

Urban Electric Bike

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Abstract— Increasing demand for non-polluting mechanized transportation has revived the interest in the use of electric power for personal transportation and also reduced reliance on automobiles. Electric bike is a low cost alternative to an automobile. The project is based on the fabrication of an electric bike that will help to commute the last mile. The system consists of a battery power source. The power module is controlled by a BLDC motor controller so as to control a 350W 60V 2.2A DC hub motor which runs off by a 60V 2.2Ah Lithium Ion battery for better performance. A Folding Mechanism is also available which makes the E-Bike compact in size. The final system has features that will appeal to a broad spectrum of users.

Key words: BLDC Hub Motor, Twist Throttle, Folding Mechanism

I. INTRODUCTION

An electric bicycle, is a bicycle with an integrated electric motor which can be used for propulsion. E-bikes use rechargeable batteries and the lighter varieties can travel up to 20 to 30 km/h. The E-bike appears to be a cheap, clean and flexible alternative for automobiles. The E-bike might prove a good alternative for short distance trips. Its advantage is the development of cycling infrastructure. Therefore the E-bike can be used as and when required for the 'last mile travel'.

A. Objectives:

Our E-Bike is:

- Compact- Foldable enough to be accommodated in trains, buses, cars etc
- Lightweight-the weight is around 15 kg.
- Cheap-It will compete with existing last mile travellers.
- Fast- It travels at a speed of 25 kmph.
- Reliable- It has a range of 12 km.

II. METHODOLOGY

The Urban Electric Bike consists of the following components (Fig. 1) – hub motor, lithium-ion battery, motor controller, twist throttle.

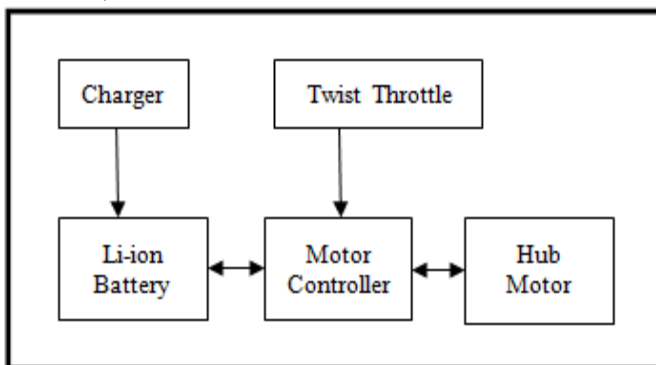


Fig. 1: Block Diagram of Urban Electric Bike

A. Folding Mechanism:

Folding is the key feature of the e-bike and this would not have been possible without the folding arms. A bolt is provided such that the arms can slide easily on the bolt. A guide has been provided on the main frame to provide rigidity to the bike. Both the plates are welded on front arm of the bike and a constraint is provided on the back arm to restrict the angle between the two arms to 50°.



Folding Arms



Guide with Slots



Folded



Unfolded
Fig. 2: Folding Mechanism

B. Hub Motor:

Ordinary electric motors use a mechanical device called a commutator and two contacts called carbon brushes to reverse the electric current periodically and ensure the axle keeps turning in the same direction. Hub motors are typically brushless motors which replaces the commutator and brushes with planetary gears and an electronic circuit. The Hall Effect Sensors help to locate the position of the permanent magnets and which coils to activate to keep the motor spinning.



Fig. 3: Hub Motor

Type of Motor	Hub Motor
Design of Motor	5 inch BLDC
Power Rating	350W
Torque	16 N-m
Speed	300 rpm
Rated Voltage	60V

Table 1: Specification of Hub Motor

C. Twist Throttle:

A Twist throttle works on the principle of potentiometer. A variable resistor called potentiometer is used which varies the voltage passing through the throttle. The more twist is

provided less is the resistance and hence more current passes through it. Hence twist throttle gives the signal to the BLDC hub motor controller to increase or decrease the current passed to the motor.



Fig. 4: Twist Throttle

D. Lithium Ion Battery:

Lithium-ion batteries are most commonly used type of rechargeable batteries as they are compact, lightweight, provide the same voltage as compared to the heavy lead acid batteries and there is slow loss of charge when they are not in use.



Fig. 5: Li-ion Battery

Type of Battery	Lithium Ion Battery (with built-in short circuit protection)
Size (l x b x h) (in cms.)	20 x 15 x 3
Voltage	60 V
Amp-Hour Rating	2.2 Ah

Table 2: Specification of Lithium Ion Battery

E. Motor Controller:

The E-Bike Controller includes the following connections:

- Battery: two terminals +ve(red) and -ve(black)
- Hall effect sensors: blue yellow green red black
- Motor: red yellow green
- Twist throttle: blue red black
- Power lock: orange red



Fig. 6: Motor Controller

F. Assembled E-Bike:

The Urban Electric Bike is driven by BLDC Hub Motor fitted in the front axle and is operated by battery power. The speed of the E-Bike is controlled by means of twist throttle which will vary the amount of current passing through the controller and hence to the hub motor. The key feature of the E-Bike is that it can be folded by means of folding arms which helps it to be accommodated in situations where it is not in use.



Fig. 7: Urban Electric Bike

Weight	15 kg
Rider's Weight	100 kg
Load Capacity	120 kg
Size (Folded) (in cms.)	26 x 46 x 83
Size (Unfolded) (in cms.)	70 x 46 x 83

Table 3: Specification of Urban E-Bike

III. FUTURE SCOPE

- The bike can further be improved by using: Solar panels and piezoelectric materials on the front and the rear frames of the mudguards or other places which would be responsible for trapping energy & converting the same into electric energy thereby improving the battery's efficiency
- The weight of the bike can be significantly reduced by using a lighter material like carbon fibre, aircraft grade aluminium.

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