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DESIGNING AND MANUFACTURING OF ELECTRIC SCOOTER

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Abstract - Electric vehicles have been attracting unprecedented attention in light of the volatile market prices and prospect of diminishing supplies of fuel. Advances in battery technology and significant improvements in electrical motor efficiency have made electric vehicles an attractive alternative, especially for short distance commuting. BLDC motors are being encountered more frequently in electric vehicles due to their high efficiency and robustness. Motor scooter manufacturers worldwide grapple with the new design challenges posed by electric motor scooters. The competition world is where the most cutting-edge design solutions are firstly tested. The present study examined the initial design and consequent iterative process of improvement and development of a e-Scooter. All parts are designed to be fabricated in Mild Steel.

***Key Words: Electric Vehicle, Battery, BLDC Motor*:**

1. INTRODUCTION

The concept of the battery electric vehicle is essentially simple. The vehicle consists of an electric battery for energy storage, an electric motor, and a controller. The battery is normally recharged from mains electricity via a plug and a battery charging unit that can either be carried onboard or fitted at the charging point. The controller will normally control the power supplied to the motor, and hence the vehicle speed, in forward and reverse. This is normally known as a 2-quadrant controller, forwards and backwards. It is usually desirable to use regenerative braking both to recoup energy and as a convenient form of frictionless braking. When in addition the controller allows regenerative braking in forward and reverse directions it is known as a 4-quadrant controller.

Fig-1: 3D model of E-Scooter.

1.1. Literature Review

The main aim of this review paper is to present the idea of harnessing the various energy and use it in today's existence of human life. For human being travelling has become vital. In order to sustain in this fast forward world he must travel from place to place. It is very important that time taking for travelling should be less, also it should be economical and easily available. Electric bike which will be driven with the help of battery and thus provide required voltage to the motor. The focus of this report is to perform power calculations and system design of this Electric Bike. The paper presents a review on Portable Electric Bike (PEB)[1] use the paper presents a review on Portable Electric Bike (PEB) In addition to the primary function of battery protection, a BMS should estimate the battery status in order to predict the actual amount of energy that can still be delivered to the load. This is quite a challenging task, as the performance of the battery in terms of usable capacity and internal resistance, varies over time. Another important function of a BMS is to extend the battery life by facing the charge unbalancing issue that may arise in series-connected cells [2] about the electromagnetic loss of the motor under different working conditions is

different. The traditional design method is based on the rated working point for the electromagnetic design of the motor. The electromagnetic design method of the motor at the working point is difficult to ensure that the comprehensive efficiency of the motor for the vehicle under the actual operating conditions of the vehicle is the highest, and even the efficiency of the motor at the rated design point is high, and the overall efficiency is low under the actual operating conditions of the vehicle. In the traditional motor design method, 80% of the area is larger than 80% of the total working area of the motor. This method can be used to evaluate the motor efficiency distribution characteristics [3]

2. PROBLEM STATEMENT

- The electric scooter was chosen in this engineering design project. The initial problem for designing this project is to design the product that wasn't similar to the current market.
- Design a solution to tackle the existing pollution problems with a Li-Ion powered scooter.
- Existing vehicles having so many problems towards the environment.
- Replacing them with more efficient and durable electric vehicles could be a possible alternative.
- This will be achieved by designing a compact, portable, easy to use EV.

3. INTEGRATED HUB-MOTOR DRIVE TRAIN

Fig. (2) Shows the hub motor which is been used for the project. The wheel hub motor (also called wheel motor, wheel hub drive, hub motor or in-wheel motor) is an electric motor that is incorporated into the hub of a wheel and drives it directly.

Fig-2: BLDC Hub Motor

Hub motor electromagnetic fields are supplied to the stationary windings of the motor. The outer part of the motor follows, or tries to follow, those fields, turning the attached wheel. In a brushed motor, energy is transferred by brushes contacting the rotating shaft of the motor. Energy is transferred in a brushless motor electronically, eliminating physical contact between stationary and moving parts. Although brushless motor technology is more expensive, most are more efficient and longer-lasting than brushed motor systems.

A hub motor typically is designed in one of three configurations. Considered least practical is an axial-flux motor, where the stator windings are typically sandwiched between sets of magnets. The other two configurations are both radial designs with the motor magnets bonded to the rotor; in one, the inner rotation motor, the rotor sits inside the stator, as in a conventional motor

Table-1: Motor parameters

Motor parameter	Specification
Construction	Brushless Gearless Hub Motor
Rated Voltage (DCV)	24V
Rated Power(W)	250W/500W
No Load Speed	24V 250rpm (0.35A)
Rated Speed	250-800rpm
Rated Torque	5-10 Nm
Gross Weight	3.8kg
Tire Diameter	254mm
Tire Width	80mm
Motor Cable	20-50cm
Brake	Drum Brake

Rated Efficiency	>82%
Load Carrying Capacity	60-180kg

4. CHASSIS

The main frame or the chassis is the core structure which holds all the systems of the scooter. Thus, this being the most crucial part, it is to be designed and manufactured first. This process was initiated from a basic 2-D sketch of the frame which should accommodate the power unit, motor controller and all other electrical components.

4.1. Material Selection

For the whole construction of the chassis on electric scooters, only one type of the materials for all of the parts in the chassis is chosen. This is because the materials that are to be used for all of the parts in the chassis are exactly the same. The materials must be the best in properties of strength, cost, green product and formability. From the comparison of each of these properties, the selected material for fabricating the frame is mild steel.

4.2. Pipe Bending

Pipe bending is any metal forming processes used to permanently form pipes or tubing as shown in fig (3). Pipe bending may be form-bound or use free form-bending procedures, and it may use heat supported or cold forming procedures. A tube can be bent in multiple directions and angle

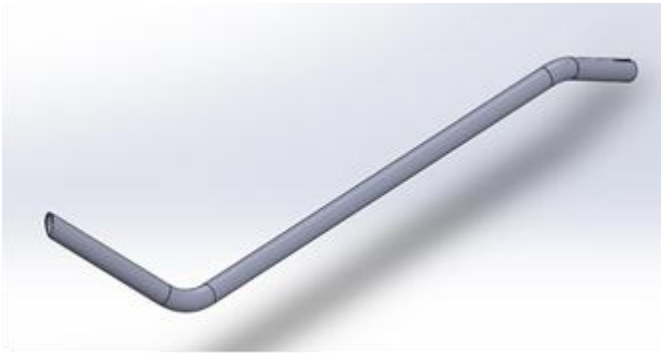

Fig-3: Main Frame Pipe Bend

5. POWER UNIT

Once the chassis was developed the next challenge was to develop a required battery box that will propel the E-Scooter. After comparing different types of batteries, we finally decided to use Lithium Ion cells and to construct a battery pack with it as shown in fig (4)

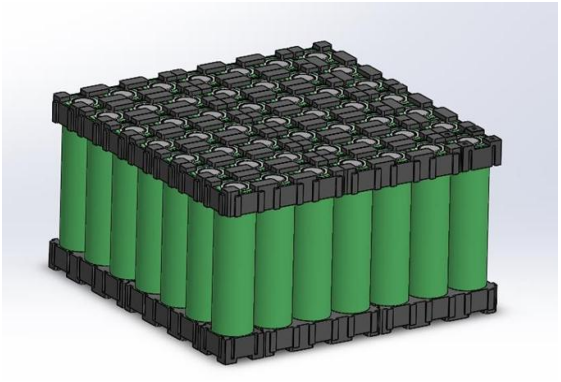

Fig-4: 7p7s Battery Pack

5.1 Mounting

In order to constraint the battery pack and the motor controller, C shaped plates are welded under the mainframe as shown in fig (5). These plates are made up of sheet metal and are bended in C shape so that the battery restes on the plates. The plates are made up of Mild Steel. Plates are manufactured by laser cutting and sheet metal bending.

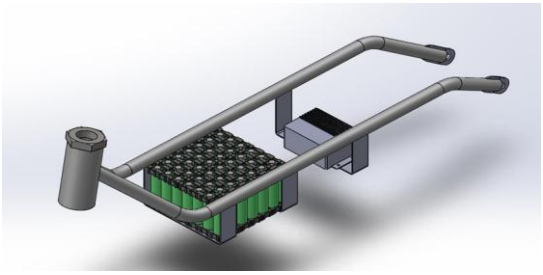

Fig-5: Mounting

6. Belly Pan

Belly Pan is attached below the main body frame. It is used to enclose all the electrical components for safety purposes. Mainly batteries, motor controller and the circuit is accommodated in the belly pan making it a crucial part in the scooter. The belly can be manufactured with steel, carbon fiber, sheet metal and Fiber Reinforced Plastic (FRP). According to project FRP was the best suitable material.

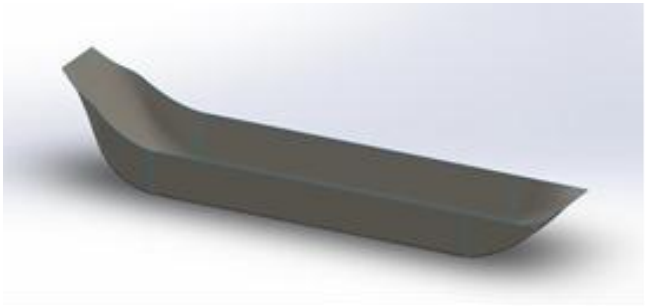

Fig-6: FRP Moulded Belly Pan

The molding processes of FRP plastics begins by placing the fibre preform on or in the mold. The fibre preform can be dry fibre, or fibre that already contains a measured amount of resin called "prepreg". Dry fibres are "wetted" with resin either by hand or the resin is injected into a closed mold. The part is then cured, leaving the matrix and fibres in the shape created by the mold. Heat and/or pressure are sometimes used to cure the resin and improve the quality of the final part fig (6) shows FRP moulded belly pan.

7. Base plate

Base Plate is bolted on the main frame. It also covers the power unit and electrical components from above making it more secure. This makes the power unit damage proof from all the possible sides. This plate is manufactured in Aluminum making it lightweight and durable in order to sustain the weight of the rider on it. This plate is first laser cut and then bended into the required shape fig (7) shows base plate made out of aluminum.

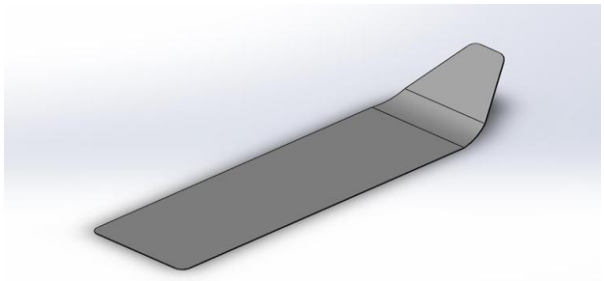

Fig-7: Aluminum Base Plate

8. Cone Set and Bearings

Cons set is an essential part of any vehicle when it comes to turning. This cone set is manufactured on the Lathe machine. Material selected is Mild Steel as shown in fig(8). This part consists of bearings inside it. This bearing makes it very smooth in turning the handle in the desired direction using very little force. In order to withstand axial loads acting on it through the front wheel, thrust bearing is selected in our model is 51106 as shown in fig (9).

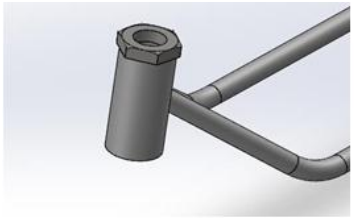

Fig-8: Cone set

Fig-9: Thrust Bearing

9. Suspention

Type: - bell crank actuated spring damper Suspension is a very important part regarding the comfort of the rider as well as the parts. It also helps in maintaining the contact between tyre and road. This part consists of a spring and damper. In this we have used a bell crank instead of a fork mechanism for the actuation of the suspension. Bell crank mechanism is used to vary the motion ratio and adjust the travel of the springs as sown in fig (10).

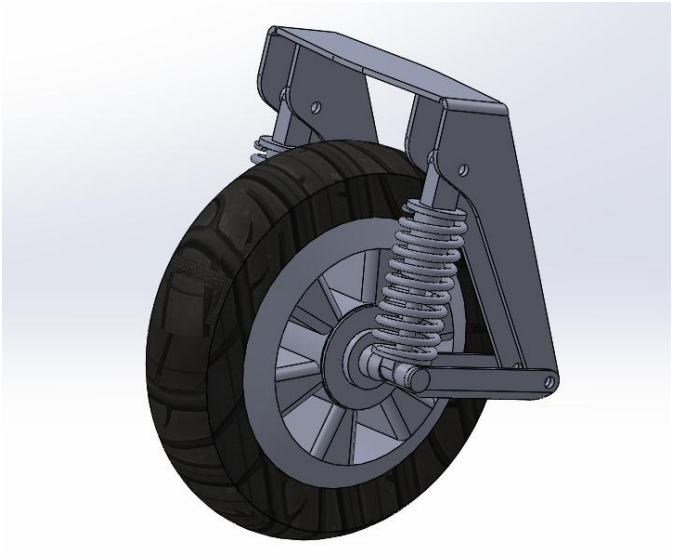

Fig-10: Suspension Assembly

10. Conclusion

- A practical method of replacing conventional bi-cycle with a motor driven E-Scooter
- Top speed of 20kmph.
- Acceleration of 0-20kmph in 8 sec
- Overall weight of the project is 26 kg

11. References

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