

Design and Manufacturing of Dry Battery Based Electric Bicycle

Prof. R. K. Nanwatkar¹, Mr. Rushikesh Deshpande², Mr. Rahul Ingale³, Mr. Vaibhav Kshirsagar⁴, Mr. Aditya Kulakrni⁵

Assistant Professor, Mechanical Engineering, NBSSOE, Pune, India¹
UG Student, Mechanical Engineering, NBSSOE, Pune, India^{2,3,4,5}

Abstract: *This project deals with the design and fabrication of a low-cost portable electric bicycle kit, which can be mounted on existing bicycles. It has two modes of drive; one is by pedaling and other one is by using an electric motor. The electric bicycle kit consists of a 250W Brush type DC motor which is powered by a 24V lead acid battery. E-bikes use rechargeable batteries and lead acid ones can travel up to 40 km/hr. and some electric bicycles speed can do excess of 55km/hr. There are two types of Electric Bicycle; one has a smaller motor to assist the rider's pedal power. The other one is a more powerful E-bike which are closer to moped style functionality, but all retain the ability to be pedaled by the rider. Major drawback of a traditional bicycle is it increases rider fatigue on long distance travel. Thereby implementing an external drive (electric motor), which can be switched between pedaling and electric drive and this will help to increase the range of travel, better riding experience and reduce rider fatigue. Expected range of an E-Bike is around 20-40 km on a single charge. E-bike can travel at a speed of 20 km/hr.*

Keywords: Low-Cost Portable Electric Bicycle Kit, Rechargeable Batteries, Electric Motor, etc.

I. INTRODUCTION

Ogden Bolton Jr in 1890 was granted with a U.S patent for a battery powered bicycle with “6- pole brush and commutator direct current which was a hub motor mounted on rear axle of bicycle”. It had no gears and the motor could draw up to 100 amperes from a 10- volt battery. Later in 1897, Hosea W. Libbey of Boston invented an electric bicycle which was propelled by a “double electric motor”. Production of the E-bike grew from 1993 to 2004 by 30-35%. Less expensive E-bikes used bulky lead acid batteries because of the huge growth they started using NiMH, NiCad and Li-ion batteries which was lighter and denser capacity batteries. These were used mainly because of the performance; however, there is an increase in range and speed with the new developments towards the E-bike. In 2007 E-bikes were increased by 10 to 30 percent of all two wheeled vehicles in major cities.

Aim:

The main motive of this project is to not to use any kind of fossil fuels and also to decrease the noise pollution.

II. PROBLEM STATEMENT (BRIEF PROBLEM STATEMENT)

1. To maximize the speed and efficiency.
2. To optimize the cost.
3. To reduce the rider physical effort compared to traditional bicycles.
4. It can be propelled by a combination of pedaling and a battery powered electric motor DETAILED

III. OBJECTIVES

1. The main purpose of this project is to review the current situation and effectiveness of electric bicycle researched by various researchers. In order to approach this purpose, following objectives are specified:

2. To maximize the speed and efficiency
3. To optimize the cost.
4. To reduce the rider physical effort compared to traditional bicycles iv. It can be propelled by a combination of pedaling.

II. LITERATURE SURVEY

1. C. Abagnale, M. Cardone, and P. Lodice “Design and Development of an Innovative E-Bike” they have designed power-assisted bicycle by using the new mechanical transmission as installing the motor as the pedal axle. This present paper describes about the pedal prototype which as a motor at the pedal axle as to increase the cost and to make the mechanism compact. This innovative solution is represented by the motion transmission from the motor to the pedal shaft which is achieved by using two different gear boxes, the first type is by using the planetary gear box and the second type is using simple bevel gear. This pedal as a new low-cost measurement system by using the driving torque based on a strain gauge load cell located on one side of the rear wheel which is between hub and the frame. This test rig is able to reproduce aforesaid parts acquired during the road tests, to measure the e-bike performance in terms of instantaneous power and speed this test rig also can simulate the resistant torque of a predetermined track and it also aims to test and to optimize the control strategy available on the electronic control unit.

They have also conducted an environmental analysis of the developed pedal prototype which is particularly compared with the e-bike with a thermal moped, in terms of environmental impact. The authors have tried to achieve a different form than the common approach by using electric motor which is located on one of the three hubs of the bicycle, they came up with the idea of pedal prototype. This paper deals with the activity carried out on the pedal prototype which is an innovative power-assisted bicycle which is designed at Department of Industrial Engineering of the University of pedal Federico II: a pedal characterized by a new low-cost measurement system of the total driving torque of the e-bike (Rider torque + Electrical motor torque) and also by an innovative layout of electrical assistance.

The pedal motor system is characterized by a driving torque due to both rider torque and an electric motor one. As the large use of traveling vehicles as increased problems which are connected to the air quality and the petroleum usage, this human-electric bicycle that supports the rider with electric power only when the rider is pedaling which can be the future of substantial modifications in the mobility of the e-bike, particularly in urban areas which is also the alternative solutions for multiple-fueling, hybridization and electrification.

2. Deep R Prajapati, Kunjan Shinde, Abhishek Mhakshe, and Aniket Prabhu “Design and Fabrication of Electric Bike” is the authors of this paper gives the exact view by bridling the various sources of energy available to mankind. They have also mentioned about the electric bike which runs on the battery by providing voltage to the motor. This paper also compromises with fabrication and design of e-bike which makes use of electric energy as the primary source and also solar energy by attaching solar panels, and it also a provision for charging the battery by removing battery from the main system.

The electrical power generated by the e-bike is used to run the bike and also for better performance compared to conventional vehicles which also causes less pollution. The system which they have innovated as various benefits both to the members of the team and also external benefits by making awareness of using alternative modes of transport, the e-bike which works on the battery powered motor is a general mode of transport for local trips. The solar panels can also use to be an alternative source for charging the battery when stationary they are using an AC motor which is powered by using DC battery and switching that electrical energy in the form of electric current to the AC converter circuit which is used to convert AC to DC but the obtained AC current is amplified again and fed to the stator winding of the AC motor.

They have tried to make the bike more efficient and cheaper and also to aid shorter distances by people of any age the solar panels are used to increase the energy production when not in use the main motive of this project is to not

to use any kind of fossil fuels and also to decrease the noise pollution since this e-bike as fewer components it can be easily dismantled to small components which perfectly leads to lesser maintenance.

3. Boopathi S, Saranya A, Raghuraman Sand Revanth R “Design and Fabrication of Low-Cost Electric Bicycle” this project is based on charging arrangement of electric bike they have used a motor which is powered by a battery which can receive electric energy from the hub dynamo, this energy is used to recharge the battery as the recent years are more interested in electric bikes and less maintenance cost this project has been initiated. As market available batteries are designed to spend 6 to 8 hours per charge by using EB supply. And e-bikes running cost is very low when compared to conventional vehicles. But they use 3 to 4 battery packs of 12V batteries. This bike uses only one 24V battery by which the cost has been reduced. This battery is charged by the hub dynamo which also reduces the electric supply cost.

The authors have initiated this project to reduce the energy consumption used by the e-bike which can be helpful in villages and urban areas as in rural areas most of the people use bicycle as a medium of transportation which can be helpful to reduce riders’ fatigue to travel long distances easily. As dynamo or an alternator is used for harvesting the electric power which is generated by the rider while riding can not only charge the battery and increase the range but also helps the rider’s physical fitness. In this project dry batteries are used to reduce the weight and to charge electronic gadgets like Mp3 players and mobiles etc. the issues associated with the e-bike maybe addressed by the custom designed drives that are more efficient over the ordinary operating cycle. As this can be used by comparison of existing drives in a systematic, comprehensive and technical way.

4. Vivek V Kumar and Karthik A “Design and Implementation of Electric Assisted Bicycle with Self-Recharging Mechanism” this project on centration eco-friendly technology, bicycle was the most independent mode of eco-friendly transportation so bicycles are considered. As e-bikes requires lesser effort applied by man for climbing slopes and riding in rough terrain, so this idea is used to develop the basics of their project called “The E-Bike” they have developed a combination of standard gear bicycle with an electric motor cum alternator which would assist the rider throughout his journey. Hence their system is modified in such a way that rider can choose a mode which it prefers i.e., we can either choose the bicycle to be driven by electric motor or it can choose to manually pedal by himself this idea of the system will effectively reduce the rider’s effort but also increases the weight that rider has to take along with the bicycle.

This is mainly designed in such a way that people of any age group can depend on it. As the people of India are trying to move towards “clean” energies this can be a huge potential growth in the market. The currently existing electric scooters are costlier compared to Ebikes, middle class persons cannot afford such a locomotive at his budget, hence lower cost e-bikes can be easy to manufacture and cheaper to afford by the common man. Therefore, above all ideas were planned to design a product which can compete with electric scooters. The main aim of this project was to fabricate a prototype that would be very light and comfortable for the rider to handle. As a motor and the other driving components would take more space in the system their design challenge was to make the motor – alternator as a single component in the system they have developed a motor cum alternator at its minimum possible size and also at the lowest cost possible.

Their other challenge was to mount the battery near the motor or could have used carrier location, as keeping the riders comfort in mind they have mounted it at the carrier location. The power transmission system consists of a motor, chain and sprockets, flywheel, housing and the rear wheel. Before they could select these components, they have performed some basic calculations relating to the energy transfer through the system primarily. They focus on the current requirements of the system, and a number of torque–speed relationships. They have to estimate when the motor requires the most current and the duration that it would draw its peak current.

This situation was considered in their calculation to select the desired battery, this project includes programming the software accompanied with the Arduino Board. When the “initialize motor” command is used charge starts to flow from the driver to the motor. and when the program enters the loop, the potentiometer values get a translated

to equivalent bytes which lets the board to allow the charge pass through the motor increasing or decreasing the speed. Once the loop is exited, the program goes back to the initial state. The conclusion of this project is to simplify the riding with minimal effort on flat as well as gradients and also to increase easiness of riding on rough terrains.

5. Mitesh M, Trivedi and Manish K “Design and Development of E-Bike” in this project author’s main reason is to identify the need to modifying e-bike to overcome the issue of pollution because of vehicles in metro towns and urban zones is swelling uninterruptedly considering, all the class of society it is not reasonable to purchase scooters or motorcycles. So, by combing both issues environmental progress supporting and economically affordable alternative would be a best solution. There are two parts of the electric bicycle as per their working and functions: Power on Demand and Pedal Assist.

The motor is activated by a throttle with power – on –demand, customarily and bar – mounted as well as on general scooters and motorcycles. By pedaling electric motor can be controlled with pedal assist, this pedal assist augments the effects of the rider when pedaling the e-bikes are known as pedal have a sensor to identify the force and speed of pedaling. Disabling the motor is the brake sensing action, the main purpose of this project is to review the current situation and effectiveness of electric bicycle which they have researched in order to approach the objective to maximize the speed and efficiency and to optimize the cost. The main objective of this paper was to explore the acceleration and speed of manually and electrically powered bicycle.

The author has considered the importance of easy feature of the e- bike. Which makes it mobile. The conclusion of this project is to ensure comfortable, compact, high speed and effective e-bike can be achieved. The results from the experiment which as obtained by different author’s advancement in current e-bike model includes pre discover results from literatures like the selection of materials of frame tubes and aerodynamic design.

ACKNOWLEDGMENT

It is indeed a great pleasure and moment of immense satisfaction for we to present a project report on “Design and Manufacturing of Dry Battery Based Electric Bicycle” amongst a wide panorama that provided us inspiring guidance and encouragement, we take the opportunity to thanks to thanks those who gave us their indebted assistance. We wish to extend our cordial gratitude with profound thanks to our internal guide Mr. R. K. Nanwatkar for her everlasting guidance. It was her inspiration and encouragement which helped us in completing our project work. Our sincere thanks and deep gratitude to Head of Department, Prof. D. H. Burande and other faculty member; but also, to all those individuals involved both directly and indirectly for their help in all aspect of the project. At last, but not least we express our sincere thanks to our Institute’s Principal Dr. S. P. Patil, for providing us infrastructure and technical environment.

REFERENCES

- [1] Vivek V. Kumar, Karthik A, “Design and Implementation of Electric Assisted Bicycle with Self Recharging Mechanism” International Conference on Innovations & Advances in Science, Engineering and Technology [IC - IASET 2014]
- [2] Deep R. Prajapati, Kunjan Shinde, Abhishek Mhaske, “Design and Fabrication of Electric Bike.
- [3] Boopathi S, Saranya A, Raghuraman S, “Design and Fabrication of Low-Cost Electric Bicycle”
- [4] Christian Gorenflo, Ivan Rios, Lukasz Golab, “Usage Patterns of Electric Bicycles: An Analysis of the We-Bike Project.
- [5] Ian Vince McLoughlin, I. Komang Narendra, Leong Hai Koh, “Campus Mobility for the Future: The Electric Bicycle”.
- [6] C. Abagnalea, M. Cardoneb, P. Iodicea, R. Marialtoc, S. Stranoa, “Design and Development of an Innovative EBike”71st Conference of the Italian Thermal Machines Engineering Association, ATI2016, 14-16 September 2016, Turin, Italy.
- [7] Mitesh M. Trivedi, Manish K. Budhvani, Kuldeep M. Sapovadiya.