WHEELCHAIR FOR PHYSICALLY CHALLENGED

ABSTRACT:

The main aim of this project is to find different part to the right material for the paraplegic wheelchair to fit the different targets group, to solve that it was required to find out an appropriate power source, battery size and many element like this. The reason for the design is to benefit all kind of the paraplegic people for their daily life. Make them as normal people as possible. The promotion of the production should also take into considering. The project started by brainstorming and trying to figure out the most right one to fit the most target group. The future design in the end is the goal people are trying to reach.

1.1 INTRODUCTION

The goal of this smart wheelchair project is to enhance an ordinary powered wheelchair using actuator to perceive the wheelchair's surroundings, a Bluetooth controller to interpret command. Intelligent wheelchair will play an important role in the future welfare society. The use of intelligent wheelchair encourages the view of the machine as a partner rather than as a tool.

The population of people with disabilities has risen markedly during the past century. As the data come from the National Health Interview Survey (NHIS), two distinct trends have contributed to the increasing overall prevalence of disability: a gradual rise, due largely to demographic shifts associated with an aging population, as well as a rapid increase that is due to health impairments and accidents.

A scissor lift used to raise or lower. The main objective of the devices used for lifting purposes is to make the wheelchair adjustable to a desired height. A scissor lift provides most economic dependable & versatile methods of lifting loads; it has few moving parts which may only require lubrication. This lift raises load smoothly to any desired height. The modification is based on these mechanism.

Generally, a motorized wheelchair usually uses a joystick as the input interface for controlling movement of the wheelchair. If we want to move forward or turn left or turn right the wheelchair, we can do it by moving the joystick to the same direction. In this project, we tried to substitute the joystick with another input interface.

Instead of the joystick, Bluetooth signal of some button are used to control movement of the wheelchair. There are five words used to control movement of the wheelchair. Those button are stop, forward, backward, left and right. In order to achieve that aim, a Bluetooth module system has been implemented to recognize the word and then control movement of the wheelchair according to recognized word.

The Bluetooth module is implemented by arduino, which controls the wheelchair. The approach used to recognize the input in the Bluetooth signal to relay. Two DC motors are used to actuate the movement of wheelchair.

Reason for choosing the design for modified wheel chair:

- Convenience purpose for the users
- Middle stage of the disable people
- It is a design for disable, old and amputated people
- More benefit became it has a bigger range of users
- Beneficial for often users like amputated and old people who find it difficult to walk apart from the main target group

- To help the disable move or do things by themselves

Psychologically to help the user have a feeling of independence

COMPONENTS

5.1 MECHANICAL SECTION

Solid Model of Frame

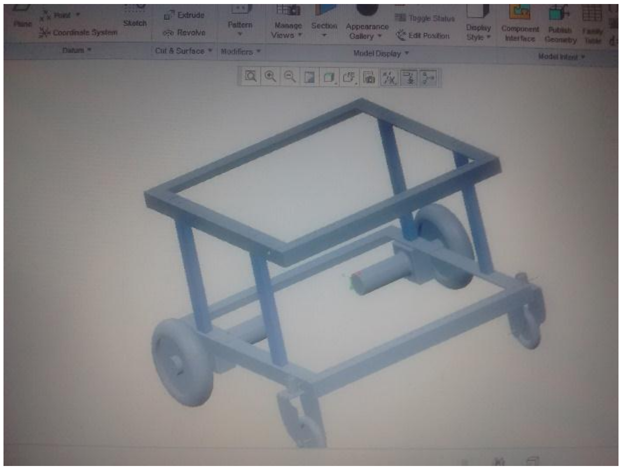


Fig 1 Solid Model of Frame

5.1.3 Material for Wheelchair Frame:

32mm L-ANGLE Mild Steel Extruded Hollow Rod with 3 mm wall thickness

Fig 5.1.3 Frame Material

5.1.4 Process Involved:

Fabrication of wheelchair involves certain mechanical process. The process involved in the production are

- Welding
- Lathe operations

5.1.5 Fabricated Wheelchair Frame:

Fig 5.1.5 Wheelchair Frame

5.2 Lifting process section:

5.2.1 Lifting device:

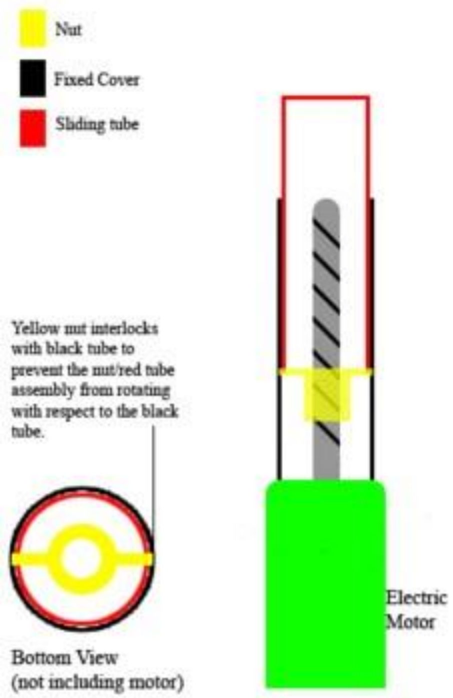


Fig actuator mechanism

Conceptual design of a basic travelling-nut linear actuator. Note that in this example the lead screw (gray) rotates while the lead nut (yellow) and tube (red) do not.

DVD drive with leadscrew

and stepper motor.

Floppy disc drive with

leadscrew and stepper motor.

5.2.2 Lifting mechanism

5.2.2.1 Introduction

A scissor lift is a mechanical device used for various applications for lifting of the loads to a height or level. A scissor lift used to stack, raise or lower, convey and/or transfer material between two or more elevations. The main objective of the devices used for lifting purposes is to make the table adjustable to a desired height. A scissor lift provides most economic dependable & versatile methods of lifting loads; it has few moving parts which may only require lubrication. This lift table raises load smoothly to any desired height. The scissor lift can be used in combination with any of applications such as pneumatic, Electric, mechanical, etc. Lift tables may incorporate rotating platforms (manual or powered); tilt platforms, etc, as a part of the design.

Scissor lift design is used because of its ergonomics as compared to other heavy lifting devices available in the market. The frame is very sturdy & strong enough with increase in structural integrity. A multiple height scissor lift is made up of two or more leg sets. These types of lifts are used to achieve high travel with relatively short platform.

Industrial scissor lifts & tilters are used for a wide variety of applications in many industries which include manufacturing, warehousing, schools, grocery distribution, military, hospitals and printing.

The scissor lift contains multiple stages of cross bars which can convert a linear displacement between any two points on the series of cross bars into a vertical displacement multiplied by a mechanical advantage factor. This factor depends on the position of the points chosen to connect an actuator and the number of cross bar stages. The amount of force required from the actuator is also amplified, and can result in very large forces required to begin lifting even a moderate amount of weight if the actuator is not in an optimal position. Actuator force is not constant, since the load factor decreases as a function of lift height.

Types of lifts can be classified as follows:-

Classification based on the type of energy used

(a) Hydraulic lifts

(b) Pneumatic lifts

(c) Mechanical lifts

Classification based on their usage

(a) Scissor lifts

(b) Boom lifts

(c) Vehicle lifts

5.2.2.2 Material Selection

It is necessary to evaluate the particular type of forces imposed on components with a view to determining the exact mechanical properties and necessary material for each equipment. A very brief analysis of each component follows thus:

I. Scissors arms

II. Actuators

III. Top plat form

IV. Base plat form

Scissors Arms: this component is subjected to buckling load and bending load tending to break or cause bending of the components. Hence based on strength, stiffness, plasticity hardness. A recommended material is stainless steel.

Actuators: this component is considered as a strut with both ends pinned. It is subjected to direct compressive force which imposes a bending stress which may cause buckling of the component. It is also subjected to internal compressive pressure which generates circumferential and longitudinal stresses all around the wall thickness. Hence necessary material property must include strength, ductility, toughness and hardness. The recommended material is mild steel.

Top Platform: this component is subjected to the weight of the workman and his equipment, hence strength is required, the frame of the plat form is mild steel and the base is wood.

Base Platform: this component is subjected to the weight of the top plat form and the scissors arms. It is also responsible for the stability of the whole assembly, therefore strength. Hardness and stiffness are needed mechanical properties. Mild steel is used.

5.2.2.3 Design Theory and Calculation

In this section all design concepts developed are discussed and based on evaluation criteria and process developed, and a final here modified to further enhance the functionality of the design.

Considerations made during the design and fabrication of a single acting Actuators is as follows:

a. Functionality of the design

b. Manufacturability

c. Economic availability. i.e. General cost of material and fabrication techniques employed Hydraulic Actuators:

The Actuators is mounted in inclined position. The total load acting on the Actuators consists of:

Mass to be put on lift: 200kg

Taking FOS = 1.5 for mass in pallet

200 x 1.5 = 300 kg

- Mass of top frame= 2 kg
- Mass of each link:1kg(1*8)=8kg
- Mass of links of Actuators mounting=4kg
- Mass of Actuators=1.75kg
- Total Mass :2+8+4+300+2 = 316kg
- Total load = 316x 9.81 = 3160N

Scissors lift calculations:

For a scissor lift Force required to lift the load is dependent on,

Angle of link with horizontal Mounting of Actuators on the links Length of link.

Formula used

Where W = Load to be lifted

S= a2 + L2 -2aL*cos α

S = Distance between end points of Actuators. L= length of link = 0.45 m α = angle of Actuators with horizontal.

Now the maximum force will act on the Actuators

When the Actuators is in shut down position i.e when the scissor links are closed.For calculations we will consider α=300 Thus substituting α=300 in eqn (1), We get F=3160N

Selecting 63mm diameter Actuators

5.2.2.4. Design of Link

Now Let Hy0 =Mass applied on the lift=200kg

B=Mass of the lift which the Actuators needs to lift=200kg

Hyi=Total weight =2200N

- Only two forces are calculated here

1. Forces at the end of link: as forces at ends of link are same in magnitude.
2. Force at middle of link.

- In our case, the levels are numbered from the top.

For level 1 X1 = XBi-1

For level 2 X 2= XBi

The angle of Actuators with horizontal is θ=200. Hyi=2200N

X2=Hyi*i$\frac{cot\theta}{2}$

=2200*1*0.5*(cot20/2)

=3022.2N

Resultant of X 2&HYi/4

R1 = √(3022.2)2+(2200/4)2

R1 = 3738.14N.

Above force will act on all the joints at end of each link.

Now force acting on the intermediate point of link is given by,

Xmi=(2i-1)*H $_{yo}$* $\frac{cot\theta}{2}$ +(2i2- $_y$ * $\frac{cot\theta}{4}$ 2i+1)*b

=Hyo* $\frac{cot\theta}{2}$ +(2i - $\frac{cot\theta}{4}$ 2i+1)*by* = (2000 X 0.5 X cot 200)+ (1000 X 0.25 X cot200) =3448.14N

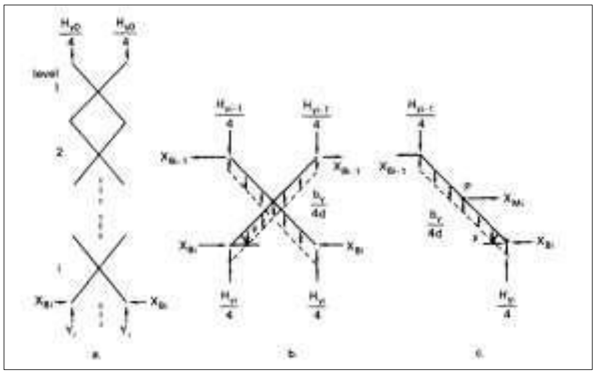


Fig No-1,Free body diagram for force applied in y direction

5.2.2.5. Design for Fabrication

For the link design it has been considered that, the entire load is acting on half of the link length.

Length of the entire link = 450mm.

Length of the link considered as the beam for the calculation purpose = 250mm.

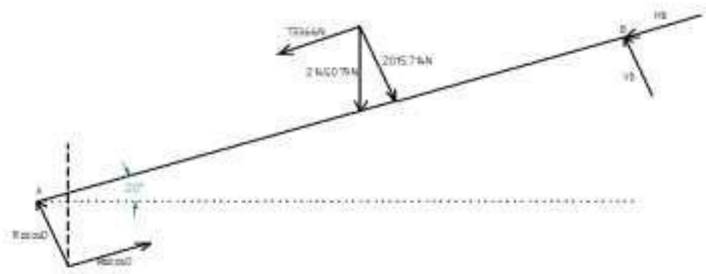
The load pattern on the top platform is considered to be U.D.L.

Hence, the load pattern on the link is uniformly varying load (U.V.L.) due to its inclination with horizontal.

The calculation is done for the link in shut height position, i.e. when the angle made by the links with horizontal is 200.

The length of the pin from the intermediate pin to the bottom roller is considered as a beam. The forces acting on the beam are-

- The reaction offered by the base to the roller, RA resolved into 2 components.
- The reactions offered by the intermediate pin, HB, VB.
- The force due to (Payload + Platform weight) resolved into two components, along the length of the link and perpendicular to the length of the link.



W = force per unit length of the beam can be evaluated as follows,

As the load pattern of U.V.L. is a triangle, we can say,

W (total force perpendicular to the link) = (1/2)*base*w

Hyi=2200N

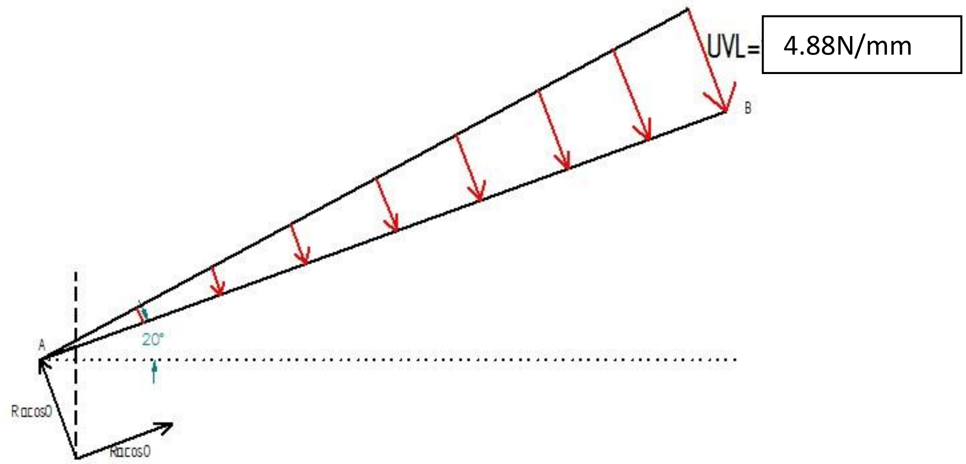
Hyi/4=(2200/4)=580N

580cos(200)=516.83N

580sin(200)=188N

Now 580=(1/2)*225*W

W=4.88N/mm



Taking moment about point A,

VB * 225 – [(580X*225 *$\frac{2}{3}$)]

Therefore,

VB = 215N

$\sum Fy = 0$,gives

VB + RAcos (20) – 580=0

Putting value of VB from equation (1) in equation (2), we get,

215+ RAcos (20) – 580 = 0

Therefore RA = 320.3N

Therefore, RAcos (20) = 300.3 N

RA sin (20) = 109N

$\sum Fx = 0$,gives

RAsin(20)+188=HB

Therefore, HB = 297.4N

$$\frac{M}{I} = \frac{\sigma}{Y}$$

Where, M = Maximum Bending moment on the link considered as beam.

Y = distance of the neutral axis from the farthest fiber = h/2.

σB = allowable bending stress

$= \frac{Sut}{f.o.s.}$

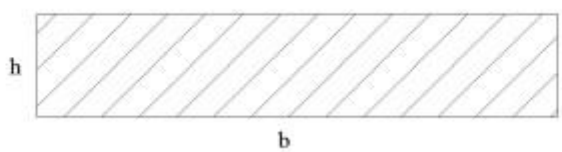
$= \frac{250}{4}$

= 62.5 MPa

I = Moment of Inertia of the link c/s about the X-X (horizontal) axis

$= \frac{bh^3}{12}$

Where, b = width of the link h = thickness of the link



Now the maximum bending moment is at the point of zero shear force.

And Maximum bending moment is given by(w*l2)/(9√3)

Bmax=(4.88*2252)/(9√3)

=15848N.mm Substituting in(M/I)=(σb/Y) Assume Y=h/2 and b=4h h=5.07 rounding the value to available dimensions h=6mm and b=40mm

5.2.2.6. Design of Moving End Pin

τall= 0.5*380/FOS

= 63.33Mpa

63.33= 4*F/3.14*D2*2

= 10.76mm

D = 12mm……………selecting standard value

5.2.2.7. Analysis of The Lift In ANSYS Software

Fig ,lift Assembly

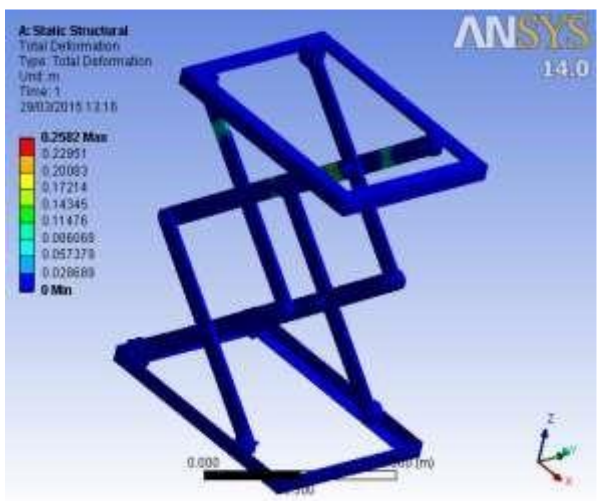


Fig No-3,Deformation Analysis

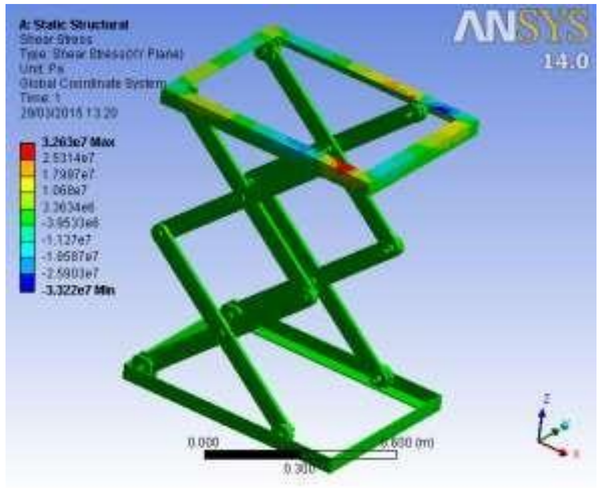
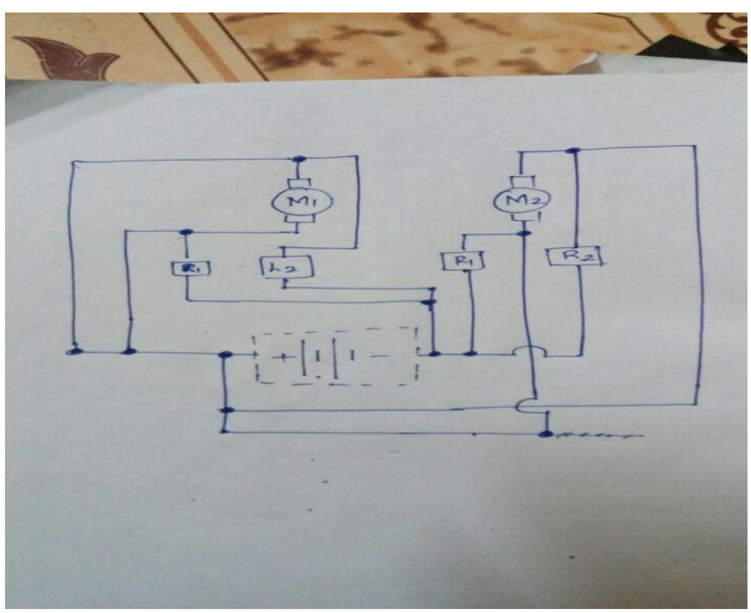


Fig No-4,Shear stress analysis

Analysis of results-

TYPE	MINIMUM	MAXIMUM
DEFORMATION	0mm	25mm
SHEAR STRESS	-332.2N/mm2	326.3N/mm2

5.3.5 DIRECTION CONTROL OF DC MOTOR



CENTRE FOR SMART AND ADVANCED MATERIALS
Academic Year 2016-2017

PROJECT MEMBERS DETAIL:

S.No	Name of The Project	Lab Utilization	Student Participated in the Project
1	Automated Wheelchair	Welding, Lathe, Drilling, Coding language, Aurdino Board, Professional tool kit	Rangarajan N, Rajkumar M

PROJECT OUTCOME:

Patent Filed

1. AN INNOVATIVE ECO FRIENDLY HYBRID TRANSPORT DEVICE FOR PHYSICALLY CHALLENGED PEOPLE, E-2/3809/2016-CHE