Design and fabrication of an innovative Planetary wheel chair for rural Area

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Abstract- Life of differentially able people is very difficult especially while moving from one place to another in rural area. Normally all the wheel chairs are available in the market are designed for smooth surface, but 75% of people with disabilities live in the rural area where uneven surface are common. The present work deals with the design and fabrication of an innovative planetary wheel chair. The use of planetary wheel reduces the impact due to uneven surface and inclined plane. The model of the planetary wheel chair are designed and simulated in the CREO and ANYSIS 14.0. The simulated model of wheel chair is validated under actual loading condition.

Keyword- Rural area, Planetary wheel chair, Impact, Disable Person, inclined Plane

1. INTRODUCTION

Disable people are facing very much difficulty while navigating for day to day work. They get tired and feel awkward. To overcome this problem, many researchers have developed wheel chair, so the disable people can travel without the help of any person, and also facilitate them to walk long distances. Most of the people feel difficulty to pull or drag object while they are moving on uneven surface and inclined plane. Some of the wheel chair are very much costly and made for smooth surface. And it's very difficult to everyone to purchase it. For that purpose, this paper aims to Design and Fabricate cheap innovative planetary wheel chair for rural area. So that maximum people belonging to rural and villages can use it. It is hoped that this new design will improve effective mobility. The models of planetary wheel chair are designed on CREO 3.0 and stress analysis of essential components is done using commercially available ANYSIS. After the design of wheel chair, the fabrication is done by the proper selection of material, which shows that the planetary wheel chair is very effective for mobility.

2. LITERATURE REVIEW

Ajit A. Mohekar [1] has explained the Design of frame and platform which includes the space considerations for wheel chair positioning and travel. Thus, parameters such as length from wheel base of wheel chair to shoulder support, length from wheel base of wheel chair to hand rest, width of wheel chair, total length of wheel chair were needed. Also to consider reach-ability data of a disabled person sitting on the wheel chair was required. Vivek Kaundal [2] explained the methodology to develop a new robotics wheel chair by modification in the design and changing the fabrication materials. The aluminum profiles are used in the skeletal structure. Instead of using integrated specially designed PCB, simple ATMEGA 8 is used for controlling the direction and speed of the wheel chair. The model of the wheel chair was prepared and simulated in Solid Works v2012 software. The profile is made of Aluminum Alloy 6063 T5, but due to advanced integrated PCB, structure of this wheel chair is very costly and need proper knowledge of hardware to operate it.

G.Azam and M T Islam [5] are designed and develop the system involves the implementation of both hardware and software. These approaches must be well implemented so that it will produce satisfactory outcome of the system which is to produce the correct wheelchair movement upon receiving the voice input command. The manual wheelchair is modified into an electrical wheelchair which is controlled using voice command. Parris Wellman [7] primary consideration in designing rehabilitation aids is safety. Because, statically stable machines are more reliable and are likely to be more acceptable to consumers than dynamically stable machines, we restricted ourselves to statically stable locomotion. A hybrid chair would be capable of using powered Wheels to navigate on a flat surface. The legs would be used primarily on uneven terrain and on unprepared surfaces. This arrangement allows for high stiffness in torsion and in bending with a very small penalty in weight. Arun Manohar Gurram [8] motorized wheelchair, power chair, electric wheelchair or electric-powered wheelchair (EPW) is propelled by means of an electric motor rather than manual power. They can also be used not just by people with 'traditional' mobility impairments, but also by people with cardiovascular and fatigue based conditions. Power chairs are generally four-wheeled and non-folding, some folding designs exist and other designs have some ability to partially dismantle for transit. The main factors that are considered for the fabrication of the wheel chair are weight or load, speed, width and height of the wheel chair. Researchers have focused hardware as well as software aspects of design for the smooth surface. In this research we are mainly focus to design the planetary wheel chair which can use on uneven surface for mobility.

3. RESEARCH METHODOLOGY

3.1 DESIGN OF FRAME

Model of the frame prepared is shown in Fig.1, which is simulated in CREO and ANYSIS14.0. This software allows us to design, draft and simulate the working of the model of the proper load application over it. Frame made of mild steel (AISI 1018). The physical properties of the material are given in table No.1

Fig.1: Isometric view of the frame (Design in CREO)

Table No.1: Properties of the mild steel AISI 1018

Property	**Value**	**Units**
Density	7.85	g/cm^3
Young modulus	200	GPa
Tensile strength (ultimate)	440	MPa
Tensile strength (yield)	370	MPa
Elongation at break(50mm)	15.0%	Mm
Poisson ratio	0.290	--
Mach inability	70%	--
Shear modulus	80	GPa
Reduction area	40%	
Hardness	179	HB
Impact strength	6.1	Kgf

3.2 DESIGN OF PLANETARY WHEEL

It is observed that all the wheel chair are being developed for the smooth surfaces and it is also observed that impact acting on the frame of wheel is very low, but when wheel chair is to move at uneven surfaces and on a inclined plane, then impact acting on the frame of wheel is more, due to this reason we have designed a planetary wheel chair which is shown in Fig 2. Dimensions of the planetary wheel chair are given in table No.2.

Fig .2: Isometric view of frame with planetary wheel

Table No.2: Dimension of planetary wheel

Dimensions	**Value (cm)**
Length of the platform	153
Width of the platform	93
Height of the platform	105

3.3 DESIGN ANALYSIS AND SIMULATION

At present day software is very essential for design and analysis. By the using of software (CAD, CAAD, CREO, SOLIDWORK, ANYSIS etc) researcher designed a different type of model, assemble the different sections, determine the maximum stress condition at any section of the model etc. In this paper design is done with the help of software (CREO and ANYSIS) and also determines the maximum stress acting on the frame and check the FOS (factor of safety) of the planetary wheel. After this we found that our design is safe at uneven surface and inclined plane.

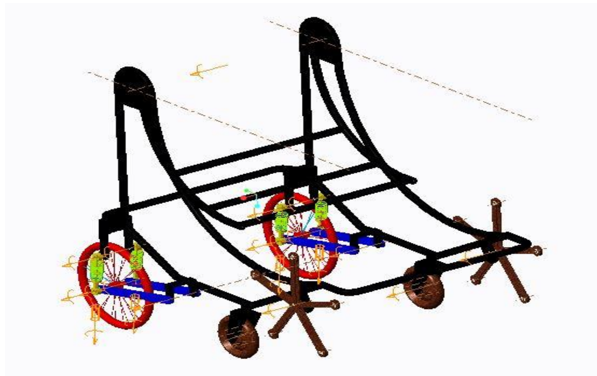

Fig.3: Final isometric view of the frame with planetary wheel chair

When the vehicle hits an obstruction due to uneven surface and inclined plane, impact force is transmitted to chassis through suspension spring. So, the component on which suspension spring is mounted is the critical component.

Let, F = Force that is transmitted through suspension system,

D_o = Outer diameter, D_i = Inner diameter, S_{yt}= yield strength

Assume the total impact force acting on the rear wheels of the vehicle in upward direction is "2g" times the weight of the vehicle.

Total force= 2×9.81×220(since weight of vehicle is 220 kg)=4316.4 N

The shape is complicated, due to this we cannot calculate by formula, so applying FEM(finite element method), with proper dimensions, D_o =33mm,D_i=30mm, after analysis the maximum yield strength=368.96 MP_a , Now, as per material selection yield strength= 370 MP_a, FOS(factor of safety)= 1.0027

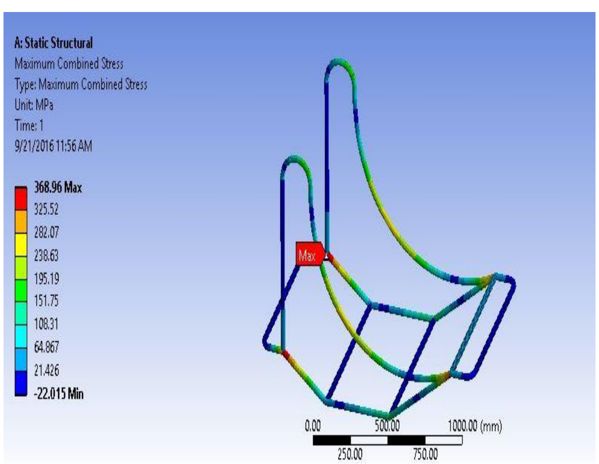

Fig.4: Isometric view of frame (stress analysis)

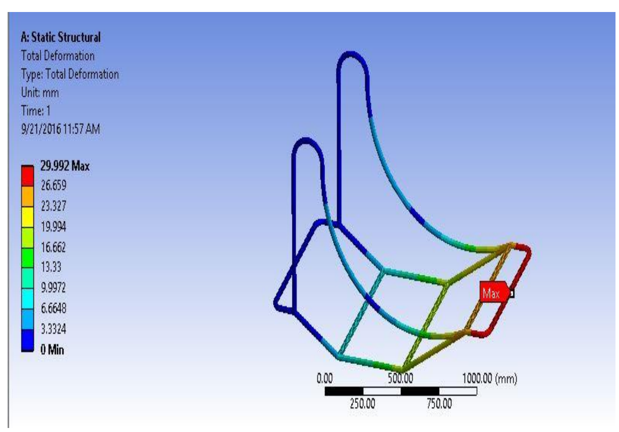

Fig.5: Isometric view (Total deformation)

After calculation of FOS we found that the frame is safe and the impact acting on planetary wheel chair is also safe condition. So planetary wheel chair are work under uneven surface and inclined plane on the rural area.
After analysis we found that if the diameter of the pipe is change then the factor of safety is also change.

Table No.3 Various FOS obtained for different dimension of mild steel (AISI 1018)

Pipe material	**D_O,(mm)**	**D_i,(mm)**	**Thickness(mm)**	**FOS**
Mild Steel	38.1	34.1	2.0	1.66
Mild Steel	38.1	34.6	1.8	1.48
Mild Steel	33.0	30.0	3.0	1.0027
Mild Steel	27.9	24.4	1.8	0.75
Mild Steel	25.4	21.4	2.0	0.68

We know very wheel that the MS tube provide high strength and are reliable for the application. Also the MS tube with 33 mm outer diameter and 3 mm thickness is well sufficient against the impact and tensile forces acting on the prototype while working. Initially, frame was designed in commercially available 3D modeling software by considering space constraints obtained in design consideration [1].

4. FABRICATION OF ACTUAL MODULE

After the designed on cero model is fabricated in workshop to test the validity of design and also performed the analysis. Which show that, the new innovative planetary wheel chair can be very reliable and useful for the rural area within the low cost.

1. Planetary wheel, 2.seat arrangement, 3.Caster wheel, 4.Shocker, 5.frame, 6.Main wheel

Fig.6: Isometric and front view of planetary wheel chair

5. RESULTS AND CONCLUSION

An attempt has been made to design and fabrication of an innovative planetary wheel chair for rural Area. The designed and fabricated prototype will be more effective in providing mobility for disabled people in the rural areas. By improving system, we directly enhance the life style of the disabled person in the rural area. This paper is more useful for elders, patients and physically challenged people those live in the rural area. Hope that this kind of system could contribute to the evolution of the wheelchair technology.

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