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Design and Fabrication of Dynamic Wheelchair

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Abstract: ***The research proposes a solution to implement The purpose of this project was to manufacture the multipurpose wheelchair in low cost which promote mobility and enhance the quality of life for the people who have difficulties in walking. This product make the users to lift the patient directly from the bed which help to reduce the pressure injuries. Along with the reducing the cost of product, we also aim to minimizing the pressure injuries and fall. Other specialty of the multipurpose wheelchair is, we can use it on indoor as well outdoor. Then after the completion of project we have successfully achieved what we set out to bring in wheelchair. We made a better multipurpose wheel chair with all safety measures, low cost and high quality. It provide a safe transferring of patients from one place to another place. The procedure that is used for transferring patients is very simple and unique***

Keywords: Patient, Wheelchair, Multipurpose wheelchair, Smart Wheel chair

I. INTRODUCTION

A wheelchair is a chair with wheels, used when walking is difficult or impossible due to illness, injury, problems related to old age, or disability. These can include spinal cord injuries (paraplegia, hemiplegia, and quadriplegia), cerebral palsy, brain injury, osteogenesis imperfecta, motor neurone disease, multiple sclerosis, muscular dystrophy, spina bifida, and more.

Wheelchairs come in a wide variety of formats to meet the specific needs of their users. They may include specialized seating adaptions, individualized controls, and may be specific to particular activities, as seen with sports wheelchairs and beach wheelchairs. The most widely recognized distinction is between motorized wheelchairs, where propulsion is provided by batteries and electric motors, and manual wheelchairs, where the propulsive force is provided either by the wheelchair user/occupant pushing the wheelchair by hand ("self-propelled"), by an attendant pushing from the rear using the handle(s), or by an attendant pushing from the side use a handle attachment.A wheelchair assists people to become more mobile and independent. There are many different types of wheelchairs that are used for various reasons. It is important to understand the limitations and safe operation of whatever wheelchair you choose.

A wheelchair is the catalyst to increased independence and social integration, but it is not an end in itself. Studies have shown that assistive technologies including wheelchairs, when appropriate to the user and the user's environment, have a significant impact on the level of participation which people with disabilities are able to achieve and when provided through a supportive service have been reported to reduce the time and physical burden for caregivers. The use of mobility devices, in particular, creates opportunities for education and work, and contributes to improved health and quality of life but may also have an impact on the prevention of falls, injuries, further impairments and premature death. Investment in provision of mobility devices can reduce health-care costs and economic vulnerability, and increase productivity and quality of life.

II. LITERATURE SURVEY

Akhil C, Muhammed Irfan et.al. (2021). Even if there is highly advanced equipments, it is highly expensive beyond common patients can't afford. So we have come up electrical and manual wheelchair available in the international market. The wheelchair will make shifting of patients to a far better way.[1]

R.Hari Krishnan et.al.(2019) .The study was Based on the conceptual design, a manual and a powered self-transfer device have been developed that can be used as an attachment to a manual and powered wheelchair respectively.[2]

*Kedar Sukerkar, Darshitkumar Suratwala,et.al.(2018).*There are several issues faced by the manufacturers and researchers which needs to be addressed so that, smart wheelchair becomes a commercial success and be widely used. Smart wheelchair have great scope in future and technological advancement in the field of robotics and sensors will lead to commercial success as well.[3]

Ninad M. Borkar, Saurabh A. Apte, et.al. (2016). The study was intended to develop a concept of wheelchair convertible stretcher with the motivation of saving space and prevent exertion of patient as well as by making sure that the patient does not get hurt. Our study shows that it is possible to save 50% space by using wheelchair convertible stretcher rather than using wheelchair and stretcher separately.[4]

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III. METHODOLOGY

Wheelchair is a device which can empower and enable a person with a disability to live a normal and independent life. Over the years wheelchairs have evolved rapidly from the manual wheelchairs to the powered wheelchairs. But still these wheelchairs have not been able to satisfy the needs of the disabled people. It is therefore critical that the problems of disabled be understood and accordingly wheelchairs are developed fulfilling their needs. Designing of Dynamic wheelchair This design phase included brainstorming, concept sketches and computer models. By categorizing and investigating different mechanisms used for height adjustment and patient transfer, a design matrix was created. Design concepts were selected based on the design matrix.

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A. Height Adjustment Mechanism

The lifting system is comprised of three primary components. The most important part is the “lifting force”, which provides the main strength in height adjustment. Two kinds of lifting mechanisms were investigated in this research, the scissor jack and Screw jack. But use of scissor jack couldn't fulfil the requirement so Screw jack was selected. The second primary component is the operation interface. Different control methods were considered for the different lifting methods and the third component is a stability for safety.

B. Transfer Mechanism

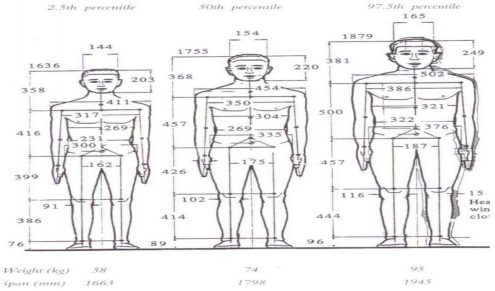
A simple mechanism is used it seems to be a normal wheelchair, but seat and the backrest are divided in two parts from centre as shown in fig. The forearm rest is pivoted at vertical member consisting of height adjustable mechanism, providing 90° of movement by each part.ts unique design helps patient to do their daily routine work like bathing, washroom etc.

C. Patient Transferring

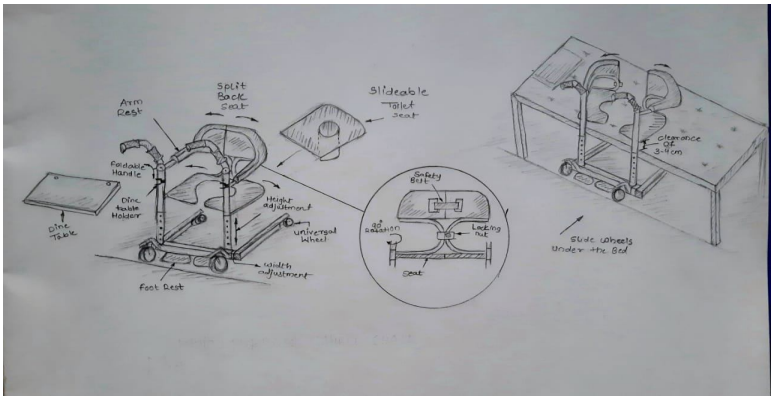
Patient resting on bed need to mobilise with care without pressure injuries and also with less effort application by care taker. Here comes Dynamic Wheelchair, patient is made to be seated on bed then wheelchair is placed next to bed as its secondary wheels rolls beneath the and seat on the bed with opened in opposite direction creating angle of 180° Then patient is slightly lifted and both seat are pushed under the patient and are locked provided on the back of wheelchair with a safety belt. The patient is successfully transferred from bed to wheelchair without any trouble also with less effort applied by care taker. And patient is ready to mobilise.

D. Study of Ergonomics

Ergonomics is about ensuring a good fit between people, the things they do, the objects they use and the environments in which they work, travel and play. Human factors (or human factors engineering) are an alternative term for ergonomics. Ergonomics needs to be considered in the design of any product, system or environment. Failure to do so may lead to designs which do not fit the physical, psychological or sociological needs of the users, leading to ineffective, inefficient or unsafe designs, which are unlikely to be commercially successful. The human sciences of psychology, anatomy and physiology provide information about the abilities and limitations of people, and the wide differences that exist between individuals. People vary in many ways: body size and shape, strength, mobility, sensory acuity, cognition, experience, training, culture, emotions, etc. Ergonomics are trained in analytical techniques, which will consider user characteristics and individual differences to the full extent in the design process. Good designers shall consider the people who will use the products, systems and environments they design, but they also have many other factors to consider. Often, it was due to commercial or percentile of population mean that ergonomics principles are compromised or not given adequate priority. Figures (a) to (d) are the body dimensions to different percentile for men and women. (Dreyfuss, 1967).



Ergonomic Evaluation Male (A)



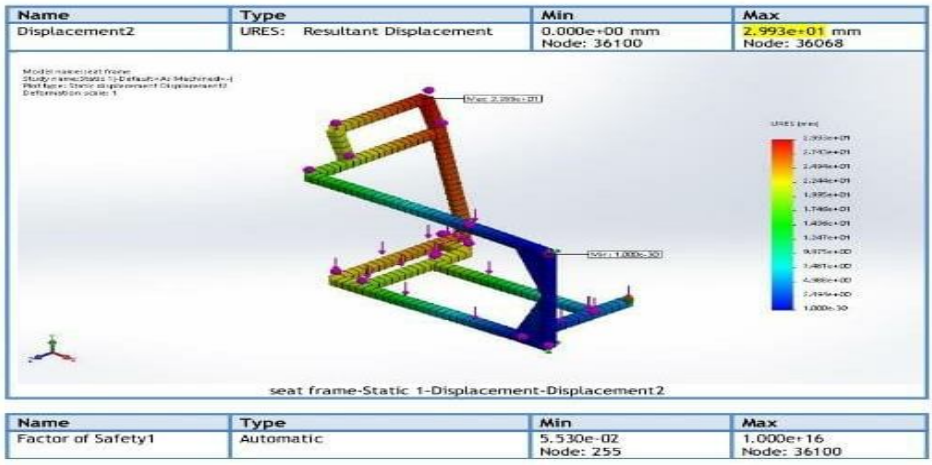
Conceptual Drawing

Design Software -Solid Works

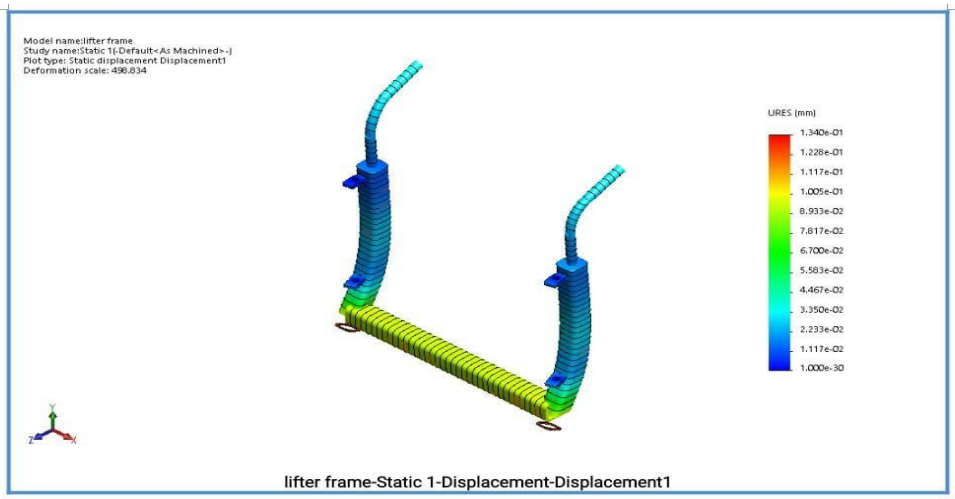


Wheelchair With Overhanging Mechanism

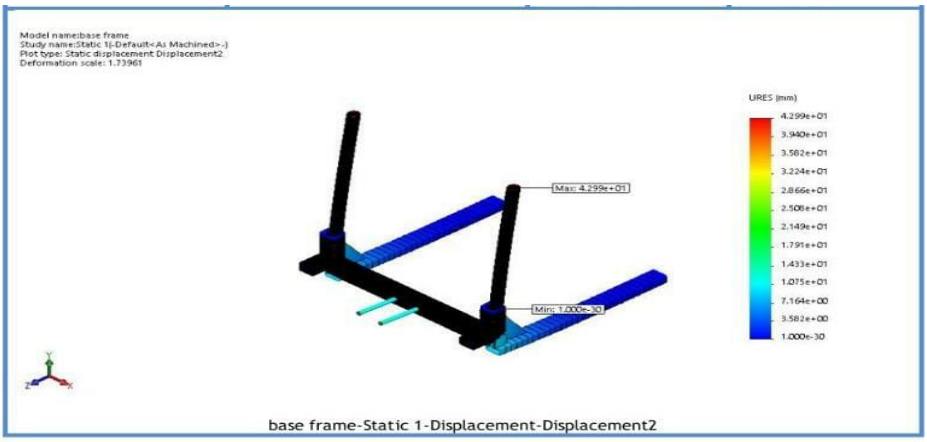
Stress Strain Analysis software -Solid Works Simulation



Seat Frame Analysis



Lifter Frame Analysis



Base frame Analysis

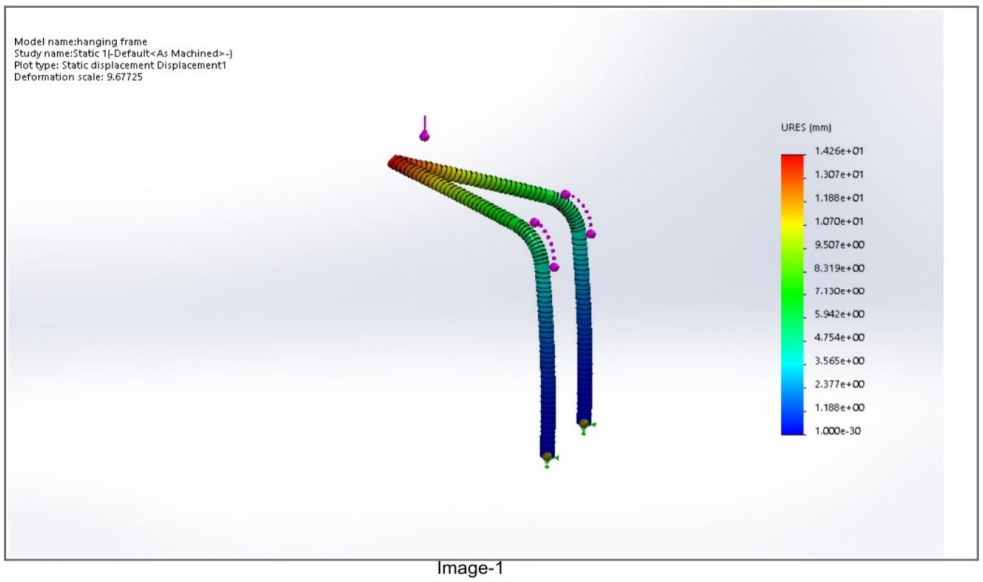


Image-1

Overhanging Frame Analysis

IV. RESULT & OBSERVATION

From this project, we designed and fabricated a dynamic wheelchair for the shifting of patients from bed with an affordable amount that will be more suitable in the Indian scenario. Analysis were done on wheelchair through both theoretically and practically.The theoretical analysis as done on Solidworks simulation .Maximum principal stress and maximum shear stress were obtained from Analysis report .The maximum stress was found to be 5.022e+08 N/m^2 and minimum of 0.000 N/m^2 .The factor of safety was obtained as 1 .According to maximum strain analysis it was found that a maximum strain of 6.425e-03 and minimum of 0.000.When the deformation was analyzed a distance of 4.299 mm displacement were found. During practical analysis 110 kg weight were loaded and lifted by Dynamic wheelchair. The cost of multipurpose wheelchair is 9000, it is very low camparing to the electrical and manual wheelchair available in the international market

Sr. No.	Parameters	Standard Manual wheelchair	Our Dynamic Wheelchair
1	Weight Capacity (kg)	Up to 100	Up to 130
2	Total Weight of Wheelchair	18	20.5
2	Length (cm)	76	60
3	Width (cm)	80	74
4	Seat Width (cm)	45	48
5	Height (cm)	76	75
6	Height With Overhanging Mechanism (cm)	No	171
7	Transferring Mechanism	No	Yes
8	Lifting Mechanism	No	Yes
9	Height Adjustment mechanism	No	Yes
10	Commode activity	Yes	Yes
11	Flexibility	Foldable	Detachable & Semi Rigid
12	Costing (Rs)	9990	9000

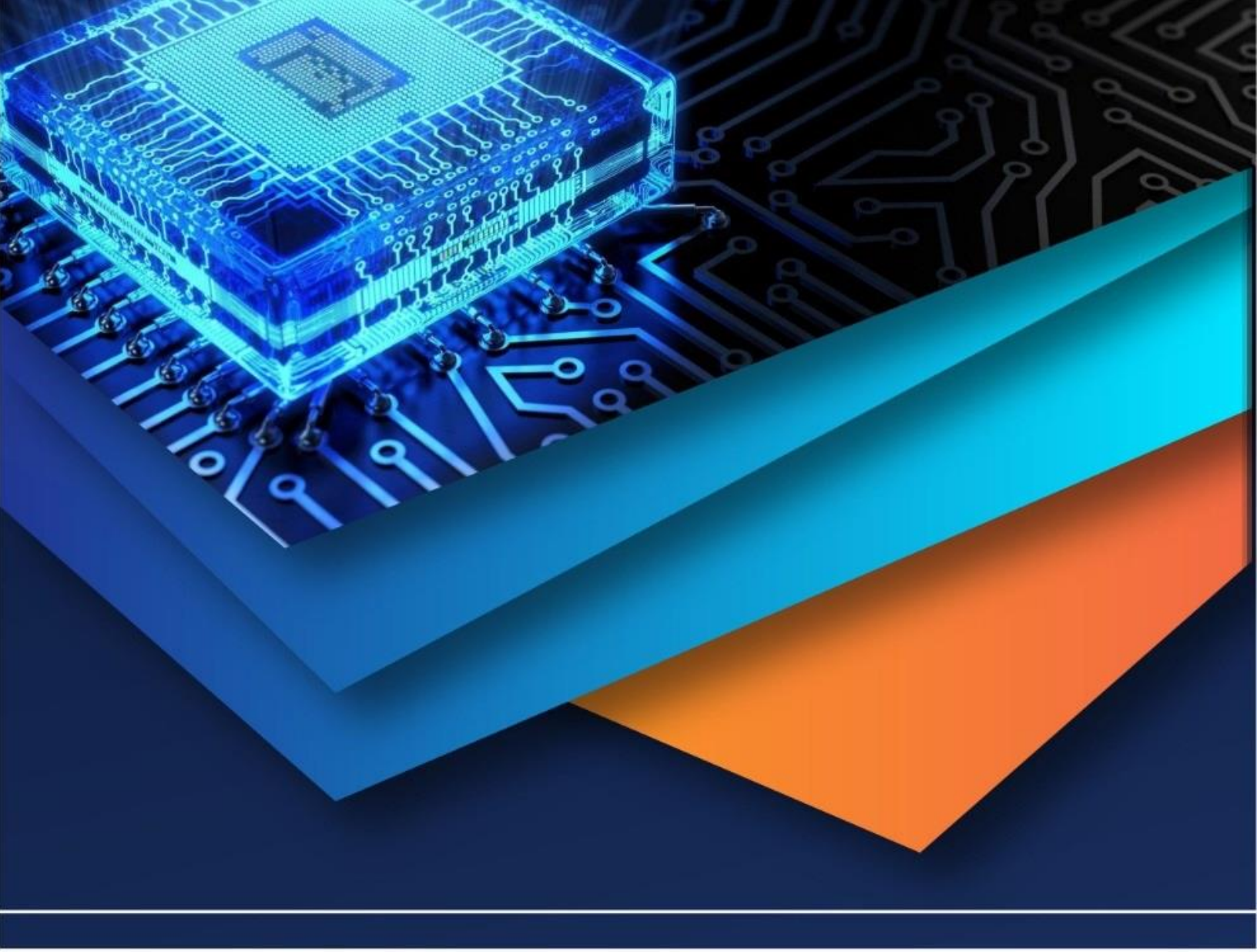
V. CONCLUSION

Caregiver shall be ensuring that the safety precaution is implement before or during transferring the disabled person from wheelchair to bed or vice versa. It is very dangerous to transfer disabled person without implement the safety precaution, as the accident may be occur. In the worse scenario, disabled people may fall down from the bed or wheelchair. Applied safety lock and canvas, it will be reduce the hazard to minimize level. From time to time, the caregiver shall perform self-inspection.

Our designed wheelchair can reduce handling process if compared to conventional wheelchair. Directly, it can be minimize the pain generate on the under arm due to improper handling by caregiver. At same time, it makes the job much easier for caregiver. He or she might not complaint about their back problem. This will be made the caregiver job more attractive and easy. As the population of elderly increase fast, this will be definitely increasing the caregiver demand.Though our project is less expensive, it does not compromise with the service provided by the conventional equipment. This equipment can be easily portable and can be used in the hospitals, old age homes as well as in houses. With the aid of my designed wheelchair, these shall be no problem of hardly to find people to serve this professional job. In short, the objectives for this research project are meet

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