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# Design and Implementation of Smart Electric Bicycle

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**Abstract**: The increasing demand of energy all over the world become the concerning subject, which inspire us to go towards renewable resources of energy. There are various ways to save energy in different sector and that is the main moto of our project. Where we are converting old conventional bicycle into E-bicycle. While making this E-bicycle, we use electrical motor (pmdc motor) which have low maintenance cost, no noise with suitable battery (LiFePO4). These E-bicycle uses chemical energy store in renewable battery. This paper deals with design and development of E-bicycle converted from conventional cycle, in which electrical energy used as primary sources.

**Keywords**: Conventional bicycle, Pmdc motor, Electric bicycle, LiFePO4.

## I. INTRODUCTION

As we know that today's world is facing lots of problems regarding climate change. It happens because of pollution. Mainly because of Air pollution. In-country Like India, most of the carbon emission happens because of the burning of carbon means for the production of electricity which is 261 tonnes per year from which 94.5% of carbon emission is generated by road transport. This promotes the use of Electric vehicles which is an alternative to IC engine Vehicles. India has successfully adopted the regulation of EVs. In 2021 more than 20 million two-wheelers per year were sold of which 6 million are scooters. At present, the percentage of EV scooters is less but, in the future, they are expected to replace the IC engine scooters. As in the future a large number of EV scooters or e-bicycles will come into the market so are moving towards one easier and cheaper option known as electric bicycle. The major motive to design the e bicycle is to reduce the problem of environmental pollution and of economy. In order to make the world a lot better and for upcoming generation, future e- bicycle is the best technical application as a solution the e-bicycle is a battery-operated bicycle which is outstandingly economical with low maintenance cost and lesser pollution for both conventional bicycles and traditional automobiles e-bicycles are an applying option which contributes to an environment friendly, fun, efficient and convenient way to travel. E-bicycles are propelled with the help of battery which is coupled with e- motor. Now a days these e-bicycles are manufactured at very large scale. Generally, the parts used in e-bicycles are pmdc/ bldc motor, battery, controller, and chain set.

## II. LITERATURE REVIEW

I] Vladimir Dimitrov [1] proposed a method in which he has given the details about the possible ways to design an electric bicycle based on the following domains electrical, mechanical and system level design and it also gives the solutions to the problems we face in each of mentioned domain.
The primary focus of this paper was to present the different ways that have been gathered in the scientific literature to design an electric bicycle. The pros and cons in choosing a particular solution are also discussed.

II] N. Pavan Kumar Reddy [2] proposed a method in which he has given the details about with the help of control system how we can design a simple, cost-effective model of e-bicycle.
This paper lists the hardware design guidelines for designing an electrical bicycle. And also lists the design criteria for an effective selection of motor, controller, battery, suspension system, breaks, material.
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## III.HARDWARE DESIGN

This section mainly describes all the physical devices that are required to build an E-Bicycle. As we mentioned here that the paper works on the hardware, electrical components, and protocol required for communication hardware, electrical components, and protocol required for communication.

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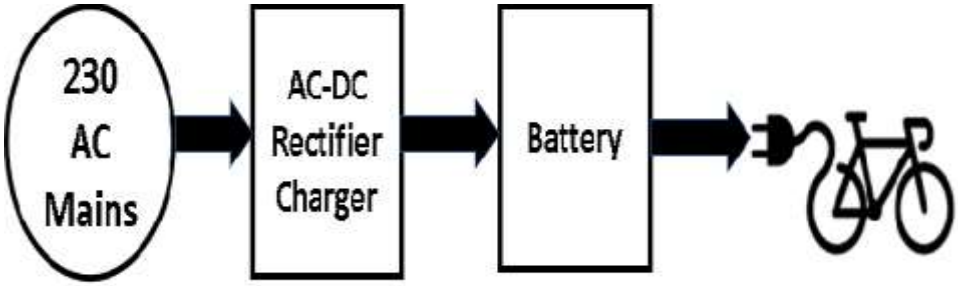


Fig. 1. Block diagram representation of the architecture.

The material should be accurate because the E-Bicycle has high duty cycles thereby we should select based on their sturdiness and durability. Each component is selected as one of the criteria. First, the components should be easy to interface with the chosen processer. The second one should be scrutinized all the pros and cons of all the components and documentation available for it. The third and most important part is the price based on its function in the product. The architecture of the system consists of the input device, power meter, and output device. This system also needs to package in a study enclosure for outdoor developments. Figure 1 represents a basic block diagram of the system. Components of E-Bicycle. The E-bicycle consist of following components.

### I] PMDC MOTOR

The motor is having rated power of 250W capacity with maximum350W rpm per min, there specifications are as follows:
Rated Voltage- 24V
Rated current- 12.2A
Maximum Speed- 20-25km
Load Carrying capacity- 80-85
Gear ratio- 9.78:1

Fig:1 PMDC motor

Only one person can ride the cycle with very minimum load. If you get a bumper while cycling, you will not be able to travel at low speed. And hence we have to speed up the motor at highest value to cross the bumper. In the same way if we are travelling on upstream then we have to drive the cycle at maximum available speed.

### II] BATTERY

A Lithium-ion batteries are the rechargeable batteries. It has used in many electric vehicles. Now a days, in this battery the Lithium-ions moves from the negative electrode to the positive electrode during discharge and back when charging. It is more efficient as it is less in weight, it has high speed and zero pollution and are more reliable.

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Fig: 2 Battery

In electric bicycle group of battery cells are connected into the series, connection which helps to provide nominal pack voltage of 24, 36, 48 Volt. As are using 250 W pmdc motor 24-volt battery capacity is sufficient to drive the bicycle.

## III] CONTROLLER

This Motor Controller 24V for 250W includes attachments for the motor, accelerator, brake, battery, battery charging, brake light, power lock. DC Motors are popularly known as scooter motors or general application motors. It is extremely durable and reliable. It's commonly found in 24V scooters or even small kid's carts and it's also been a proven motor in robotics.

Fig: 3 Controller

The E-bike controller is the brain of the e-bikes. It is connected to all the other electronic parts such as the battery, motor, and throttle if it exists. It takes all the inputs from all the other components and determines what should be signalled to them in return. This motor brush controller for Electric bicycles & scooters is compatible with the 250W DC motor.

## IV.CALCULATION

**I] Calculation for Torque:**
As the PMDC motor is being used with 250W power and 3300 rpm with 24 V and 3 amps. Motor can be reaching a peak current during starting equal to 6 amps.

P= 2*3.14*N*T/60
250=2*3.14*3300*T/60
T=0.72379Nm= 723.79N-mm

**II] Calculation of gear ratio:**
Chain drive reduction= 49/16=3.06:1
Wheel shaft torque= T*R chain

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= 723.79*3.06
= 2214.7974 N mm
Wheel shaft speed = 3300/3.06
= 1078.43 rpm.

## V. TESTING

**Testing performance of cycle: -**
After the proper assembling of our cycle, we tried riding it and tested various parameters like Speed, Distance travelled in a charge, MAX speed, Speed Downstream and upstream.
Following are the results:

Final Speed: 25Km/h
Distance travelled in a single charge: 17km (varies on the capacity of the battery)
Max speed: 29.5Km/h
Downstream speed: 30.5Km/h
Upstream speed: 24.5Km/h

Fig :4 Actual Image

## IV. CONCLUSION

Electric vehicles are the future of our world with the increasing concussion of non-renewable resources such as petroleum, diesel which leads us to step our way towards the renewable sources such as solar hydroelectric power and battery. There are alternative ways by which we can save energy. One of such way is electric bicycle or electric bike; it is also the new way of transport which provides us easy way of transport to provide of any age. It is cheap source of a transport and affordable to anyone. The motor used in this bicycle has high efficiency and the battery bank has less weight with high speed. These bicycles are environmentally friendly, needs less maintenance and can be also assembled to small components. Engineering Department, for the whole support, innovative ideas and encouragement that we received during the entire course of project work.

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