

A Review: Design, Analysis & Optimization of E-Bike

Mane Shital¹, Gawade Anjali², Dhumal Suraj³, Waghmode Pankaj⁴

^{1,2,3,4}Student, Department of Mechanical Engineering Department, S. B. Patil College of Engineering, Indapur, Maharashtra, India

Abstract - The main purpose of this paper is to present the idea of designing E-BIKE with minimum cost as well as should have great efficiency. During the revolution for the eco-friendly technologies e-bike were the most depended modes of e-bike transportation, along with this the consideration of the increase in fuel price and the environmental factors. We must admit that is far more better to use an e-bike over a motor vehicle for short distance travelling-bike running cost is very low compare to other available source. Nowadays there are several type of automobile but the cost of fuel goes on increasing. Over all these disadvantages the e-bike is best solution. In market there is many types of attractive looks e-bike available in market. Its cost of electric supply for the battery charging also very low. As well as the maintenance cost is also low.

Key Words: Controller, Battery, BLDC Motor, Design

1. INTRODUCTION

Main reason to identify the need of finding and modifying E-BIKE is to overcome the issue of the pollution because of the vehicles in metro towns & urban zones is swelling uninterruptedly. Day by day there is increasing cost of fuel Also their availability decreases. For that reason people try another type of energy source. Electric motorcycles are noiseless, pollution free. The large use of the travelling vehicles has increased the problems connected to the air quality and to the use of petroleum.

India is the second most popular nation in the world. Like many other countries where agriculture is the main activity, biomass and other non-commercial fuels constitute around 40% of energy requirement in India.

E-Bike is the plug-in electrical vehicles with two or three wheels. The power on which this bike works is stored in a rechargeable battery which drives the motor, in India, many of the villages are still without electricity and most of them use E-BIKE as their medium of transportation. This would charge the Lithium-ion batteries. The feasible design concepts of a power-assisted are presented with detailed analysis of its performance during standard duty cycle. The main purpose of using this E-bike is that is user eco-friendly, economical and relatively cheap. In village e-bike are used in transposition purpose.

2. LITERATURE REVIEW

C. Abagnale ^[1] this studied that system model is based on the longitudinal vehicle dynamics and on the electrical motor

one: the pedelec dynamics can be expressed as a combination of the bicycle longitudinal dynamics and the electric motor dynamics. A new model of power-assisted bicycle has been designed, set up and tested. The main innovative solutions for the pedelec prototype are described in the present paper: the electric motor position; the new mechanical transmission; the low cost measurement system of the driving torque; the special test rig. Differently from a common approach in which the electric motor is located on one of the three hubs of the ebike, the idea of the pedelec prototype consists of an electrical motor in the central position that, by means of a bevel gear, transmits the torque on the central hub.

Robert Cong ^[2] Experimentally Investigate This project revolves around supplying and utilizing energy within a high voltage battery. It demands for a battery with longer running hours, lighter weight with respect to its high output voltage and higher energy density. Among all the existing rechargeable battery systems, the lithium ion cell technology is the most efficient and practical choice for the desired application. The battery chosen for this project was a high capacity lithium ion battery pack designed specifically for electric bikes by Golden Motor Technology Co Ltd. Aluminum casing is provided to house the internal components of the battery yet remains at a reasonable weight below 12.12 pounds. The battery is rated is at 48V, 12AH. A maximum electrical output results at an approximate constant speed of 50km/h (31mph). The amount of charging cycles of the battery is greater than 800.

Lithium ion batteries are one of the most popular types of battery for portable electronics. Although slightly lower in energy density than lithium metal, lithium-ion safe, provided certain precautions are met when charging and discharging. With its many advantages over other conventional types of batteries, the lithium ion battery was the optimum choice for an electric powered ebike.

Shao - Yuan Fang ^[3] This paper presents the design of an axial-field PM brushless D.C. motor drive for use on an electric bicycle. The electric motor for use on an electric bicycle should be small in size, light in weight, and should have a high efficiency. Due to space limitations, the motor must have a short axial length. The motor must provide sufficient torque to overcome the road load which consists of the aerodynamic drag, the rolling resistance, the tractive force against the gravitational pull when climbing up a slope, and the tractive Assuming a payload of 110 kg (which includes the weight of the cyclist, weight of the bicycle, and

the weight of goods carried) and a maximum speed of 20 kmph, the rolling resistance is 11 N while the aerodynamic drag is 2 N approximately. The maximum power consumption on level road is about 72 W. A bicycle for adults typically has a diameter of 0.66 m, hence the motor torque required is 4.5 N/m and for a direct drive the motor speed is about 200 r/min. In order to reduce the motor size and hence the cost, the pedals should be retained. These provide auxiliary torque for starting and acceleration, thereby avoiding large surge currents from being drawn by the drive motor. This 'power-assisted' option also obviates the complicated licensing procedures required by law for power-driven vehicles. Force for acceleration. They Conclude applicability of Electromechanical system (based on the brushless electrical drive fed from 24V and 36V battery supplied DC link) with control system realized according to the requirements to operate with maximum efficiency and high power density during the standard duty cycle.

Dennis H. Braun ^[4] They studied in electrical e-bike system occurs due to the regenerative power regulating to prevent a DC-link over-voltage condition. Regenerative power control circuit is absorbing regenerative power in the battery. Details of the motor and the electronic converter are given. The regenerative power control for electric bicycle method is a sample and a low-cost solution. The battery types chosen in this work are Nickel Metal Hydrate with a nominal voltage of 24V and 36V and a 9Ah capacity. The battery voltage level indicates how the vehicle is moving: acceleration leads to its reduction, in the opposite case, it leads to its increase, and the regenerative braking happens. In the latter case the control system activates the Buck converter to store part of the kinetic energy in the super capacitors bank.

Senatore A. ^[5] Experimentally investigate that human sensibility for the energetic and environmental problems is encouraging the research in alternative solutions for the automotive field, as multiple-fueling, hybridization, and electrification. At the same time, particularly as concerns urban areas, new standards have imposed substantial modifications in the mobility.

Vignesh M. ^[6] How the design and analysis of the frame was done, based on the requirement of the customer. The collection of data consists of several factors such as availability, machinability, cost, reliability, feasibility and ergonomics. The total length, height and weight were also taken into considerations. The selection of rake angle is the crucial part in designing of bike frame. Rake Angle also called as steering head angle, which is the angle between the neck and the vertical axis of the wheel axle. It determines the type of vehicle whether it is a cruise or sport type vehicle. It plays a major role in inducing stability of the vehicle. The angle for the front neck with respect to the vertical axis is 19° which might optimize the length of ebike.

3. CONSTRUCTIONAL DETAILS:

There are following components are to be used in the formation of E-Bike.

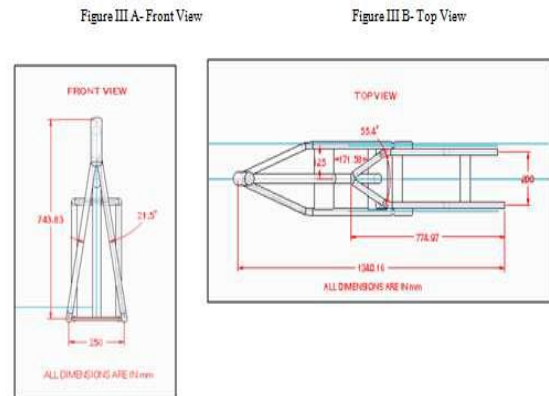


Fig-1: Design of Electric Bike

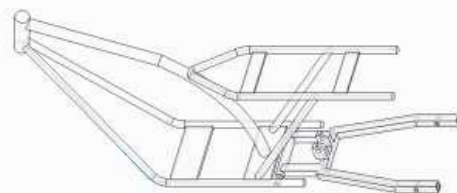


Fig-2: Isometric View of assembly diagram

- Base Frame
- BLDC Motor
- Lithium ion battery
- Control unit/ PCU
- Swing Arm

4. METHODOLOGY

3.1 Setting of Wheel Base Geometry

After the completion of neck angle, considering the wheel base of 1530mm, a base line is drawn to initiate the design of the frame for the mountings such as motor, battery, controllers and other accessories as per customer's requirements.

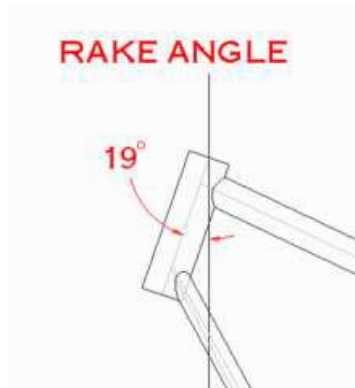


Fig-2: Design of Rake Angle

It also includes the construction of the frame's main link seat tube; which acts as the base for placement of rider's seat as well as suspension. Additional significance is considered for the selection of the bend angle and diameter of the tubes. Finally the top tube, down tube and supporting structures were also considered and developed towards completion.

3.2 Swing Arm

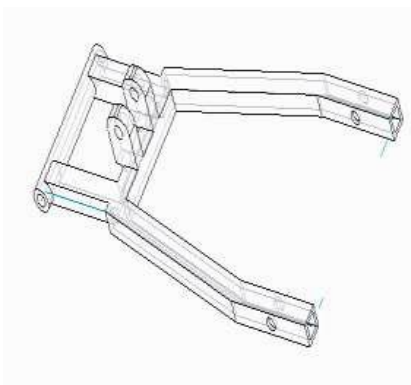


Fig-3: Isometric view of Swing Arm

Swing arm is an ideal mechanical link which connects the suspension with transmission system. It was connected to chassis with the help of connecting pin. The suspension provides the action, in order to maintain the consistent contact between wheels and roads. For such sufficient action, the swing arm acts as the major platform for after design completion of frame and swing arm separately, assembly was performed by combining both the frame and the swing arm. Thus an assembled design was produced as a result.

4. MATERIAL SELECTION

The selection of the material in design depends on various factors such as load, function, climatic condition, lifetime, and overall expenditure. Taking the above factors into consideration, material selection was done in order to design an efficient and economical type of frame. Steel Alloys, Aluminum and its alloys, Titanium, Carbon Fiber was

preferred type of materials during selection. Comparatively, AISI 4130 Alloy Steel was used in the present study as it is easily available, cost effective, and has improved mechanical properties.

5. CONCLUSION

With the increasing use of natural resources of petrol, diesel it is important to shift our way towards alternate resources like the Electric bike and others because it is essential to identify new way of transport. Electric bike is a modification of the existing cycle by implementing electric energy and solar energy if solar panels are provided, that would sum up to increase in energy production.

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