

Standing Wheelchair with Lead Screw Mechanism

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Abstract— The wheelchair users are exposed to many physical and psychological health problems associated with prolonged seated posture with being inactive in a wheelchair, e.g., fatigue, pain in hip joint, pressure sores, etc. Other related issues are increase in caregiver dependency, lower back pains among caregivers, and injury incidences during transfer support, etc. Many elderly subjects who can walk are confined in wheelchairs due to the lack of standing ability. With fewer caregivers and increased numbers of lower limb disabled and elderly subjects, there is a significant need for improved wheelchair designs aimed at enhanced independence of wheelchair users.

The focus of present work was at designing a novel reconfigurable wheelchair incorporated with stand and sit capabilities for the purpose of enhancement of independence and quality of life of lower limb disabled and elderly subjects. Further work presents an overall product design and development phases of a reconfigurable wheelchair. The major contributions of paper can be summarized as Modelling and fabrication of a proposed wheelchair and testing it in a real time constraint with load application. The proposed inventive solution to the problems of long-term wheelchair users has a promising potential to enhance independence and quality of life of disabled people.

Index Terms: Independence, Lead Screw Mechanism, Wheelchair Users, Reconfigurable type, Disabled people.

INTRODUCTION

Generally wheelchairs are supposed to transport disabled peoples with seating position only. A standing wheelchair is assistive technology, similar to a standing frame, that allows a wheelchair user to raise the chair from seated to standing position and vice versa. Mechanically operated standing wheelchair is a modification of basic wheelchair to enhance the life of disabled peoples by giving them a mean to stand and move anywhere. It is social friendly, easy to use, reliable and affordable since it is full mechanically operated. Designing of standing wheelchair is based on the gear mechanism, belt

drive, chain drive, and ratchet. This wheelchair is economic friendly and maintenance friendly.

Wheelchair is a mobility device designed for shifting patients, moving physically challenged people from one place to another with the help of attendee or by means of self-propelling. The wheel chair is divided into two different types based on the power used for mobility: 1. manually powered wheelchairs. 2. Electric powered wheelchairs. Manual powered wheelchairs are driven by manual power which is again classified into foldable and non-foldable with or without commode design. Electrical powered wheel chairs runs with electric power however manual operation is required to operate the joystick for the movement of the chair. The redesign of the manual wheelchair was considered for this project. The design of the wheelchair started by means of literature review to know its evaluation from earlier to the present generation. Market study was carried out to know the present competitors available in the market with cost analysis of the existing product.

LITERATURE REVIEW

New Mechanism Used in Standing Wheelchair:

It is inevitable for any country to have people with disabilities or have trouble with standing up, especially arthritis patients. The most commonly used devices for disabled people are wheelchairs. What's more, the life quality of disabled people and patients has caught the attention of society. Modernized wheelchair has become a popular engineering challenge for decades. We aimed to design a new mechanical system in wheelchairs to help people stand up. This mechanism should be safer, simpler in structure, less power consuming and more economical. A parallelogram structure was designed for wheelchairs to fit the natural human standing posture. Springs installed at two nonadjacent vertices can accumulate energy. A motor with less power and

cheaper prices is reasonable, energy-saving and easily provide the power to lift up. After research and calculation, this parallelogram structure reduced almost 45% power compared with pure motor drive one. And the effort of every part can well support human's body to form a natural and comfortable lifting process. The standing wheelchair we designed may help people with disability to surge self-esteem; reach objects placed high, deliver speech on podium. By the way, it's boring for a person to sit for a long time.

Design and Fabrication of Wheelchair for Paraplegia Patients:

In India the number of paralyzed individuals is increasing every year. Mobility aids are useful for patients for transportation and a replacement for walking especially in indoor and outdoor environment. Transferring the patients from wheelchair to other medium like bed, car etc. is always an issue for the attendant or helper. Understanding the various issues regarding the mobility equipment and introducing a better design will be an asset for the medical field and helping hand for paralyzed individuals. This is an assistive mechanism to provide an easy, safe and convenient way of shifting wheelchair users from wheelchair to other mediums and ease the life of caregivers. It drastically reduces the efforts of caregivers in handling patients, especially transferring. The wheelchair also provides a standing mechanism without any electronics components. This is a cost reducing project which helps mainly paralyzed patients to do their daily things.

Development of convertible wheelchair:

It is inevitable for any country to have people with disabilities or have trouble with standing up, especially arthritis patients. The most commonly used devices for disabled people are wheelchairs. What's more, the life quality of disabled people and patients has caught the attention of society. A modernized convertible wheelchair has become a popular engineering challenge for decades. We aimed to design a new mechanical system in the wheelchair to help people stand up as well as they can rest and sleep, this mechanism should be safer, simpler in structure.

Working Principle

When the operator seats on wheelchair and shifts the forward position of DPDT switch responsible for the movement of wheelchair, then it starts activating the drive connected with rear axle and makes wheelchair to move forward. Similarly when the position is reversed wheelchair moves backward.



Fig 1. Lead Screw Mechanism

When the operator wishes to stand then the drive which controls the lead screw is operated in a clockwise direction which causes it to rotate about its axis and tends to move the nut towards top which gets meshed with it. The movement of the nut extends the link which causes the operator to stand with the support of the extended link, once the position of the drive gets reversed the home position of the wheelchair is obtained..

Construction

The wheel chair structure is created using square tubes and channels by metal cutting and metal joining process called welding. Four wheels are attached to the frame, in which two at front and other two at rear side using axle shafts. The rear axle shaft is connected to DC drive with the help of lead screw drive arrangement. The seating arrangement has two pivoted links in which one is hinged to the base frame and other link is hinged to the vertical frame, on the other end the free end of each link is connected with each other. At the center of the top link nut is welded which get meshed with lead screw connected with a separate drive which is mounted to the base frame. The source to operate the drive is provided with the help of a battery and to control rotational direction of drive a DPDT switch is used.

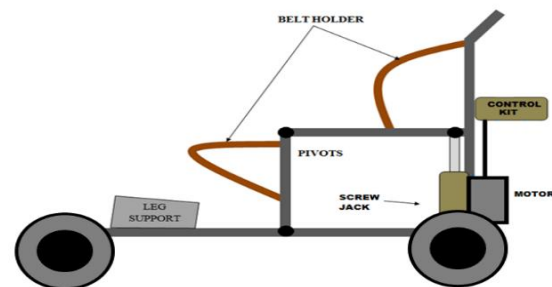


Fig 2. 2D Layout of Model

ADVANTAGES

1.Mobility – Chances are over a span of years, your mobility has become increasingly affected and your activities have lessened, resulting in a lifestyle that is mainly spent indoors. Wheelchairs provide you freedom to move around as you wish. Most wheelchairs are designed to fit into small, tight spaces. This allows you to move within your home easily giving you a more comfortable and active lifestyle.

2.Independence – You may have a difficult time walking and need to frequently lean on someone or hold onto their arm as they walk next to you. Feeling unbalanced when you walk is a common reason many seniors live a sedentary lifestyle. You may have fear of walking within your home while you are alone or have a fear of falling. This type of fear can cause you to become isolated from friends and family. A wheelchair is a great source of help, it will give you back your independence and free spirit to move around your home and the outdoors as you wish. You can begin enjoying your hobbies and many activities that you have given up.

3.Comfort – Many wheelchairs provide support for your back and comfortable seating. You will be able to be seated comfortably with strong support that encourages good posture.

4.Enjoy Activities – Enjoying the outdoors is usually the common activity new wheelchair users look forward to doing the most. You can enjoy picnics with friends at the park, explore park trails, bird watch, capture pictures of scenery and much more. You can go shopping at your favourite stores, dine at restaurants, travel, and go to the movies, visit friends and family and much more. Wheelchairs provide the user with a more active lifestyle that usually results in a happier, healthier more positive outlook on life.

5.Increased Socialization – When you have a wheelchair, you have a new sense of freedom that allows you to safely and comfortably enjoy life. Visiting friends and participating in social activities and clubs are all possible when you have a wheelchair. Seniors, who have been otherwise isolated in their homes without a wheelchair, find that once they gain their mobility and confidence in using their wheelchair, they look forward to participating in activities and socializing more often.

APPLICATIONS

This mechanism deeply beneficial in medical field as it has the following applications

- 1.Improve functional reach to enable participation in ADLs (Activities of Daily Living (i.e. grooming, cooking, reaching medication)
- 2.Enhance independence and productivity
- 3.Maintain vital organ capacity
- 4.Reduce the occurrence of Urinary Tract Infections
- 5.Maintain bone mineral density
- 6.Improve circulation
- 7.Improve passive range of motion
- 8.Reduce abnormal muscle tone and spasticity
- 9.Reduce the occurrence of pressure sores
- 10.Reduce the occurrence of skeletal deformities, and Enhance psychological well-being

CONCLUSIONS

The design of the wheelchair is compact and helpful for many people who are disabled with paraplegia disease. They can make use of this wheelchair without any external aid or a caretaker. So this is a multi-functional medicinal aid focusing on the improvement and self-reliability of paraplegia patients. Modifications made in the prevailing equipment meant for the disabled ones will be of great use in upcoming time and we were able to apply our theoretical knowledge into practice. All data provided is precise to the best of our ability. The project was aimed at designing and fabrication of wheelchairs for paraplegia patients that can overcome the shortcomings of a conventional wheelchair, with focus on cost effectiveness and utility.

The model presents a wheelchair that is controlled by using without any electrical components providing maximum functions to paraplegia patients. The wheelchair can be controlled by the paraplegia patient alone and a lever is used to steer the wheelchair, making the movement and control of the wheelchair easy for a paraplegia patient. This will help the paraplegia patients to achieve social respect from the society by doing small works and mental strength. It will help the patients to cure from paraplegia condition. By the project work, we gained a lot of practical knowledge regarding planning, purchasing, machining and assembling. We feel that the project work is a good solution to bridge the gates

between the institution and the industries. We are proud that we have completed the work with in time successfully.

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