IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 01-04

Foldo E-Cyk

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Abstract: *Imagine a futuristic world with flying cars and flying people, of course with jet packs. Now, this a fine vision for development, but development is not an egg that just hatches one day it is like a child that grows slowly. In this ever-growing, ever-developing world, one does not think much about the other side of the coin. Progress, today, is synonymous with the deterioration of our environment. As most of the vehicles in the present world are petroleum fuel based, the only alternative to these remains the cheapest and simplest vehicle of all, a Cycle. In today's fast running world a bicycle may seem like a snail' s sprint machine, but electric cycles have changed the scenario, leading to the incorporation of electric systems in cycles and thus increasing the speed at the output. A solution has also come to the compaction factor in the form of folding cycles. Our project aims at folding an electric cycle. Although such projects have been made earlier, our project is trying to incorporate a self-charging system in an electric, folding cycle.*

Keywords: *batteries, dynamo, electric, environment, folding, motor, self-charging*

I. Introduction

An electric bicycle is a bicycle with an electric motor that supports pedalling. A battery powers the motor. With the same amount of energy from the cyclist, the e-bike has a higher speed compared to the conventional bicycle. In other words, a cyclist on e-bike needs to give less energy to reach same speed as a cyclist on a conventional bicycle.

With this project of ours we aim at creating a better, cleaner, healthier world. The frame will be aluminium, the most abundant metal in the earth's crust. This ensures that we take up resources from the nature that are easy to use and recyclable and also make a system that does not exploit any other resources in the form of fuel, by introducing an electric self-charging system. In addition to it, this product gives the flexibility of extreme urban vehicular efficiency. One can carry the cycle in buses, trains, etc.

There are many types of electric or folding cycles in the market, with researchers coming up with mini-sized electric cycles which can pile up more distance in a single charge as well as can be carried in backpack. Also there are cycles which are solar powered as well as makes use of dynamo to charge the batteries[5]. But a normal folding electric cycle is generally 8 to 9 kilograms heavier than the conventional cycles due to the use of motors, batteries and sometimes even dynamo.

Folding electric cycles are a boon to daily commuters as it saves cost, time and even the environment, thanks to its eco-friendly nature.

II. Problem Definition

Currently, the major problems faced by the people is congestion. Lots of vehicles on the road means heavy traffic as well as finding a place to park your vehicle. Environment issues like pollution, global warming, etc. also occurs due to the emission from these vehicles. The next major problem is the problem of scarcity of the fuels. Also the problem of the vehicle being theft is a serious issue. With this project, we aim to solve the major issues of portability, traffic, theft, energy scarcity, size and pollution.

III. Components

The Foldo E-Cyk is a cycle where motor, dynamo and batteries work together simultaneously to give the desired output. The components used for making this project are explained below.

3.1 Battery

The heart of any electric vehicle is a battery and the heart for electric bicycle is no different. There have been many electric cycles which makes use of lead-acid batteries [5] and lithium ion batteries [3]. In this project,

we make use of Lithium Polymer batteries which has a voltage rating of 12V and a capacity of 2200mAh. The two batteries are connected in series to get the desired 24V output to run the motor.

The reasons for choosing lithium polymer batteries were its capacity to store more energy, its size and weight. Also it is available in various shapes which means integration of batteries in the desired space is possible.

The batteries to be used for self-charging system are lithium ion batteries of 12V and 2200mAh. These batteries are considered for self-charging system because lithium polymer batteries can be easily damaged in case of overvoltage or overcurrent.

3.2 Controller

The controller basically consists of IC LM339 which is basically a comparator which has four comparators in it. The comparator compare the input signal with the reference signal and provide output.

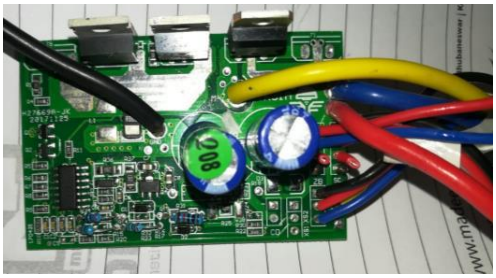

Figure-1

3.3 Dynamo

A dynamo is a machine that converts mechanical energy to electrical energy. A dynamo is basically used mainly in e-bikes for headlamps and tail lamps. Also it can be used to store energy in batteries.

For this project, we use a 12V, 6W dynamo for developing a self-charging system.

3.4 Electric Brakes

The electric brakes are usually used to cut off the motor during its run. This saves the motor from damage due to reverse currents flowing in it. Also the electric brakes have mechanical brakes which are used to stop the movement of the wheel i.e. it works as a combination of electric as well as mechanical brakes.

3.5 Hinges

There are different folding techniques which can be used for cycles. The folding can be done at different location keeping in mind the balance of the entire structure as well as its centre of gravity. The hinges we used for folding are normal door hinges which folds the cycle exactly from the centre of its entire length and not from the centre of its wheelbase. Also the handlebars of cycle can be folded. Here in this project we make use of customized designed 3D printed hinges which helps to fold the handle into two halves in the plane of the cycle, thus reducing its size.

3.6 Motor

A motor converts electrical energy to mechanical energy. A motor plays a huge role in the electric vehicles. There are various types of motors used for e-bikes like a brushed magnet dc motor or a brushless dc motor.

For this project, we use a 24V, 18.6A, 350W Permanent Magnet DC (PMDC) motor.

Figure-2

IV. Design

4.1 Mechanical Design

There are many methods adopted to fold a cycle. There is method of having a rotating arm which folds the cycle in such a way to bring the rear wheel to the front with its axis being near the pedals[9].

Figure-3

In this project we make use of hinges to fold the cycle. The hinges being welded on the central rods folds the cycle to bring it to half its length. The total length of the cycle is 1380mm the ground to seat height (adjusted to maximum height) is 760mm (refer Figure-3). After folding the length is reduced to 720mm (refer Figure-4).

Figure-4

4.2 Electrical Circuitry Design

The electric circuit basically consists of a motor, battery and controller. The motor is powered by the batteries while the controller controls the amount of power to be given to the motor according to the throttle input. The motor comes with class E insulation which takes cares of its temperature handling capacity.

For self-charging system, a dynamo is used which is fixed at the front wheel and is connected to a bridge rectifier, since the output of the dynamo used is ac while for charging the batteries dc supply is required. A voltage regulator IC LM7812 is used which regulates the voltage. A battery management system (BMS) is used for protecting the batteries from overcurrent or overvoltage. The self-charging system is currently in development path. The entire system is shown in Figure-5.

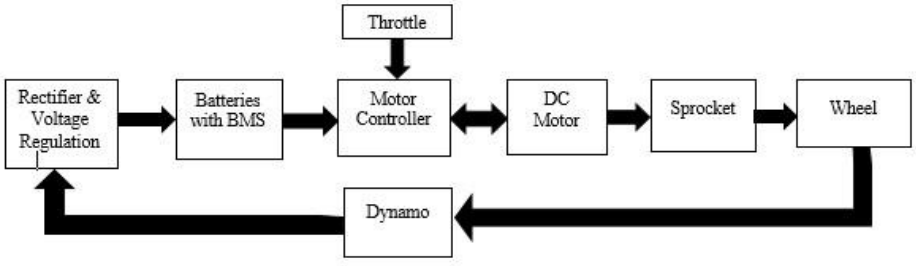

Figure-5

V. Testing

The e-bike was tested on no load as well as with varying loads. The e-bike was successfully tested on smooth roads as well as rough roads. The results are given in the next section.

VI. Results

The e-bike was tested with various loads and the data is given in the following table.

Sr. No.	Weight (kg)	Speed (kph)
1.	62	25
2.	69	23
3.	75	19

Table No.1

The discharging time for batteries used on no load turned out to be 68 minutes. And normal discharging time for batteries on load is around 30 to 35 minutes.

VII. Future Scope

The next stage in the project includes the up-gradient testing of cycle, implementation of self-charging system where the dynamo would be used to charge the batteries, pedal-assist system wherein the motor runs according to the amount of force applied on the pedals and not with the use of throttle. Also there are some features to be added like the speedometer and battery level indicator.

VIII. Conclusion

Currently the Foldo E-Cyk has following advantages: portability, size, eco-friendly, and cost saving. There are limitations though which include the weight has increased by around 7 kilograms from its original weight. Also the battery discharging time can be controlled more efficiently. Further there is a scope for increasing the battery capacity as well as using the heat energy generated during motor operation to generate electricity and charge the batteries. As of now, the project can be easily use for daily commute as a substitute to conventional cycle.

Acknowledgements

This research was supported by Mr. Kunal Kashikar (CEO, Isagon Tech) and Mr. Amit Padhy (CEO, AVP Robotics) and we thank them for greatly assisting the research. They have contributed in every aspect of the project from mechanical to electric circuitry designing.

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