Design and Development of Multi-Purpose Wheelchair for Differently-Abled Person

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***Abstract* – The main aim of our project is to design and develop a wheel chair for paralysed people which may be highly suitable for persons is paralysed. In India the number of paralysed individuals is increasing every year. Mobility aids are useful for patients for transportation and a replacement for walking especially in indoor and outdoor environment. Wheelchairs are the most commonly used medical equipment for the transportation of paralysed patients. Understanding the various issues regarding the mobility equipment and introducing a better design will be an asset for the medical field and a helping hand for paralysed individuals. There is a need for a wheelchair to facilitate the disabled patient's mobility and to provide novel medical equipment for use in the Indian hospitals. Hence this project is selected and designed with the basic requirements and the fabrication part is carried out with almost care. The project we fabricated can act as a conventional wheel chair and can be moved automatically and also can be acted as a push back seat with the help of simple toggle switches.**

***Keywords* – Mobility, Indoor, Outdoor, Conventional wheelchair, Toggle switches**

1. INTRODUCTION

Earlier, people who were affected with paraplegia (a medical condition in which the part of the body below the torso is completely paralyzed), used wheelchairs as major source of transportation for moving short distances. For most of the cases, those being in a sitting posture do not matter. However, in certain jobs such as teaching, industrial jobs, etc, them being in a standing position is necessary. In teaching, they may use board for teaching, where as in industrial jobs, operating lever may be required. People with paraplegia are generally not preferred for the above mentioned jobs. As a result, certain mechanism needs to be developed so that people whom are affected by this condition can be able to stand also rather that just sitting. Also, this mechanism is made is such a way so that no safety issues can occur, which in turn provides a secure feeling to the user.

1.1History

A three-wheeled wheelchair was worked in 1655 or then again 1680 by a crippled German man, Stephan Farffler, who needed to have the capacity to keep up his versatility. Since he was a watch-producer, he had the capacity to make a vehicle that was controlled by hand wrenches.

In 1789, two French designers built up a three-wheeled vehicle, controlled by pedals; they called it the tricycle.

The main records of wheeled seats being utilized for transporting debilitated individuals date to three hundreds of years after the fact in China; the Chinese utilized early push carts to move individuals just as substantial objects. A qualification between the two capacities was not made for another few hundred a long time, around 525 AD, when pictures of wheeled seats made explicitly to convey individuals start to happen in Chinese craftsmanship.

Wheelchair is utilized by individuals who experience issues in portability. For the most part individuals who use are, Lower appendage debilitated individuals, Patients at the clinics, Elderly individuals.

2. LITERATURE REVIEW

2.1 Manual Wheelchairs with Stair-Climbing Capabilities

In 1962, Ernesto Blanco, while working at Massachusetts Institute of Technology (MIT), designed a self-moved stair-climbing wheelchair [6], yet a full scale model was never manufactured. In any case, a little model of Blanco's plan was worked to grandstand how his wheelchair would perform coming in level ground just as how it would climb and plummet stairs. Fig. 2.1 demonstrates an image of Blanco's wheelchair show climbing a staircase. Albeit no friend checked on writing was distributed on Blanco's wheelchair, the instrument can be inspected from the portrayal given in MIT's site and image of the model.

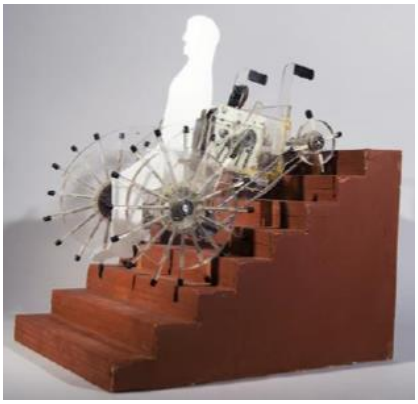

Fig 2.1 Ernesto Blanco's Wheelchair Climbing a Staircase

Another manual stair-climbing wheelchair found is The Manuscale appeared in Fig 2.2. Here, again, little writing has been distributed on this wheelchair, from which the accompanying perceptions are made. The Manuscale proceeds onward the drive and turning wheels as an average manual wheelchair. Prior to climbing, the wheelchair is upheld in turn around just before the staircase. The client at that point pulls on a handle bar which leans back the seat, drops the climbing sprockets to the floor, and lifts the drive and diverting wheels from the floor. In this position, the wheelchair drive wheels are presently associated with the climbing sprockets by a progression of chains and drive sprockets, to such an extent that, as the client dismantles to turn the drive wheels, the chains drive the climbing sprockets. As the sprockets go in reverse, they drop on the highest point of the initial step and lift the wheelchair up. The client keeps on destroying on the drive wheels to keep climbing the rest of the means.

Fig 2.2 Manuscale Wheelchair

A third manual stair-climbing wheelchair found through a web seek is Vardaan. Figure 2.3 [7] is a wheelchair planned by a gathering of four building understudies at the Indian Institute of Technology (IIT). Vardaan is equipped for climbing a wing of stairs by pulling on handle bars associated with sets of "Y" formed wheels. The power arms are associated with wrenches and braking frameworks making a sheltered and stable ascension and plunge. Likewise with the past wheelchairs, there exists almost no distributed documentation that further clarifies how Vardaan climbs. Lola Nayar [8] depicts the undertaking and its imaginative climbing technique directed by Shanu Sharma, et al. also, tutored by Prof. Kanpur. Right now, the wheelchair structured by Shanu Sharma has been affirmed by the IIT science and innovation divisions for further research and conceivable large scale manufacturing.

Fig 2.3 Vardaan Manual Stair-Climbing Wheel chair

The Stair bicycle appeared in Fig. 2.4 is a working model of a manual stair-climbing wheelchair intended to assist dynamic people with great condition who experience the ill effects of paraplegia [9]. With constrained writing distributed about the Stair bicycle the accompanying perception can be expected. The client is leaned back practically parallel to the ground in a truly awkward and risky position. One can envision the trouble, quality and coordination required to convey the client to a rolling position (upstanding) in the wake of climbing or slipping a staircase. The two bunches of four wheels on the back are fuelled by chains and pedals for the client to control with his/her hands.

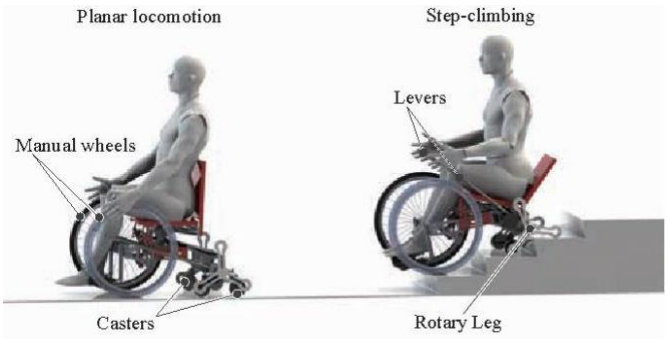

Fig 2.4 Stair bike climbing a Staircase

The last checked on manual wheelchair that professed to have stair-climbing abilities was Peak. This is a manual stair-climbing wheelchair applied structure by Josefina Chaves-Posse et al. appeared in Fig. 2.5 in a joint effort with the University of Alberta [10]. By watching the image of the wheelchair, we can infer that Zenith proceeds onward two tracks on level territory and climbing stairs. It very well may be seen that there are groups of three legs with little wheels at the closes that assistance amid climbing mode.

Fig 2.5 Zenith 3D Model

2.2 Power Wheelchairs with Stair-Climbing Capabilities

The primary kind of wheelchairs uses wheels or groups of wheels to climb. Fig. 2.6 demonstrates the TGR Scoiattolo 2000 Wheelchair [1]. This wheelchair is equipped for conveying a paraplegic individual upstairs with the assistance of a right hand. An associate alludes to a grown-up person who helps the client (paraplegic client) to climb or drop the staircase.

Fig 2.6 TGR Scoiattolo 2000 Wheelchair

The Independence iBOT 4000 Mobility System is a wheelchair that uses groups of wheels to climb stairs as appeared in figure 2.7 [2]. This framework made by Independence Innovation, a Johnson and Johnson Company, is a wheelchair that can help paraplegic patients in proceeding onward level landscape just as climbing ventures without the need of a collaborator. The iBOT can move level landscape moving on its four wheels, a capacity proposed to be utilized primarily in open air situations. In this capacity, the iBOT is fit for travelling through delicate or shaky landscape, for example, grass, rock, soil, and shoreline sand. What's more, when the wheelchair moves over a bend or slope, the group pivots relatively to keep up a dimension situate and augment the tipping over factor of security as portrayed in [2].

Fig 2.7 Independence iBOT 4000 Mobility System

Another wheelchair that utilizes its wheels to climb stairs is the OB-EW-001 Observer Maximus as appeared in Figure 2.8. This gadget uses two amazing engines to drive the front and the back wheels freely, making it a power 4WD wheelchair. The wheelchair additionally utilizes a spinner to screen the tendency of the seat when climbing stairs and slopes and an engine to modify the seat level with leveled ground.

Fig 2.8 OB-EW-001 Observer Maximus

2.3 Wheelchairs and Wheelchair Carriers that Use legs to Climb

The second sort of stair-climbing wheelchairs and wheelchair transporters comprises of leg-like components to overwhelm stairs. Fig. 2.9 demonstrates the Zero Carrier wheelchair structured by Jianjun Yuan et al. [3,4]. Zero Carriers is an eight-legged wheelchair furnished with wheels joined toward the finish of every leg. Moreover, the legs are developed from square tubing fitted inside a greater square tubing fit for packing and growing. Each of the eight legs are freely driven by eight engines giving the Zero Carrier the likelihood to pack or extend any leg autonomous from the rest.

Fig 2.9 Zero Carrier Wheelchair

Wheelchair transporters that use leg-like components to climb stairs incorporate the C-MAX U1 by AAT the Stair climber People [5] as appeared in Figure 2.10 C-MAX U1 is a wheelchair transporter that is tied to the back of most manual wheelchairs. The client requires a right hand to climb stairs. The transporter lifts up the client on two legs and the right hand takes to position of the back legs to keep it from falling back. The C-MAX U1 is made out of an electric engine that runs a rack joined to the legs and pushes it descending far from the principle edge of the transporter.

Fig 2.10 C-MAX U1 Climbing a Staircase

3. WORKING PRINCIPLE

The exploratory setup of our venture comprises of a gentle steel outline welded in the state of a seat with the goal that the deadened individual can sit easily. Additionally a head rest is given which can be utilized to put the head while resting. The seat setup is associated with the lead screw course of action impelled by an engine. Consequently when the engine turns, the rotating movement is changed over into the direct motion. Also the wheels of the wheel seat are associated with an engine through a lot of goad gears. This is

utilized for accomplishing movement to the wheel seat. The flip change is utilized to supply capacity to the whole framework.

The deadened individual is made to sit on the wheel seat serenely and when he is drained, the engine associated with the lead screw is worked so the seat brings down and goes about as a bed type setup so the individual can rest in his seat itself. Again when the flip switch is squeezed, the engine is pivoted in the invert course, with the goal that the seat is lifted and takes after a conventional wheel seat. The movement to the wheel seat is conveyed with the assistance of an engine. The engine conveys capacity to the wheels through a lot of goad gear. The goad gears are utilized for appropriate speed decrease.

4. DESIGN AND

CALCULATION 4.1 3D Design of Wheel Chair

Creo Elements/Pro offers a scope of devices to empower the age of a total computerized portrayal of the item being planned. Notwithstanding the general geometry instruments there is likewise the capacity to produce geometry of other incorporated plan teaches, for example, modern and standard pipe work and complete wiring definitions. Devices are likewise accessible to help community oriented improvement. Various idea configuration apparatuses that give in advance Industrial Design ideas would then be able to be utilized in the downstream procedure of building the item. These range from reasonable Industrial plan outlines, figuring out with point cloud information and extensive freestyle surface apparatuses.

We made 3D model of this undertaking by utilizing CREO programming. The models are appeared as follows Figure 4.1.

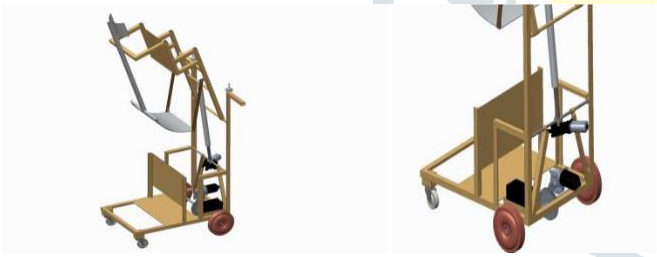

Fig 4.1 3D Diagram of Standing Wheel Chair

4.2 Calculation

Power Calculations

Torque required on a flat surface

Normal force (Fn) = force applied = m*g
= 100*9.81 = 981N
Friction force (Ff) = μ*Fn
= 0.3*981 = 294.3 N
Torque required = Ff * r_w
= 294.3*0.2 = 58.86 N-m

Torque required on slope

Stair dimensions
Land: 400 mm
Rise: 250.5 mm

Slope of stair (θ) = tan-1(252.5/400)
= 32°
Total mass acting (including setup) =100kg =100*9.8 = 981N
Normal force acting (Fn) = m*g*cosθ
= 100*9.81*cos (32°)
= 831.93 N
Frictional force (F_f) = μ*Fn
= 0.3*831.93
= 249.57 N
Opposing force (Fo) = m*g*sinθ
= 100*9.81*sin (32°)
= 519.85 N
Torque required = (F_f + Fo)*r_w
= (249.57+519.85) 0.2
= 153.88 N-m

5. CONCULSION

The present investigation was planned to build up an idea for a programmed wheelchair-cum-stretcher, with the inspiration of sparing space and blocking effort by the patient. By give Toggle Switch to the simplicity of patient to move without being subject to anybody or applying additional power for development. Likewise to expel challenges of moving patients from stretchers to a wheelchair.

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