ion battery pack. The other components which are represented are frame, throttle, sprocket, rear wheel, front 2 wheel.

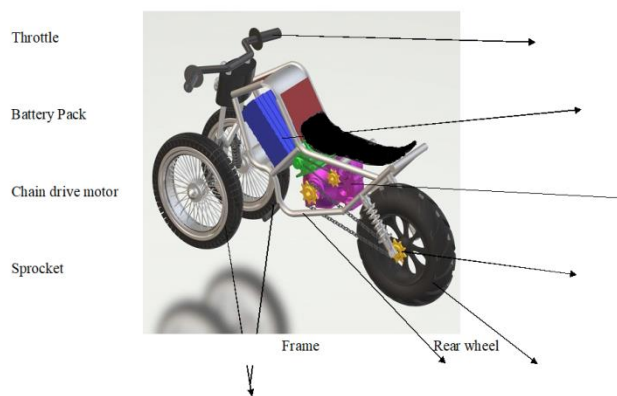


Figure-1 Design of bike Front 2 wheels

Figure-1 Side view of proposed 3 wheel E-Bike

The above figures show the final layout and basic positioning of the parts in the system. In the system the chain drive

motor is placed in the center of the vehicle to provide better stability for the rider.

Vehicle: The Ebike employs the frame, chassis and other structural components are adopted from a normal bike.

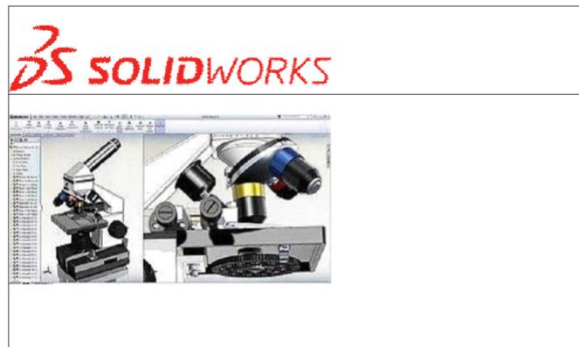


Figure 2- SolidWorks 2012 displaying a 3D assembly in multiple views.

Table 1 – Solidworks Information

Battery: The battery is required to supply energy to run the vehicle through the chain drive Motor. The battery is 48V/30Ahr

Building a model in SolidWorks usually starts with a 2D sketch (although 3D sketches are available for power users). The sketch consists of geometry such as points, lines, arcs, conics (except the hyperbola), and splines. Dimensions are added to the sketch to define the size and location of the geometry.

DESIGN OF VARIOUS PARTS: There are tons of bike-specific terminology to understand if you want to get to grips with how your machine works and what each bike component does. Some are pretty obvious and self-explanatory, whereas other bike parts are a bit trickier. Bike components such as bottom brackets and freehubs have a lot of complexity hidden away – and bike brands seem to love to come up with new and slightly different ways of doing things. Even pedals come in a confusing number of variants.

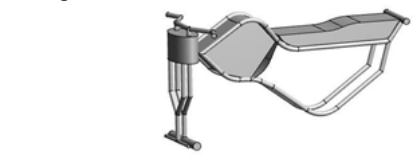


Figure 3 Bike Frame Design
Tools used – Draw the sketches for the frame and trim the extra parts from them. Creating an angle and

turning the sketch by 90 degrees. Make the Solid Sweep from there required draw the union.

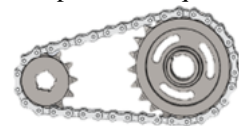


Fig-4 Chain Sprocket and path Design
Tool Used – Select the front plane and sketch the chain sprocket. With the help of extruded boss tool, extrude the chain sprocket. Now use the extruded cut tool to obtain the required shape.

Isometric View – Isometric view uses segments of equal length to create a three-dimensional image on a two-dimensional surface. Since isometric means equal measure, from the

Developer(s)	Dassault Systems
Initial release	November 1, 1995; 26 years ago
Stable release	SolidWorks 2021 SP2.0 / January 11, 2021
Operating system	Microsoft Windows
Type	CAD and CAE

Greek derivation, images in isometric view should be drawn so that they have equal size pieces. As seen in the image of the cube, the result is that the axes intersect at 120-degree angles.

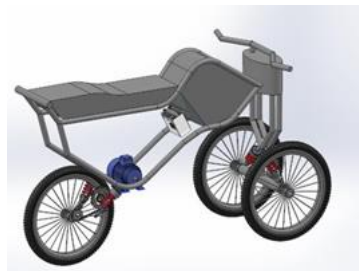


Figure 5 Vehicle Isometric View
Side View: The side view is a drawing that shows the object as it would appear from the side. It is a two-dimensional representation of the object, with the height and width dimensions shown in their

true proportions, but the depth dimension shown as a single line.

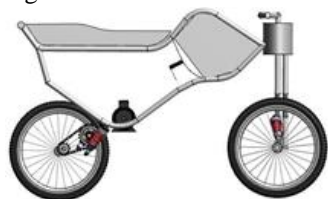


Figure-6 Vehicle Side View

REQUIRED COMPONENTS FOR THREE WHEEL E-BIKE High Power Motor

An electric motor that is intended to produce a large quantity of power or mechanical output is known as a high-power motor. It can provide a lot of torque and handle heavy loads. Applications requiring a lot of power, like industrial machines, electric cars, marine propulsion, aerospace systems, and heavy equipment, use high-power motors.

Specifications of Power Motor

Power	750W
Voltage	48VDC
Speed	480r/min
Type	Chain Driven

Table-2 Specifications of power motor

Chain Drive

In battery-powered vehicles like electric motorcycles and bicycles, chain drives are typical forms of propulsion. Chain drives provide effective power transfer and consist of a motor-driven sprocket, a chain, and one or more sprockets on the wheels or drivetrain. Chain drives enable efficient power transfer, result in increased overall performance, with mechanical efficiencies that are typically in the range of 90% to 95%. Chain drives have the ability to change gear ratios, which is one advantage. In order to achieve optimal performance and endurance, chain drives do need routine maintenance. To minimize wear, reduce friction, and prevent chain failure, routine chores including cleaning, lubrication, and tension adjustment are required.

Motor Mount

A motor mount is a key component that houses and secures an electric motor in place in

various industry and automotive systems. Its main job is to stabilize and support the motor, guaranteeing perfect alignment and reducing noise and vibration. Usually, motor mounts are made to withstand the mechanical forces and stresses that are produced when a motor is operating. Durable materials that offer strength and stiffness, such as steel or aluminum, are used to build motor mounts. They are redesigned to support the weight and torque generated by the motor, offering a stable attachment to the machine or vehicle's chassis.



Figure-7 Motor Mount

Shock Absorbers

To manage and reduce the impacts of shocks and vibrations, vehicles and machines must include shock absorbers, sometimes referred to as dampers. Their main job is to dissipate the energy produced by bumps, uneven terrain, and other disturbances, resulting in a smoother and more controllable functioning. The oscillations and vibrations brought on by these disturbances are dampened by shock absorbers in conjunction with springs.

Drum Brakes

Although the widespread use of disc brakes in recent years has reduced the use of drum brakes, they are still a common braking method for motorbikes. However, some motorcycles still have drum brakes, especially entry-level or inexpensive versions. A drum brake consists of a metal drum that is mounted to the wheel and is often constructed of cast iron or aluminum. Curved brake shoes that are lined with friction material and located inside the drum are frequently referred to as brake linings or brake pads.





Figure-8 Drum Brake Handle Drum Brake E-Bike
 The motorcycle's handlebar, sometimes known as the "motorbike handle," is an essential part that gives the rider control and manoeuvrability of the vehicle. It is often built of a robust, long-lasting material like metal, such as steel or aluminium, and is intended to be lightweight. A major bar that extends horizontally from the steering stem of the motorcycle's front forks makes up the handlebar.
Battery: E-bikes frequently employ lithium-ion (Li-ion) batteries because of their high energy density, light weight construction, and long cycle life. They provide a next extended range and constant performance for electric bikes, making them a dependable and efficient power supply. The following details on lithium-ion batteries used in e-bikes:

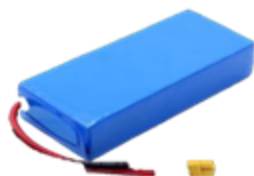


Figure-9 Li-ion Battery

Specification of battery

Weight	3.4Kg
Voltage	48V
Current	30A
Charging Speed	6-7hrs.
Discharge Speed	4-5hrs.

Table-3 Specification of Li-ion battery

Specification of controller

Confined Voltage	40-50V
Confined current	45A
Power	1000-1500W
Temperature	60-120C

Table-4 Specifications of controller

RESULT

Stability: The three-

wheel design provides enhanced stability, especially on uneven or challenging terrains. The additional wheel adds stability and balance, making it easier to navigate rough terrain with confidence.

Off-road Capability: A rough terrain 3-wheel e-bike is designed to handle various off-road conditions, including gravel, dirt trails, and rocky surfaces.

Electric Assistance: The e-bike features electric assistance, which means it is equipped with a motor and battery to provide pedal assist or full electric propulsion. This makes it easier to traverse rough terrain, particularly when climbing hills or tackling steep inclines.

Enhanced Comfort: Rough terrain 3-wheel e-bikes often feature suspension systems to absorb shocks and vibrations from uneven surfaces. This results in a smoother and more comfortable ride, reducing the impact on the rider's body and enhancing overall comfort during off-road adventures.

Accessibility: The three-wheel design of these e-bikes can make them more accessible for riders with balance or mobility issues. The additional stability provided by the third wheel can instill confidence and allow individuals who may struggle with traditional bicycles to enjoy off-road adventures.

CONCLUSION

Rough terrain 3-wheel e-bikes are purpose-built machines that excel in off-road environments, offering a multitude of advantages for adventurous riders. With their unique three-wheel design, these e-

bikes provide enhanced stability, control, and traction, making them ideal for tackling rough terrain such as gravel paths, dirt trails, and rocky surfaces. The additional wheel at the front distributes the weight evenly, resulting in improved balance and reduced risk of tipping over, especially on uneven surfaces. This increased stability instils confidence in riders, allowing them to push their limits and explore challenging trails with ease.

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