Basic Design of Electric Vehicle

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Abstract - *An electric vehicle for physically challenged people gives a solution to those people who were unable to move and those are really dependant on others. As we know nowadays the electricity playing a vital role in our lives, so to use this for a project which may again lead to the progress for the electric field. Considering this we have an idea as our project for the physically challenged people (BLA & OLA) to nullify or at least reduce their dependency on other person and to help them to earn from this also. We have designed this project according to the problems which physically challenged people facing today. To reduce their dependency on another person and to provide them a way for their employability hence that they can earn at least for their basic needs from this project we have planned this project. Along with this without charging it is difficult to fulfill the demand of electricity for the vehicle accordingly based on that idea charging facility is given along with the vehicle. As a result this charging system works on lithium-ion battery cells which will lead to better reliability. Thus this is what the actual implementation of the idea that will suggest a better solution to physically challenged people.*

***Key Words*: BLDC Motor, Battery, Differential Axle, Chassis**

1. INTRODUCTION

Providing a reliable, feasible and easy means of transport to the physically challenged has been a problem that has challenged engineers and inventors worldwide. In a survey conducted by National Organization on Disability (NOD), almost a third of those with disabilities reported that inadequate transportation was a problem for them; of those individuals, almost half said that it was a major problem (Institute of Medicine, 2007). More was the severity of the disability, more severe was the difficulty reported in transportation (National Organization on Disability-Harris Interactive, 2004). This not only prevents them from using a convenient transportation, but also hinders them from pursuing occupations in the transportation service industry.

An electric vehicle for physically challenged people gives a solution to those people who were unable to move and those are really dependant on others. As we know nowadays the electricity playing a vital role in our lives, so to use this for a project which may again lead to the progress for the electric field. Considering this we have an idea as our project for the physically challenged people (BLA & OLA) to nullify or at least reduce their dependency on other person and to help them to earn from this also.

1.1 Background

The shift to electric vehicles (EV) is well and truly underway, with more electric cars than ever on our roads. There are also more industry and government initiatives available to help people to make the switch. As many as 11,000 new e-rickshaws hit the streets every month, and annual sales are expected to increase about 9 percent by 2021, according to consulting firm A.T. Kearney. Three-wheeled vehicles make up a $1.5 billion market and manufacturers of electric versions. The EV market is continuously expanding. Electric cars are no longer a niche product restricted to short commutes and city driving. Improvements in design and technology mean that motorists don't have to compromise their lifestyle when purchasing an electric car or electric vehicle. Many EVs on the market now have increased real-life ranges of between 250 and 300km.

This is what the expected from the output of electric vehicle but our main objective is to reduce the dependency of physically challenged people and the following data made us think about the E- vehicle for physically challenged people. Disabled Population in India as per census 2016 In India out of the 121 Cr populations, 2.68 Cr persons is disabled which is 2.21% of the total population. Among the disabled population, 56% (1.5 Cr) are males and 44% (1.18 Cr) are females. In the total population, the male and female population is 51% and 49% respectively.

1.2 Motivation

Electric vehicle is the solution for future demand for fuel and along with this why not we should make such a vehicle that will give a better solution to society. Especially those people who are dependent on others & unable to survive. So it gives rise to an idea that designing such a vehicle that reduces dependency as well as to make independent by providing a way to earn money. We started to work on it by taking inspiration from the biggest problem happening in India. This will gives a solution for fuel reservoirs and problematic solution for physically challenged people. Normal people can also drive this vehicle easily and with lower cost.

2. DESIGN METHODOLOGY

There are various factors and parts of the project that either had to be designed or selected. The major ones are given below with criteria for selection or design of each.

2.1 **Overview of design of electric vehicle**

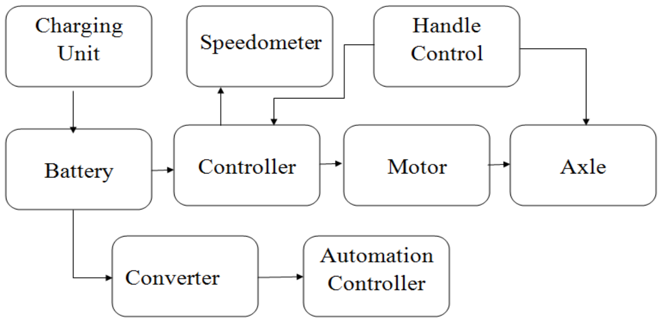

Fig 1- Block Diagram of electric vehicle

The block diagram gives whole process about the control system for vehicle. The charged battery gives the supply for controller. The controller controls whole automated controlling devices. The controller gives respective commands to the motor, speedometer etc. Proper commands given from the input were further given to the controller and controller operates. Controller drives the motor which deal to move the vehicle. Automation controller controls the whole automation devices which are based on the user input. Display indicates details regarding to the various parameters such as speed, GPS system, location etc. To stop the vehicle braking mechanism is provided so that when brakes are applied vehicle gets stopped. The control for whole the process is based on the hand control which is easier as compare to steering.

2.2 Design of Chassis

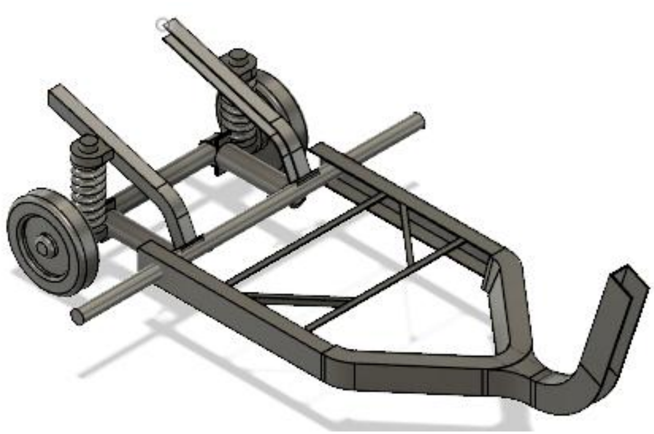

Fig 1-Design of Chassis

Most of the cities in developing countries are highly polluted. The main reasons are the air and noise pollution caused by transport vehicles, especially petrol-powered two and three wheelers and about 1.5 million petrol and diesel powered three wheeler and their population is growing at a healthy rate of about 15% per annum. The chassis is the "skeleton" of the rickshaw which provides the structural strength and the mounting points for other components. The chassis provides necessary support to the vehicle components placed on it such as suspension components and the weight of the driver. Electric auto rickshaw chassis designing and fabrication involves tradeoffs.

Table -1: Approximate masses of main components

S. No.	Components	Mass(Kg)
1	Body	125
2	Chassis	70
3	Driver	100
4	Passenger	300(No of passenger=3)
5	Battery	25
	Total	620

2.3 Selection of BLDC Motor

Brushless DC motor may be described as an electronically commuted motor which does not have brushes. These types of motors are highly efficient in producing a large amount of torque over a vast speed range. In brushless motors, permanent magnets rotate around a fixed armature and overcome the problem of connecting current to the armature. Commutation with electronics has a large scope of capabilities and flexibility. They are known for smooth operation and holding torque when stationary. In brushes motors, there are permanent magnets on the outside and a spinning armature which contains electromagnet is inside. These electromagnets create a magnetic field in the armature when power is switched on and help to rotates armature. The brushes change the polarity of the pole to keep the rotation on of the armature. The basic principles for the brushed DC motor and for brushless DC motor are same i.e., internal shaft position feedback. Brushless DC motor has only two basic parts: rotor and the stator. The rotor is the rotating part and has rotor magnets whereas stator is the stationary part and contains stator windings. In BLDC permanent magnets are attached in the rotor and move the electromagnets to the stator. The high power transistors are used to activate electromagnets for the shaft turns. The controller performs power distribution by using a solid-state circuit.

Fig 2- BLDC Motor

Calculations –

- Total Mass of electric vehicle: 420kg
- Weight of Chassis: 100kg
- Battery: 50kg
- Person weight: 200kg
- Other: 70kg
- Standstill or Initial velocity of EV: 0
- Max velocity: 30km/hrs
- Time require reaching max velocity: 3 minute

I = 22A
V = 48v
P = 900w
N = 2700 RPM
Pole=8

- Torque:

$$P = \frac{2\pi NT}{60}$$

$$900 = \frac{2\pi * 2700 * T}{60}$$

$$T = \frac{900 * 60}{2\pi * 2700} = 3.18 N/M$$

- Output power:

$$W = \frac{2\pi * 2700}{60} = 282.74\ rad/sec$$

$$Pout = T \times W = 3.18 \times 282.74 = 899.12$$

- Efficiency:

$$Pin = V \times I = 48 \times 22 = 1056$$

$$\%\eta = \frac{Pout}{Pin} = \frac{899.12}{1056} \times 100 = 85.15\%$$

$$Pout = Pin \times \eta = 1056 \times 0.8514 = 899.12$$

- Terminal Resistance:

$$V = I \times R$$

$$R = \frac{V}{I} = \frac{48}{22} = 2.18\Omega$$

The motor power should be >899.12W

2.3 Selection of Differential Axel

A vehicle with two drive wheels has the problem that when it turns a corner the drive wheels must rotate at different speeds to maintain traction. The automotive differential is designed to drive a pair of wheels while allowing them to rotate at different speeds. The size of differential axle is 33" (33 inches).

Fig 3- Differential Axel

2.4 Selection of Battery

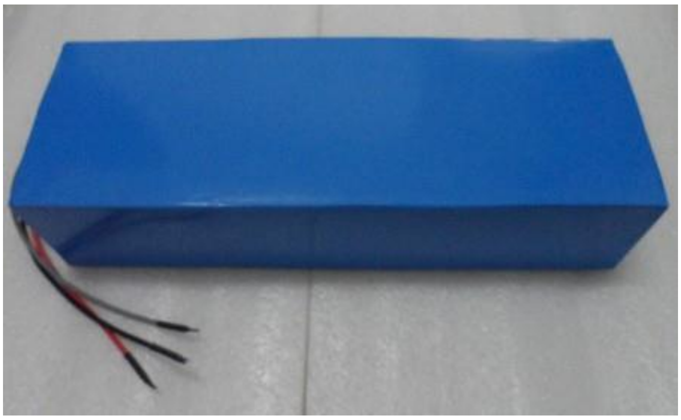

Fig 4-Lithium Ion battery

Calculation of Lithium Ion Battery -

Voltage = 48v
Amp/hrs = 39
Rated watt-hour Capacity = Rated Ah Capacity × Rated Battery Voltage
= 39 × 48
= 1872 watt-hour

$$Charging\ Current = 8\%\ of\ rated\ ampere\ hour$$

$$= \frac{39 \times 8}{100}$$

$$= 3.12\ Amp$$

$$Charging\ time = \frac{Ampere\ hour\ rating}{charging\ current} = \frac{39}{3.12}$$

$$= 12.5\ hrs$$

To charge fully discharge battery required 12.5hrs time duration.

3. CONCLUSIONS

The paper shows the custom design of electric vehicle. While designing the vehicle there are different consideration and calculations. The one of main point is the selection of the battery and the capacity. The design of chassis is also play the vital role in vehicle manufacturing. The points considered in this paper are the basic need of the designing of electric vehicle.

REFERENCES

[1] Till Gnanna, Simon Funkea, NiklasJakobssonb, Patrick Plötza, Frances Spreibf, Anders Bennehagc, "Fast charging Infrastructure for electric vehicles: Today's and future needs." transportation research part D 62 (2018) 314-329
[2] Palinski, "a Comparison of Electric Vehicles and Conventional Automobiles: Costs and Quality Perspective". Trans pp, SD, May 2017.
[3] Akshay Krishnan1, Abhiram AM2, Biswanand PM3 Akshay S Jayaraj4, "Electric Auto rickshaw" IRJET e-ISSN: 2395-0056 Volume: 05 Issue: 09 Sep 2018
[4] K.W.E CHENGl," Recent Development on Electric Vehicles", IEEE Trans. Power Electronics, April 15-2016
[5] Xuning Fengab, Minggao Ouyanga Institute of Nuclear and New Energy Technology, Tsinghua University, Beijing, 100084, "Thermal Runway mechanism of Lithium ion Battery for electric Vehicles: A review, Energy Storage Material.
[6] C. C. CHAN, FELLOW, IEEE, "An Overview of Electric Vehicle Technology"
[7] A. Joseph Godfrey, V. Sankaranarayanan Department of Electrical and Electronics Engineering, National Institute of Technology-Tiruchirappalli, Tiruchirappalli 620015, Tamilnadu, "A new electric braking system with energy regeneration for BLDC motor driven electric vehicle.",engineering science and technology, an international journal.
[8] Theodora-Elli Stamati, Pavol Bauer, Senior Member IEEE Delft University of Technology, "On-road charging of Electric Vehicles"