

Designing Battery Operated Electric Bicycle

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Abstract— Our day-to-day life, fuel vehicles are very important for travelling from one place to another. But now a day, cost of fuel going to increase. And we know these fuels are limited or non- renewable and produce pollution in air because of burning of fuel. So, design electric vehicles but these vehicles used for short distance travelling and these vehicles are costly for poor people that they can't buy or due to corona virus pandemic. We all know, cost of battery is so expensive to purchase. So, this paper totally focus on design electric bicycle and battery to make at reasonable price.

In this project, we used bicycle, hub motor kit, lithium-ion cell, bms, charger. This electric cycle and lithium-ion battery can design. We modify old cycle into new electric bicycle. Here we also have pedal assist system.

Indexed Terms-- Hub Motor, Controller, Battery, Battery Charger, Throttle, Anti- Theft Alarm, Head Lamp.





I. INTRODUCTION

Our day-to-day life, fuel vehicles are very important for travelling from one place to another. But we know that, this vehicle produce pollution in air or environment because of burning fuel. There is also available Electric vehicle for short distance travelling. To limit global warming there is one agreement “Paris Climate Agreement” is a legally binding international treaty on climate change. India, being the 3rd largest consumer of bicycles in the world and in 2020, the Indian bicycle industry hit a peak that it hadn't reached in the past decade because people can't buy fuel or electric vehicle because cost of vehicle is expensive that is why they travelled by bicycle or bus and due to Corona Virus Pandemic. So we have been designing ELECTRIC BICYCLE. Electric Bicycle is cheaper than other vehicles. It is eco-friendly for our

environment. Pedaling or cycling make our body is fit, increased muscle strength, etc. It is also help in less traffic, take less space for parking. There is one carrier for sit and keep material. It is easily balance. It is safe. We all know, cost of battery is so expensive to purchase and this battery use in electric vehicles.

That's why we also design BATTERY to get at reasonable price. Design of tracking system with low power can be useful with the help of IoT for future analysis[13-14]

II. LITERATURE REVIEW

Project Name	Component Required	Year	Image
Design and implementation of low cost electric bicycle with battery level indicator [10]	250W BLDC hub motor, 295.6WH li-ion Battery, PAS, controller, throttle	December 2020	
Design and Fabrication of a self- charging bicycle [11]	Bicycle, BLDC motor, Dynamo, Lead Acid Battery, Bridge wave rectifier, Sprocket (4 nos.), Chain	2018	
Electric Bicycle with three Way Charging [6]	BLDC hub motor, Solar panel, li-ion battery, Controller , battery control and protection	April 2016	
Design and Development of BLDC controller and its implementation on E-Bike[12]	BLDC hub motor, battery bank, Controller box , Throttle, speed meter	July 2018	

III. METHODOLOGY

Block Diagram of Electric Bicycle

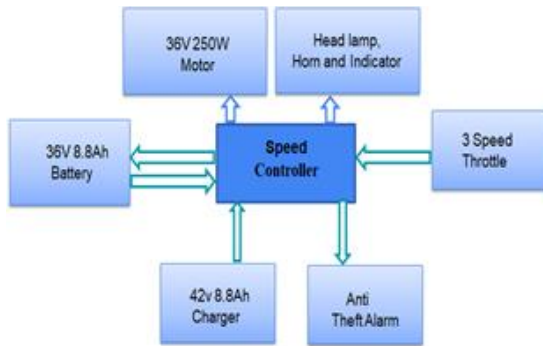


Fig.1: Block Diagram of Electric Bicycle

Circuit diagram of Electric Bicycle:

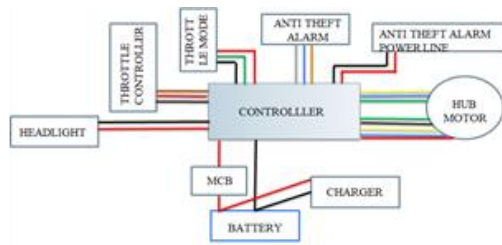


Fig.2. Circuit diagram of Electric Bicycle

Working of Electric Bicycle:

1. Switch on the MCB. Now Controller start to work. Here controller is the brain of the system or electric cycle.
2. Give signal to the controller to open the lock by Remote to drive cycle.
3. Now twist the throttle, the cycle will accelerate and go forward and turns on the motor to rotate, it takes supply from controller and controller gets 36V 8.8Ah supply from battery.
4. Then Electric cycle ready to ride.

IV. COMPONENT DETAILS

4.1 Hub Motor

Type: 36V 250W rear hub motor

Hub gauge: 4mm

Hub diameter: 14.8cm

Bear of hub: 3.4cm

Hub motors are brushless motors also called BLDC hub motor, innerr part with the coils is called stator and the outer part is called rotor.

- How it is works: the electronic circuit sends power to the copper coils in turn, making the gray outer case spin around the copper coils and circuit board.
- How does the circuit know which of the coils to switch on and off and when? there are several tiny magnetic field sensors known as Hall-effect

sensors positioned between some of the coils. As the permanent magnets on the outer rotor sweep past them, the Hall-effect sensors figure out where the north and south magnetic poles of the rotor are and which coils to activate to make it keep spinning. The trouble with this is that it means the motor does need an electronic circuit to operate it.

4.2 Brushless Sine Wave Controller

50W 36V Controller Main technique parameter:

Controller type: Brushless type

Rated voltage: 36V

Rated power: 250W

Under-voltage protection: 30-32V

Current limiting protection: 17A-19A

Adaptation motor: 36V 250W

Ambient temperature: 20°C--45 °C

- The controller is the main parts of an electric bicycle, it is the brain of the electric bicycle, controlling the motor's speed, start, and stop.
- It is connected to all the other electronic parts such as the battery, motor, and the throttle (accelerator), Headlight Switch Control and Charger port.

4.3 LED Headlamp

A headlamp is lamp attached to the front of a vehicle to illuminate the road ahead.

4.4 Throttle

Type: 3Speed Throttle

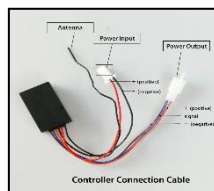
Installation: Left/Right [6]

- A throttle is a handle that can be twisted to operate and control the motor.
- It is connected at the right handle bar of cycle. When the throttle is twist the motor provides power to the motor and the bike forward.



4.5 Anti-Theft Alarm

- The Anti-theft alarm system is used to protect our bicycle if anyone take. It works with the help of sensors.
- IR sensor is installed in it and if anyone movements is happen the vehicle then triggers the Anti-theft alarm system and sounds the alarm. The alarm goes off and alerts the



owner. Even, the change in the vehicle's position it can also alert.

4.6 Component Connection to the Cycle



4.7 Connection of Lithium Ion Battery:

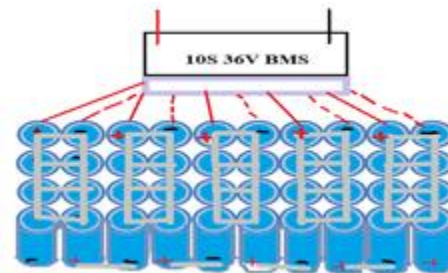


Fig.3 Connection of Lithium Ion Battery

4.8 Lithium-ion Cell (18650)

Voltage: 3.7 Volts

Capacity: 2200 mAh

Rechargeable: Yes

Battery Size:

Diameter- 18mm x

Length- 69mm



Lithium-ion batteries power the lives of millions of people each day. From laptops and cell phones to hybrids and electric cars, this technology is growing in popularity due to its light weight, high energy density, and ability to recharge.

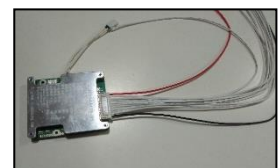
4.9 Battery Management System

Modal: Li ion BMS 10S 36V

Voltage: 1.8V

Current: 15A

BMS is use to keep the battery within the safety operation region in terms of voltage, current, and temperature during the charge.



4.10 MCB

A Miniature circuit breaker is an automatically operated electrical switch. It is used to prevent damage to an electrical circuit due to the excess current to trip during an overload or short circuit to protect against electrical faults and equipment failure.

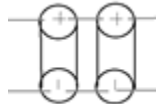
There are two methods

1. Hairdryer
 2. Lighter
- Here we use lighter as shown in fig.

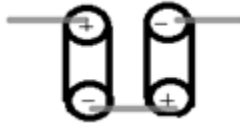


4.11 Battery Arrangement in Series and Parallel

1. Check voltage 3.7V by multi-meter.
2. Connect 10 cells in series (+, -, +, -,).
3. $36V/3.7V = 9.729 \sim 10$ cell in series



4. Connect 4 cells in parallel (+, +, +, +, -, -, -, -).
5. $8.8A/2.2A = 4$ cell in parallel



6. Continue Connection
7. Complete connection

4.12 Connection of the BMS to the Battery

1. red wire connects to the positive terminal of the cell 1.
2. Black wire connects to the negative terminal of the cell 40.
3. White wires connect to the negative terminal of cells as shown in the fig.
4. Remaining to the positive terminal of the cells.



4.14 42V 2A 84W Universal Battery Charger Li-ion Power Adapter for Smart Electric Scooter [13]

- Universal
- Power Input: 100-240VAC,50/60HZ,1.7A
- Output Voltage: 42V V
- Power Consumption: 84 W
- Overload Protection
- Power Cord Included

Charger used to charge Battery. This charger Protect from overvoltage and overheating protection and Over Temperature.

- Calculation of Battery Charging Time:
 Battery Ampere's = 8.8A
 Charging Current = 2A
 Time for Full Charge = ?

$$\text{Time for Full Charge} = \frac{\text{Battery Ampere}}{\text{Charger Ampere}}$$

$$= \frac{8.8}{2}$$

$$= 4.4$$

$$\text{Time for Full Charge} = 4 \text{ hours } 25 \text{ minutes}$$

- Calculation of Battery Discharging Time:
 Battery Ampere's = 8.8A
 Load Ampere's = 6.94A
 Time for Discharge = ?

$$\text{Time for Discharge} = \frac{\text{Battery Ampere's}}{\text{Load Ampere's}}$$

$$= \frac{8.8}{6.94}$$

$$= 1.27$$

$$\text{Time for Discharge} = 1 \text{ hours } 16 \text{ minutes}$$

4.12.1 Nickel strip connection to the battery by Spot Welding:



Spot Welding



doing Spot



Series and parallel nickel strip



Complete connection of Ni strip by Spot

4.13 PVC Sleeve wrapping of Battery



4.15 Features of Electric Bicycle

Hub Motor	36V 250W
Speed Controller	36V 250W
Battery	36V 8.8Ah
Battery Charger	42V 2A
Throttle	3 speed
Anti-theft Alarm	Remote
Charging time	4-5hrs
Battery Mileage	25-30km/h

CONCLUSION AND FUTURE SCOPE

Electric Bicycle is successfully operated using Battery.

Electric Bicycle is efficient to use. Have less maintenance. It is eco-friendly for environment. Save fuel, riding with minimum effort. This bicycle also gives safety driving for human because of its limited speed. Electrical bicycle is cheaper affordable to anyone.

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