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Fabrication Of Tri-Wheeled Electric Vehicle To Aid Disabled

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ABSTRACT: In daily life we can observe the difficulties of carrying the patients, old people, physically challenged in public places like airports, railway stations, bus stands, hospitals, college campuses etc. To aid such people we modeled and fabricated a tri-car. This tri-car is a three wheeled electric powered vehicle with two seats one against other back to back and can accommodate two pillions and a driver. We designed the vehicle to be propelled by an electric hub motor mounted in the front wheel and powered by 48V Lithium-ion battery.

Keywords: eco friendly vehicle; electric tri-car; electric buggy; Hub motor; Li-ion battery.

1 INTRODUCTION

IN daily life we can observe the difficulties of carrying the patients, old people, physically challenged in public places like airports, railway stations, bus stands, hospitals, college campuses etc. To aid such people we prepared an electric tri-car to ease the task of carrying them. The final object should not be a simple motorized wheel chair or trolley car. It must be a concept vehicle that can be manufactured with least cost, and best in performance. Moreover, it must be a multi purpose vehicle to carry pilgrims in pilgrim places, to carry inspection teams in industries, estates or campuses etc. The seating must be such that the disabled can easily get into the vehicle and also get down.

Fig. 1. *Internal transportation of patients and luggage at Vizag airport in India*

2 MODELING AND FABRICATION PROCEDURE

2.1 Requirements of the project

The vehicle is designed to be very compact to gone through narrow places like hospitals, industries etc. It must be light in weight to increase the range of the vehicle and to carry better weight. It must have low height to be compact and for better stability and at the same time must have good ground clearance to negotiate rough and uneven ground.

2.2 Design, Modeling and Final Drawing

To do this project we prepared lot of drawings and finalized one concept which has three wheels and reverse manner opposed seats [1]. one seat for driver and other for pillions. The pillion's seat can accommodate two persons.

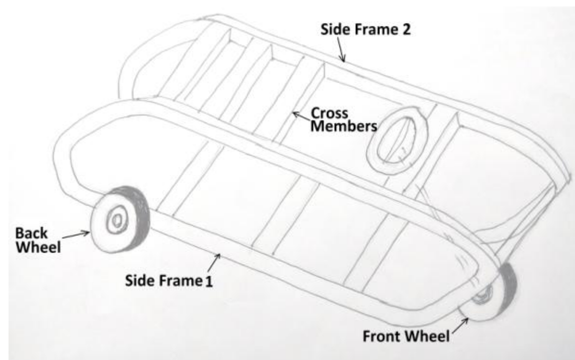

Fig. 2. *Rough Sketch of the Tri-car*

The finalized drawing is shown in fig. 2. It consists of two side frames which are in oval shape with cross members. These two frames are interlinked with channel sections. It is intended to prepare the chasis with hollow box mild steel sections for having light weight. For body we have chosen perforated Galvanized Iron sheet which has less weight. The front wheel has to mount centrally and the rear wheels have to support under the frames using Plummer block. The rear axle is a dead axle. For supporting the rear wheels 25mm diameter Mild Steel shaft is sufficient.

2.3 The Step by Step Procedure of the Project

1. Selection of materials for the chasis.
2. Fabrication of chasis by bending the channels or box sections and by welding according to the prepared drawings.
3. Preparation of back axle of diameter 25mm.
4. Selection of wheels and bearings.
5. Fixing of front fork.
6. Fixing of perforated sheet to body and seats.
7. Mounting of wheels and hub motor.
8. Attaching battery and giving electrical connections.

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Fig. 3. *Glance of fabrication of Tri-car*

2.4 Material Requirement for Chasis and Body

We have chosen hollow Mild Steel square and rectangular box sections of size 25 x 25 sq.mm. for the preparation of side frames and 50 x 25 sq.mm. for the cross members and foot board frame work. For the body we have chosen perforated Galvanized Iron sheet as it reduces the weight of the body. The back axle is dead axle, for this we have selected 25mm Mild Steel rod. For the wheels we have chosen old bajaj sunny scooter wheels.

Fig. 4. *Front wheel with hub motor and Back axle wheel*

3 Final Views and Performance

After fabrication the final views are shown in fig. 5.

Fig. 5. *Views of completed Tri-car*

Fig. 6. *Front wheel handle*

As the vehicle is provided with only one front wheel and the vehicle is lighter in weight (approx. 70kg) it may not need a steering system. But the handle deteriorates the look of the vehicle. To get catchy look we prepared the handle in frame as in fig. 6. The accelerator or speed regulator is provide at the right side of the frame and the brake is provided at the left side of the frame.

Fig. 7. *Completed Tri-car*

4 Power Drive

For the selection of power drive and power pack we have gone through lot of literature survey[2],[3],[4],[5],[6],[7] and finally decided to use hub motor and Lithium ion battery. In

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traditional electric vehicles one motor powering all the wheels using transmission devices like gears or chains. We mount the motor directly into the hub of front wheel so the motor and wheel unite together and acts as a single element. These motors are called hub motors. In the basic ordinary motor, there is a hollow, outer, ring shaped stationary permanent magnet called 'stator' and an inner metallic core that rotates inside it called the 'rotor'. If the axle is firmly fixed it can't rotate and the motor is switched on, then the rotor stays and the stator spins around it. The main advantages and characteristics of a BLDC motor compared to a conventional DC motor are

- Low Cost to manufacture
- Simple in design
- Higher efficiency due to less weight
- Higher reliability and longer life
- Can reach peak torque from stand still
- Ability to operate at various speeds
- Constant torque output

Motor controllers: The motor controller regulates the power to the motor. The battery block is interfaced with the '**motor controller block'**. The motor controller is the central component of the system that controls all the functional capabilities. The basic requirement for the control is to regulate the amount of power applied to the motor, especially for DC motors. The motor controller can be adjusted to synchronize with other brushless motors. There are also many built-in functions for this controller that vary from detecting any malfunctions with the motor hall sensors, the throttle, and the brake levers to protect functions against excessive current and under-voltage, which are ideal for protecting the lithium ion battery. One key feature that is integrated with the interface of the controller and the motor was the regenerative braking. A regenerative brake is an energy recovery mechanism that reduces the bicycle's speed by converting some of its kinetic energy into a useful form of energy instead of dissipating it as heat from conventional brake friction. The energy is then supplied back to the power source. The majority of the components were collected from Ultra Motor Co. The power source for the system was a DC battery of output 48V. The battery has lithium ion cells of each 12V. Lithium-ion batteries can be very dangerous. They should not be charged while operation. The batteries are kept under the seat in hard metallic cage prepared with mild steel box sections. The AMTECH battery has a high voltage rating diode at the output, and uses it as a current protector. If the vehicle is to be operated by solar charging system, it is better to keep the solar panels on ground by the side of path of vehicle. It is not economical to carry with the vehicle.

5 Power Pack

Li-ion battery is the most widely used secondary battery (rechargeable battery) in laptop computers, moderate to high-end digital cameras, camcorders, and cell phones and electric vehicles. These are very expensive, posses very high energy density, very low rate of self-discharge. The main draw backs are these are not usually available in "common" battery sizes. There is a chance of explosion if short-circuited, allowed to overheat.

6 Performance

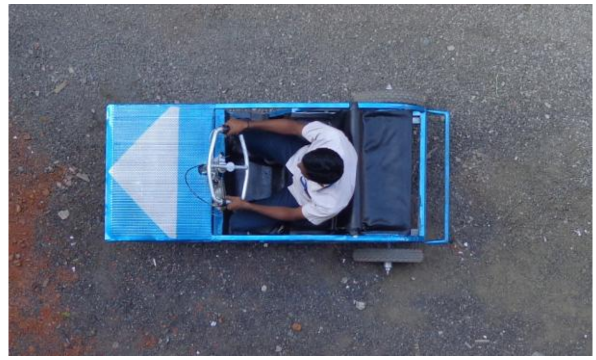

Fig. 8. *Driver Position in Tri-car*

The driver position is shown in fig. 8. The driver seat is good enough to sit for a long time and has lot of space for keeping legs.

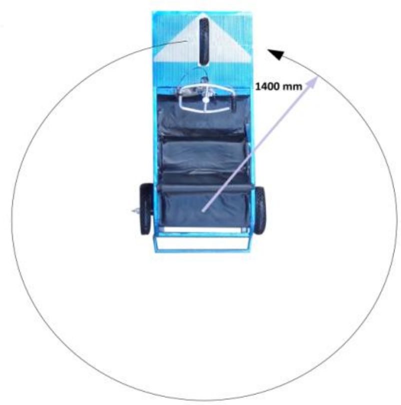

Fig. 9. *Very Short Turning Radius (1.4m) of Tri-car*

As the back side seat is in reverse to the driver seat it reduces the total length of the vehicle and is just 2metres including foot rest. As the seat is provided low in height the patients or the disabled people can easily get on to the vehicle and also can easily get down. We tested the vehicle on road and also in our college building. The vehicle can travel with maximum velocity of 35km/hr. We got the range of 35km on road with full charging with only driver and without pillions. With two passengers with the same condition the range is dropped down to 25km. In inside the building we got a range of 20km with two passengers and driver due to low speed. As the vehicle is provided with front wheel driven system we obtained very short turning radius of just 1.4 metre as in fig. 9. This facilitates the vehicle to pass through narrow places like corridors of hospitals rooms and can turn on ramps.

Fig. 10. *Passing through small ramp with full load*

We tested the vehicle on short ramps. The vehicle can easily gone through short ramps.

7 APPLICATIONS

The prepared vehicle can be used for internal transportation of patients in hospitals and disabled or physically challenged passengers in big aerodromes, railway stations, pilgrim places and other public places. Moreover, the vehicle can be used as inspection vehicle in industries, estates, campuses etc.

Fig. 11. *Application: Inspection of campus by Dr. M.Srinivasa Kumar, principal of Srinivasa Institite fo Engineering and Technology on Tri-car*

8 CONCLUSION

Finally we designed, modeled, drafted and fabricated a Tri-car which can carry three members of people like inspection teams, pilgrims, disabled etc. with ease in public places or industries and campuses. The utilization of hollow box sections reduced the cost and weight of the vehicle and also can bear greater loads. The utilization of perforated sheets had decreased the weight of the vehicle. The utilization of hub motor decreases the extra weight of transmission elements and troubles caused by them. As the vehicle is prepared with low height with better ground clearance and enough width and length provides greater stability to the vehicle. We hope that the vehicle can pull three persons easily and even it can climb short ramps.

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