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Design and Analysis of Wheelchair Shifting Technology for Disabled Person

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Abstract:
Personal mobility means freedom for the physically challenged. One of the best inventions in the medical field that helped both the elderly and the handicapped is the mobility vehicle. The fact that they are no longer depending on someone else to perform daily duties is a big step forward. A large variety of mobility vehicles are available, from which one is to be selected as per requirements. Mobility Vehicles are designed based on the usage, i.e. either indoor or outdoor. In this project we attempt a wheel chair technology for disabled person that the person can handle the wheel chair. Mainly, the person should move near to motorcycle by own. Then the person will shift from wheel chair to motorcycle or somewhere easily. This proposed technology will present with simple prototype model and analyzed by ANSYS software.

Key Words: Personal mobility, Mobility vehicle, Disabled Person, Wheel chair, Ansys software.

1. INTRODUCTION

There are different varieties of mobility solutions available in the market. Even there are chairs which can climb stairs, obey voice commands or even respond to human thoughts. The costs range from a couple of thousand dollars to tens of thousands of dollars, which comes to be around one lakh to ten lakhs Indian rupees or more. The bulk of the market is in a basic design which can provide mobility for a person on indoor level surfaces. It is assumed that the user can see where he is going and can press a few switches and operate a remote control. Most machines have the capability to go up a short ramp, but not up steps. All conventional powered wheelchairs have two motors; one each; driving one of the main wheels on either side of the vehicle. As in manual wheelchairs where the occupant of the chair uses his hands to rotate the main wheels on either side using handrails fixed to the wheels, all maneuvering is by varying the relative speed of rotation of the wheels on either side. This is technically called “Differential Steer”. In motor wheelchairs the differential steer is achieved by properly controlling the speed ratio of the two motors. The electronics has to interpret the two components of the remote displacement and control the motor speeds accordingly. Apart from the main pair of driven wheels there has to be castor wheels for support. These align automatically to roll in which every direction they are pushed.

1.1 HISTORY OF WHEELCHAIR

The first records of wheeled seats being used for transporting disabled people date to three centuries later in China; the Chinese used early wheelbarrows to move people as well as heavy objects. A distinction between the two functions was not made for another several hundred years, around 525 AD, when images of wheeled chairs made specifically to carry people begin to occur in Chinese art.

Wheelchair is used by people who have difficulty in mobility. Generally people who use are,

- Lower limb disabled people
- Patients at the hospitals
- Elederly Person

1.2 TYPES OF WHEELCHAIR

There are many types of wheelchairs available in the market like manual or powered wheelchair and the choice of wheelchair depends upon the physical and mental ability of the user. General types of wheelchairs are,

i. Manual self-propelled wheelchair:

A self-propelled manual wheelchair incorporates a frame, seat, one or two footplates (footrests) and four wheels: usually two caster wheels at the front and two large wheels at the back as seen in Figure 1.1. There will generally also be a separate seat cushion. The larger rear wheels usually have push-rims of slightly smaller diameter projecting just beyond the tyre; these allow the user to manoeuvre the chair by pushing on them without requiring them to grasp the tyres.

Figure.No. 1.1. Manual Self-Propelled Wheelchair

ii. Manual Attendant-Propelled Wheelchairs:

An attendant-propelled wheelchair is generally similar to a self-propelled manual wheelchair, but with small diameter wheels at both front and rear as seen in Figure 1.2. The chair is manoeuvred and controlled by a person standing at the rear and pushing on handles incorporated into the frame. Braking is supplied directly

by the attendant who will usually also be provided with a foot- or hand-operated parking brake.

Figure.No. 1.2: Manual Attendant-Propelled Wheelchair

iii. Powered wheelchairs:
An electric-powered wheelchair, commonly called a "power chair" is a wheelchair which additionally incorporates batteries and electric motors into the frame and that is controlled by either the user or an attendant, most commonly via a small joystick mounted on the armrest, or on the upper rear of the frame as seen in Figure 1.3.

Figure. No 1.3: Powered Wheelchair

iv. Mobility scooters:
Mobility scooters share some features with power chairs, but primarily address a different market segment, people with a limited ability to walk, but who might not otherwise consider themselves disabled as seen in Figure 1.4. Smaller mobility scooters are typically three wheeled, with a base on which is mounted a basic seat at the rear, with a control tiller at the front.

Figure. No 1.4. Mobility Scooter

v. Single-Arm Drive Wheelchairs:
One-arm or single arm drive enables a user to self-propel a manual wheelchair using only a single arm as seen in Figure1.5. The large wheel on the same side as the arm to be used is fitted with two concentric handrims, one of smaller diameter than the other. On most models the outer, smaller rim, is connected to the wheel on the opposite side by an inner concentric axle. When both handrims are grasped together, the chair may be propelled forward or backward in a straight line. When either hand-rim is moved independently, only a single wheel is used and the chair will turn left or right in response to the hand-rim.

Figure. No 1.5: Single Arm Drive Wheelchair

2. COMPONENTS DESCRIPTION

i. ELECTRICAL MOTOR

Most electric motors operate through the interaction between the motor's magnetic field and winding currents to generate force in the form of rotation. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. A **DC motor** is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism. A DC motor is shown In fig 2.1. DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances.

Figure. No 2.1: DC Motor

ii. BATTERY:

An electric **battery** is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, Smartphone's, and electric. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and

deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved additionally to include devices composed of a Single cell. Shown in fig 2.2.

Figure.No 2.2: Battery

iii. SCISSOR JACK:

A jack is mechanical device used to lift heavy loads or apply great forces. Jacks employ a screw thread or hydraulic cylinder to apply very high linear forces. A mechanical jack is a device which lifts heavy equipment. The most common form is a car jack, floor jack or garage jack which lifts vehicles so that maintenance can be performed. Car jacks usually use mechanical advantage to allow a human to lift a vehicle by manual force alone. More powerful jacks use hydraulic power to provide more lift over greater distances. Mechanical jacks are usually rated for a maximum lifting capacity. Scissor jacks are simple mechanisms used to drive large loads short distances. The power screw design of a common scissor jack reduces the amount of force required by the user to drive the mechanism. Most scissor jacks are similar in design, consisting of four main members driven by a power screw. A scissor jack is operated simply by turning a small crank that is inserted into one end of the scissor jack. This crank is usually “Z” shaped. The end fits into a ring hole mounted on the end of the screw, which is the object of force on the scissor jack. When this crank is turned, the screw turns, and this raises the jack. The screw acts like a gear mechanism. It has teeth (the screw thread), which turn and move the two arms, producing work. Just by turning this screw thread, the scissor jack can lift a vehicle that is several thousand pounds. Power screw in a scissor jack is the foundation of whole mechanism of scissor jack. scissor jack is shown in fig 2.3

Figure. No 2.3: Scissor Jack

iv. WHEEL:

A wheel is a circular component that is intended to rotate on an axle bearing. The wheel is one of the key components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labour in machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel, potter's wheel and flywheel. Shown in fig 2.4.

Figure.No 2.4: Wheels

v. FRAME STRUCTURE:

Frame structures are the structures having the combination of beam, column, and slab to resist the lateral and gravity loads. These structures are usually used to overcome the large moments developing due to the applied loading. **Framing**, in construction, is the fitting together of pieces to give a structure support and shape. Framing materials are usually wood, engineered wood, or structural steel. This frame structure is a base of our prototype model and it gives shape our desire machines. We use material for this frame structure is mild steel because it material properties is suitable for our construction. The frame structure has been fabricating with some manufacturing process which we discussed next chapter.

Figure.No 2.5: Frame Structure

vi. LEAD SCREW

A lead screw also known as a Power screw or translation screw is a screw used as a linkage in a machine, to translate turning motion into linear motion. Because of the large area of sliding contact between their male and female members, Screw threads have larger frictional energy compared to other linkages. a lead screw is shown in fig 2.6.

Figure.No 2.6: lead screw

3. WORKING PRINCIPLE

Our prototype model consists of wheelchair setup, electrical motor, battery, scissor jack, control switches, lead screw etc. The motor is coupled with wheels and used to rotate the wheels. The scissor jack is used to lift and down the chair by this process the disabled person can move easily. The lead screw is used to move the seat into horizontal direction .by this action disabled Person can easily to shift wheel chair to bike and anywhere.

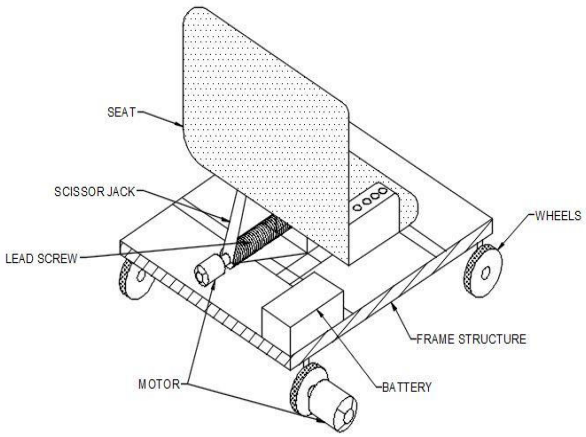

Figure.No 3.1:working diagram

4.DESIGN OF WHEEL CHAIR

4.1 3D MODEL

Figure.No 4.1:3D Model

4.2 EXPLODE VIEW

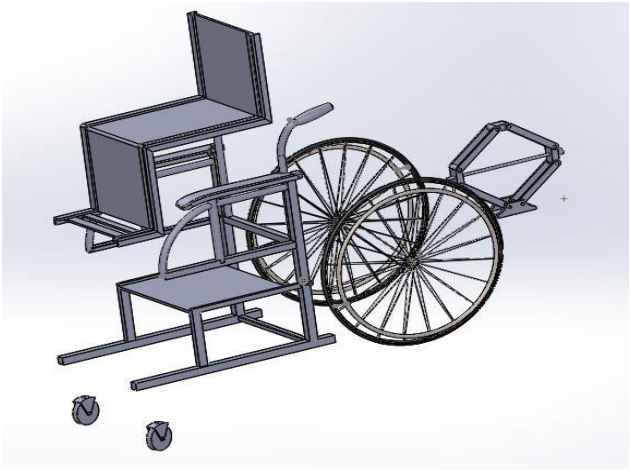

Figure.No 4.2:Explode view

4.3 WORKING MODEL

Figure.No 4.3 : Working model

5. ANSYS RESULT IMAGES

5.1. MESH

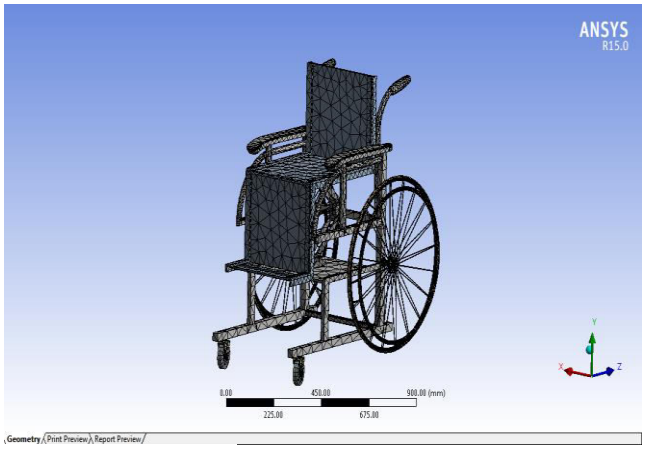

Figure.No 5.1: Mesh

5.2. LOAD

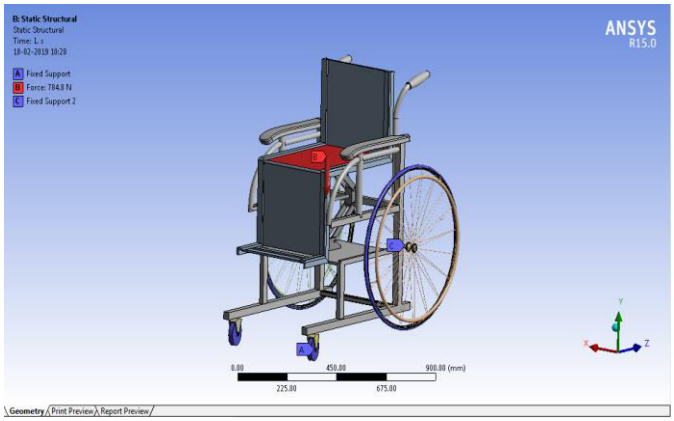

Figure.No 5.2: Load

5.3. DEFORMATION

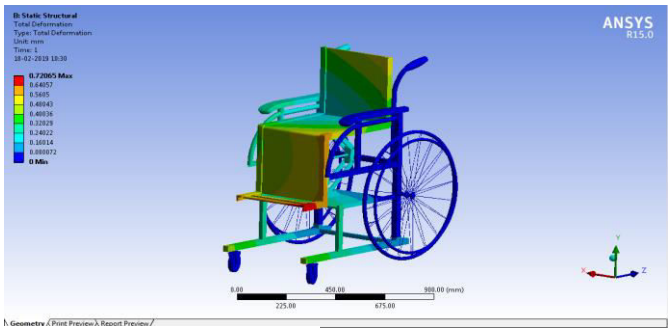

Figure.No 5.3: Deformation

5.4. STRESS

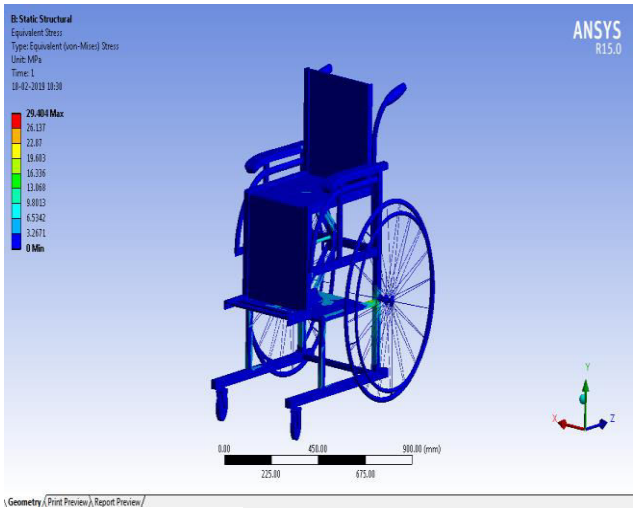

Figure.No 5.4: Stress

5.5. STRAIN

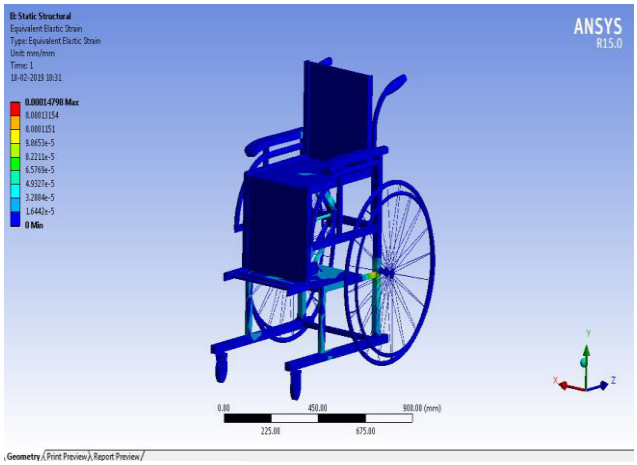

Figure.No 5.5: Strain

6.MODEL CALCULATIONS

- Seat size = 50*50cm
- Diameter of large wheel = 70 cm
- Diameter of small wheel =10cm
- Distance between two tyre =70cm
- Normal setup height =100cm

a. Properties of the scissor jack

- Max lifting weight =100kg
- Max height =30cm
- Min height =9cm
- Weight =2kg
- Pitch =3mm

b. Mechanical Properties of lead screw

Table no : 6.1

ITEM	DESCRIPTION
Tensile strength.	275 to314N/mm^2
Tensile yield strength.	216 to 245N/mm^2
Compressive yield strength	539 to686N/mm^2
Fatigue strength	294to343N/mm^2
Charpy impact	132N/mm^2 *10^7
Elongation	1to 5%
Hardness	120 to 145 Hv

c. Specification of wiper motor

Table no : 6.2

ZD 2730/ZD 1730 Wiper motor	
Voltage	12V, 24V
Power	120W
MOQ	100 pcs

7. CONCLUSIONS

We proposed a wheelchair with lifting and shifting function For disabled upper and lower limbs. This equipment facilitates easy and safe transfer from wheelchair to a motorbike or bed or anywhere. Result show that this equipment had good maneuverability. We also demonstrated that the equipment had sufficient ability of moving up and down a 20 cm height and moving horizontally maximum 10 cm long. The maximum load capacity of this wheelchair is 100kg. In future works, we Plan to improve this system for better Practical use, mechanical strength, and design. Better seating, safty, and comfort will also be required.

8. REFERENCES

[1]. M. A. (2006, Oct. 01). Professor Ernesto Blanco: A Lesson in Creative Engineering. Available: http:// mitadmissions. org/ blogs/ entry/ professor Ernesto Blanco.

[2]. Minuscule.(2013,Oct.01).'United Spinal' Tech guide. Available: http://www. usatechguide.org/ itemreview.php? itemid =1612

[3]. S.Sharma. (2012,Oct.01). Verdean:stair climbing wheelchair. Available:http://www.techpedia.in/award/project-detail/ VARDAAN-A-Convertible-Manual-Stair- Climbing-Wheelchair

[4]. Nayar. (2012,oct.02). Where the pedal meets the mettle. Available: http://photo. outlookindia. com/images/ gallery/ 20120612/wheelchair_iit_20120625.jpg

[5]. J. Y. S. Hirose, "Zero Carrier: A Novel Eight Leg-Wheels Hybrid Stair Climbing Mobile Vehicle," Journal of Robotics and Mechatronics, vol. 17, pp. 44-51, 2004.