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Electric Commuter 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.

Keywords — BLDC Hub motor, twist throttle, folding mechanism, Lithium Ion Battery, Motor Controller.

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 17 kg.
Cheap-It will compete with existing last mile travellers.
Fast- It travels at a speed of 21 kmph.
Reliable- It has a range of 8 km.

II. METHODOLOGY

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

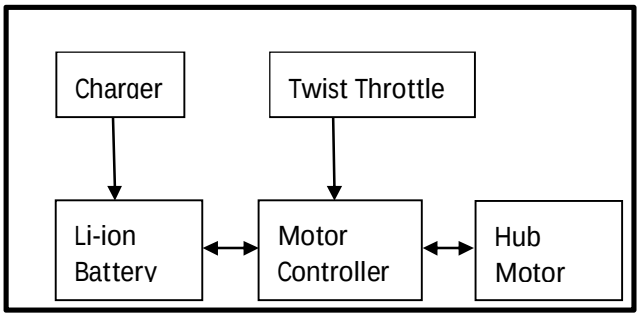


Fig. 1: Block Diagram of Electric Commuter Bike

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°.

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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. It can provide a voltage variation of 0-60 V.



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. Here we have used 2.2 Ah battery as we wanted more compactness and less weight. To increase the range of the bike, higher capacities of Lithium Ion batteries can be used; but the weight of the bike as well as the cost will increase.



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

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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 Electric Commuter 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. As per our design, the weight is more on the back side as compared to the front. So the center of gravity is shifted to the back side. Hence a stand is provided to balance the center of gravity because of which no load acts on the motor at folded position. 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: Electric Commuter 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 Electric Commuter Bike

III. RESULTS

Parameter	Electric Commuter Bike	Bicycle
Maximum Speed Limit	21 kmph	10-15 kmph
Driver's Pedaling Requirement	No	Yes
Cost	21000 Rs.	3000 Rs.
Weight	17 kg	15 kg
Max. Traveling distance at a stretch	8 km	15-20 km
Charging Time	2 hrs. for 2.2 Ah Battery	Not Applicable
Type of Energy Used	Electrical power	Muscle power

Table 4: Comparison of Electric Commuter Bike and Bicycle

IV. 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.

To increase the range of the bike, higher capacities of batteries can be used.

V. CONCLUSION

It is clearly seen that hybrid economy ensures a cleaner and more economical solution to the energy crisis. People use bikes and fuelled vehicles for even travelling short distances without making use of cycles and other non –fuelled vehicles. Most number of people from the list have been those which think riding a cycle is equivalent to providing extra effort for cycling.in order to avoid this an electric assistance has been provided to the cycle that will ease the user to ride the unit with the help of a motor. All these aspects are available keeping in mind the factor of pollution being affected at all.

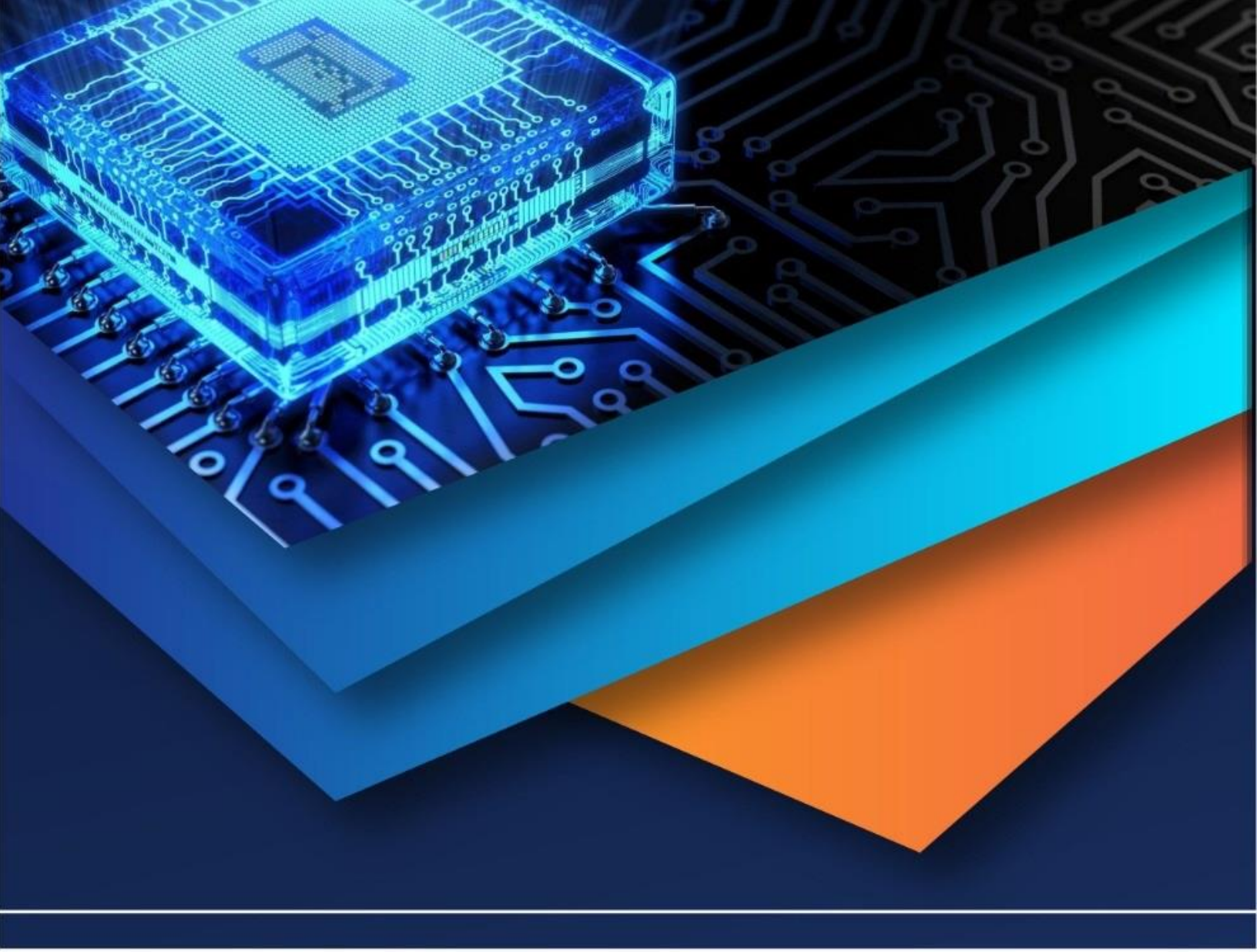
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