

A REVIEW OF DESIGN AND FABRICATION OF MULTIPURPOSEE-WHEELCHAIR

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ABSTRACT

There are many peoples who cannot walk on their own or the peoples who are physically disabled or injured. Some of them are satisfied by the normal wheelchairs available in the markets and the hospitals, but some of them are finding difficult and impossible to use these manual wheelchairs. To eliminate this problem many researchers have made their research on electronic or self-propelled wheelchairs which reduces the physical power needed to move from one place to another and to operate these power wheelchairs. We are developing a multipurpose electronic wheelchair which belongs to the same group of variety of commercial power wheelchairs with some modifications. The modifications are the addition of strong suspension system, powerful breaking system, better controlling and navigation system, increased space, a defecation system, and flexible seat for sitting as well as for sleeping purpose, a working table, powerful motor, and long run battery. All these modifications are made by considering the common problems of physically disabled peoples and for those who cannot walk on their own. This paper will describe the design and functions of this Multipurpose Electronic Wheelchair.

Keywords: *Electric powered motor, Suspension system, powerful breaks, flexible seats, Defecation System,*

I. INTRODUCTION

This project focuses those peoples who are unable to walk on their own. Independent mobility is critical for some peoples. This project is all about a wheelchair which can be move through electric power so it preferably calls as Electric wheelchair. The design of this wheelchair is based on understanding of the user (physically disabled) and requirements. There are many electric wheelchairs are already available in the market, but only going from one place to another is not the only aim of this project. We did some new improvements in design and comfort level of the previous E-wheelchairs. This E-Wheelchair is electrically powered as well as it has some more features which make it different from others.

These modifications in new designs are very helpful to those peoples who needed to travel long distances or to those peoples who wants to take a long ride with some more speed. It has sufficient space available according to human comfort level. The seats of this wheelchair are flexible, which means it can be stretched in back side and can be used to take rests. Electric wheelchairs are available in the market but they can't bear jerks and sudden loads applied on them. Here we add 4 suspension systems in all three wheels in the wheelchair. Due to this suspension system it can bear any jerks and sudden load apply on it. Apart from that we used a very powerful

motor (36 V and 450 W) which can supply adequate amount of power to the wheelchair. In order to run this motor 3 batteries (of 12 V and 30 A) are used.

When we talk about any self-propelled vehicles then the first thing comes in our mind is about the braking system. So in order to control the vehicle we added a disc brake in front wheel which is capable to control speed of 50-60 km/h. To control the speed we used the speed controller. After observation we found that peoples who take help of wheelchair for mobility, are face difficulties during defecation. So we added a defecation pad which can be used during emergencies. We observed that defecation pad is very necessary during medical issues and as per other user recommendations these necessary things should be attached in a wheelchair.

II. LITERATURE REVIEW

In a research paper “Design of multipurpose wheelchair for physically challenged and elder people”, Mr. Mohan Kumar at al. Shows a new design of wheelchair which can be used for multipurpose. They made some observations on the physically disabled persons, ill peoples, hospitalized peoples, and all those peoples who cannot walk on their own and they use a wheelchair to move from one place to another place. On the basis of their survey they made some modifications in the conventional wheel chair and add some new features in it. They found that those peoples are having difficulties in defecation so they add a commode in it. In that wheelchair the seat is flexible so that the user can use it for sleep if needed. A working table is also added in it which can be used for different purposes at different time. In this project these we added these facilities with some modification and make an E-wheelchair which is self-propelled.

III. METHODOLOGY

In this project the conventional wheelchair is totally converted into electric wheelchair with some new facilities and some. In order to enhance the working and comfort level the modifications in conventional wheelchair has been done in this project. In this wheelchair several changes has been done in the seat size and the design from conventional wheelchair. In this the size of seat is made of 50 cm *50 cm (length*breadth). This is done to provide sufficient space because we added some more features in it and all are made according to human comfort. After observation we found that the disabled persons and ill persons are sometimes very weak so in short time intervals they require proper rests. So In this E-Wheelchair we make the seats flexible and it can stretch in backward direction so in this way the chair can be used for sleeping purpose also. The given image is made in designing software named as CATIA. This image shows the space and expanding capability of the seats. These seats can be expanded whenever the user required to do some rests.

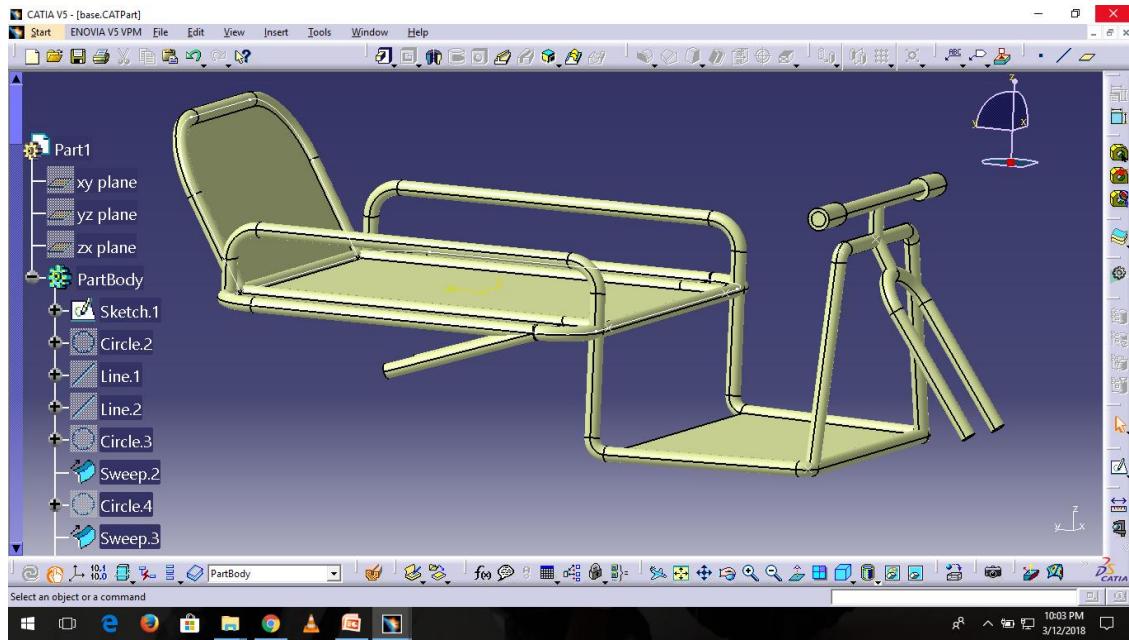


Figure 1: Internal space of seats and the expanded seat

We observe that previous wheelchairs are well designed but in jerks it fails to provide the comfort to the user. So we decided to add 4 strong suspension system in 2 rear wheels and 1 suspensions system in front wheel in it. In rear wheels we use coil suspension system while in front wheels hydraulic suspension type fork is used which is capable to control the jerks in front wheels. This can bear the jerks around 1 ft. depth and still balanced. User will not be affected from it at all.



Figure 2: Coil suspension system

Powerful Motor and Battery

Figure 3: Hydraulic suspension system

We used a very powerful motor which can easily bear a weight around 100 Kg and battery which will be sufficient to provide adequate amount of power to the wheelchair at a better and controllable speed. Its maximum speed is around 30 Km/h hence the user can balance it easily.

Motor specifications are given below:

TYPE	Dc Motor
SPEED	2650 Rpm
POWER	250 Watt
RATED CURRENT	13.7 A
VOLTAGE	24 V

When we think about electric wheelchair then it always comes to our mind that how we control the speed of the wheels and we stop it if it needed. Therefore we used disc brakes in this E-wheelchair which can control the speed of 50-60 km/h. This is helpful to those peoples who would like to travels at high speeds and needed strong breaks.

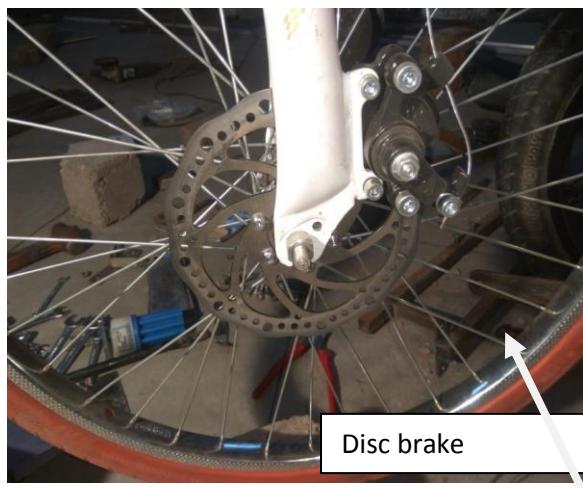


Figure 4: Disc Brake



Figure 5: Rim brake

Defecating Pad and working table

It is observed that in the medical issues the user required a defecating system on their wheelchair but due to unavailability it was not possible yet. In order to solve this issue this wheelchair contains a commode pad which can be used in any emergency cases for the user. A working table is also available in it which is completely foldable and can be used for eating food studying and to use laptops on it.

IV. CALCUATIONS

4.1 Calculation for frame -

Outer diameter, $D_o = 24.5 \text{ mm}$

Inner diameter $D_i = 20.55 \text{ mm}$

$$\text{Area of the frame tube} = \frac{\pi(D_o^2 - D_i^2)}{4}$$

Area of frame tube = 141.37 mm^2

Load on the frame is = weight of rider + frame weight + Load due to drive mechanism.

$$\begin{aligned} &= 687 + 245.25 + 325 \\ &= 1257.25 \text{ N} \end{aligned}$$

4.2 Stress generated in frame -

$$\text{stress} = \frac{F}{A} = \frac{1257.25}{141.37}$$

$$\text{Stress} = 8.89 \text{ N/mm}^2$$

Maximum allowable stress in steel is 140 N/mm²

Allowable stress = 140/4 = 35 N/mm²

4.3 Assumptions of vehicle

- i. Velocity of vehicle = 25 m/sec
- ii. Efficiency = 90 %
- iii. Angle of inclination = $20^\circ - 30^\circ$
- iv. Weight of cycle = 20 Kg
- v. Weight of rider = 70 Kg
- vi. Coefficient of friction = 0.4

Weight of cycle and weight of rider = 20+70 = 90 N

Frictional force (F) = $\mu * N$

$$\begin{aligned} &= 0.4 * 90 * 9.81 \\ &= 353.16 \text{ N} \end{aligned}$$

V. RESULTS AND DISCUSSIONS

In result we found that the stress generated in the frame is 8.89 N/mm² and if we take the factor of safety 4 then the allowable stress in the steel is 4 N/mm². The overall weight of rider and wheelchair is around 90 N and frictional force is 353.16 N. So the frame is strong enough to bear the overall load of rider and its stuffs. The suspensions will help to overcome the jerks in the wheelchair. Due to lack of these properties in electric wheelchairs made this project different from the conventional wheelchairs.

VI. CONCLUSIONS

On the basis of previous papers and observations we concluded that some modifications must be done in conventional wheelchair. Soon the basis of user requirements and their needs we made some modifications in the wheelchair. After modifications we conclude that these modifications are very helpful to those peoples who are unable to walk or having difficulties in walking and still desire to travel long distances. They feel very comfortable ride because of having strong suspension system in it. The commode fitted on the seats is also very useful to them. The seats are very comfortable to the peoples; if user wants to take rest then it will be very helpful. Since we are talking about E-wheelchair, we observed that the speed goes up to 35 Km/h.

So overall conclusion is this Multipurpose E-Wheelchair is very helpful to those peoples who are physically disabled, ill or suffering in their older ages, and all of them who are not capable to walk on their own and needed more facilities in the wheelchairs. It provides them a way through which they can feel that they are also the part of the same society and are independent in life.

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