

Stair Climbing Mechanical Wheelchair

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Abstract

The wheelchair is vehicle where the disabled person spends his maximum life for the purpose of the movement. The from the early 2000's wheelchair innovations have been interest of medical equipment engineers. Some modifications are costly, some are useful while some tends to be failure. In this project the wheelchair has specific stair climbing wheel arrangement and this will make the hurdles of the disabled person easier. All the design parameters of wheelchair were based on the standard design of the stairs in India. Major part of the project focuses on the proposed design concept and concludes by discussing upon the physical working model developed for the proposed design solution. Design of the wheelchair is easier to understand as well as easy to repair. Target surface of the wheelchair are staircases, rough area, and small size obstacles. Every part of wheelchair is designed considering higher stress and load so it will have lower possibility of failure. This wheelchair is future of the rural disabled people. Because rural people have minimum available benefits.

1. INTRODUCTION

The wheelchair is one of the most commonly used assistive devices for enhancing the personal mobility of people with disabilities. An estimated 1% of the world's population, or just over 65 million people, need a wheelchair This wheelchair is summarized design of the all the automatic and manual wheelchair.

Wheelchairs come in a wide variety of formats to meet the specific needs of their users. They may include specialized seating adaptations, individualized controls, and may be specific to particular activities, as seen with sports wheelchair and beach wheelchairs. The most widely recognized distinction is between motorized

wheelchair, where propulsion is provided by batteries and electric motors, and manual wheelchairs, where the propulsive force is provided either by the wheelchair user/occupant pushing the wheelchair by hand, by an attendant pushing from the rear using handle(s), or by an attendant pushing from the side use a handle attachment.

This wheelchair is the result of what we studied throughout the research also the wheelchair has many functions. Many hospitals, public places, old apartments don't have facility of elevators so the disabled person is either unable to reach their destination or they have to arrange 2 to 3 persons to lift the whole wheelchair which is risky task. Also, on moving normal road or sideways obstacles, road gap, surface irregularities cause the wheelchair imbalance. So main motive of this project was to analyze, design and manufacture a wheelchair which is able to overcome all the basic problem of the disabled person.

1.1 Objective:

The objectives of the project are:

- Decrease the cost by using new mechanism.
- Works reliably under different operating conditions.
- Multipurpose such as stair climbing and stretcher.
- To save space and precluding exertion of the disable person.

1.2 Methodology:

- Determination of basic parameters of wheel system
- Determination of coefficient of friction
- Designing the wheelchair on AutoCAD
- Stress analysis
- Pulling force calculation

LITERATURE REVIEW

2.1 Introduction:

This wheelchair is manually operated stair climbing consisting planetary wheel system, damper, and safety features such as brakes. Literature review is the one of the most contributing part in this project.

2.2 Literature Review:

Many researches have contributed to the development of wheelchair development, some of the applications are summarized below:

- In the analytical method of determining the center of gravity of a person propelling a manual wheelchair; Bartosz Wieczorek, Jan Gorecki, has described the position of center of mass have effect on the system movement as it controls the inertia of stable or moving body or system related to it. Every person's body part have 7 different center of mass and hence the total body have center of mass. Using a avg. Person sitting in wheelchair and calculating center of mass considering wheelchair and person as one system. This helped us thinking about different positions while stair climbing and effect of center of mass on it. The advantage of this method presented it eliminates the need to take measurements from the wheelchair user and that the changes in the location of the center of gravity can be analyzed for a single specified position.

- In Design of a self-leveling cam mechanism for a stair climbing wheelchair; Giuseppe Quaglia presented that the new wheelchair system is designed and tested. This concept tries to overcome the issues and problem and various technicalities faced by traditional wheelchair.

Their Main goal was to design wheelchair in lighter in weight, stronger in strength, safe, comfortable and mainly reduction of cost. this innovation allows to increase the static stability and also to reduce jerks delivered to seat of the person. Also using the planetary wheel system was the essence of research paper

- “Design and development of wheelchair with stretcher Attachment,” IJPME, Vol: 01, Issue no: 01, Page No. 10-18; Shebang Gonane et al. (2015) described the mobility aids are useful for patients for transportation and for walking especially in indoor and outdoor environment. The main objective of our work is to provide the patient with exercising equipment and to reduce the cost of the existing system. Today there is lot of development in the healthcare sector. The best example is the wheelchair. By observing the evolution of wheelchair as mobility equipment over time, it is considered as one of the important mobility aids. However, there is lot of developments in the technology used in wheelchair. But the cost criteria make people not to buy that. The model which is developed in this project work is easy to use and can be manufactured at an affordable cost. Not much wheelchair models are available as on today.
- “Design and development of conceptual wheel chair cum stretcher (Sreerag C.S et al. (2011) The progressive design optimization, development and testing of Pyra-Aid™, a retro fitted, user friendly, momentum powered mechanical device to aid in mounting of single steps, has been successfully undertaken. A systematic design approach, informed by wheelchair user and support group liaison, was critical to the iterative development of the enablement device. Critical design criteria adopted in development of the innovative 3 wheeled pyramid configuration include operation, efficiency, stability, safety, ease of attachment / detachment, versatility, wheelchair brand universality, manufacturability, aesthetics and cost. Pyra-Aid™, a generation progressive device, has been manufactured and tested both in field and laboratory. Initial step mount tests for the three developed and manufactured prototypes have proven to be very promising.

- Design and Fabrication of Pneumatically Powered Wheel Chair Stretcher Device (Rashid Ahmed et al) A prototype of the pneumatically powered stretcher-chair device for a patient weight of 100kg was designed and fabricated. The chair to bed conversion feature of this device makes patient transfer easier. The use of simple shifting aids such as patient shifters can further optimize the patient transfer by avoiding heavy lifting situations and possible back injury to the caregivers. This device combines the concept of patient mobility, patient transfer as well as patient comfort. Thus, the spending of time for the patient to shift from a normal wheelchair to a separate stretcher or from a separate stretcher to wheelchair vice versa is reduced.
- “Design of Solar Tricycle for Handicapped Person,”: Ravikumar Kandasamy et al. (2013); Solar panels and solar lighting may seem quite expensive when you first purchase it, but in the long run you will find yourself saving quite a great deal of money. After all, it does not cost anything to harness the power of the sun. Unfortunately, paying for oil is an expensive prospect and the cost is still rising consistently. Why pay for expensive energy when you can harness it freely. Solar powered panels and products are typically extremely easy to install. Wires, cords and power sources are not needed at all, making this an easy prospect to employ. Solar power technology is improving consistently over time, as people begin to understand all of the benefits offered by this incredible technology. As our oil reserves decline, it is important for us to turn to alternative sources for energy. Oil, which is what most people currently use to power their homes, is not a renewable resource.

This means that as soon as the oil is gone, it is gone forever and we will no longer have power or energy. Very little maintenance is required to keep solar cells running. There are no moving parts in a solar cell, which makes it impossible to really hurt them. Solar cells tend to last a good long time with only an annual cleaning to worry about.

2. Design:

Specifications of the materials

1. Bearings:



SKF Single row deep groove ball bearing 130mm inside x 200mm outside x 22mm width

Single row deep groove ball bearings are used in a wide variety of applications, they are simple in design, non-separable, suitable for high speeds and are robust in operation, and need little maintenance. Deep raceway grooves and the close conformity between the raceway grooves and the balls enable deep groove ball bearings to accommodate axial loads in both directions, in addition to radial loads.

Market available bearing size for wheelchair:

Principal		Dimensions
Inside	diameter:	130mm
Outside	diameter:	200mm
Width:		22mm
Basic	Load	Ratings
Dynamic:		83.2kn
Static:		81.5kn

2. Trolley Rubber wheels (4 Inch)



- Rigid rubber trolley wheels Wheel
- Material: Rubber Wheel, Steel Core Size:80 x 32mm
- Loading Capacity: 90Kg

3. Rubber wheel (6 inch)



Customized:

Color: Multi-colored

Type: Rotating Wheel
Surface Treatment: Chrome Plated
Size: 4inch
Material: Rubber

3.5 3D Design :

Software used:
Solidworks 2021

Wheelchair parts
design:

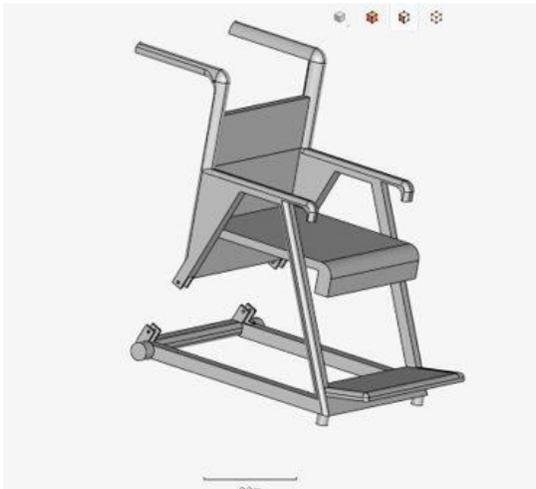


Fig.3.5.1 Main frame construction

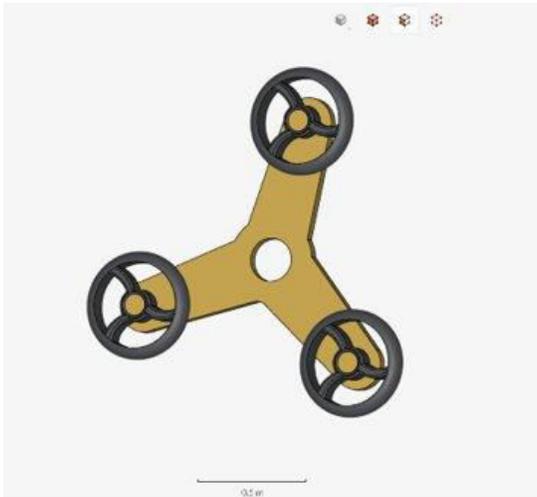


Fig.3.5.2 Planetary wheel assembly



Fig. 3.5.3 Design of wheelchair view - 1



Fig. 3.5.4 Design of wheelchair view -2



Fig 3.5.4 Design of wheelchair view – 3

4.List Of the materials

Sr. No.	Name Of the Materials	Specification
1	Rubber Wheels	6 inch, rubber, 60mm width
2	Triangular Star Shaped Plate	O.D.= 300mm, Star shaped, laser cutting made, fitting holes dimension M6 mm, thickness – 5mm
3	MS Square channels	20 X 20 Square, 2mm thickness
4	MS Pipe	30mm Outer diameter
5	Bearings	SKF6202 ball bearing
6	Circular plates for bearing housing	----
7	Break assembly	----
8	Welding electrodes	Mild steel grade arc welding electrodes
9	Nut bolts for wheel fitting	M6 X 20bolt + MC Nut
10	Nut Bolts For break fitting	M3 X 30
11	Wheels Rubber	4 inch front wheels

5. Conclusion

This designed stair climbing wheelchair can climb up stairs up to angle of 60 degree. In this wheelchair rubber crawler provide proper grip on step while climbing up stair cases. It can be operated by handicapped person without help of any person. It can also climb maximum step height up to 180 mm

- energy-saving, environmentally friendly, but also reduces the weight of the wheelchair by not installing a motor.
- It can climb up stair case angle up to 60 degrees. Maximum payload is 80 kg.
- some future steps have been proposed and some practical steps have been taken towards even better steps for human and humankind a vision of providing mobility equality for all. As paper conclude that Disabled people are increasingly able to lead an independent life

Research Paper

1. Shebang Gondane et al. (2015) "Design and development of wheelchair with stretcher Attachment," IJPME, Vol: 01, Issue no: 01, Page No. 10-18.
2. Sreerag C.S et al. (2011), "Design and development of conceptual wheel chair cum stretcher", Ramaiah school Bangalore.
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6. Ravikumar Kandasamy et al. (2013), "Design of Solar Tricycle for Handicapped Person," IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Vol: 5, Issue 2.
7. Ehsanullah Khan et al. (2011),"Synthesize of Trolley cum wheelchair for patient handling," Vol: 3, Issue No.8, Page No.6311-6316
8. On the kinematic functionality of a four-bar based mechanism for guiding wheels in climbing steps and obstacles.
9. Measurement of wheelchair contact force with a low cost bench test.



10. Design of a self-leveling cam mechanism for a stair climbing wheelchair
11. The analytical method of determining the center of gravity of a person propelling a manual wheelchair.