IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114101

Review on Design and Development of Hydraulic Chair for Handicapped Person

Thavare Ajit S.[1], Shelke Aniket A.[2], Tupe Nilesh K.[3] and Prof. S. V. Kulkarni[4]

Student, Department of Mechanical Engineering, Sahakar Maharshi Shankarrao Mohite Patil Institute of Technology and Research, Shankarnagar Akluj, Maharashtra, India[1,2,3]

Professor, Department of Mechanical Engineering, Sahakar Maharshi Shankarrao Mohite Patil Institute of Technology and Research, Shankarnagar Akluj, Maharashtra, India[4]

Abstract: In many medical situations, it is necessary to lift patients. This need for assistance could be due to reduced patient strength as a result of an extensively invasive operation, inherent weakness, or old age. Generally, elderly or post-operative patients come to examinations in wheelchairs or with the assistance of a walker. In most cases, it is easier to help patients out of wheelchairs than to lift them up to the top of exam tables. To facilitate lifting of elderly or post-operative patients, it is necessary to design a device that is capable of safely transferring patients from a standing position on the ground to a level where they can easily get onto an exam table. To reduce patient anxiety, the device will include handles or another similar structure for patients to hold onto as they are being transferred. Finally, the device will be easy to operate and will minimize the required effort by the patient and medical personnel. In this paper we study the various research papers on design and development of hydraulic chair for handicapped person, the used the different technology for lifting the patients.

Keywords: Hydraulic chair, Transfer device, Jack

I. INTRODUCTION

One of the most common methods for lifting patients is manual labor. In this method, trained medical assistant wraps their arms around a patient underneath the shoulder joint. The assistant then carefully lifts the patient vertically. Carefully walking backwards while holding the patient, the assistant must then rotate slowly and lower the patient down onto the desired destination which is, in many clinical settings, an exam table. If the patient's lower body is partially incapacitated, it is often necessary for a second assistant to hold the patient while the other assistant steadies the patient's legs. If the patient is totally incapable of using their legs, they are then placed onto a hammock type sling in the lying position. Two assistants are then required to hold the two ends of the sling and lift the patient. Although manual lifting is mechanically simple, it requires a lot of physical exertion by the assistant. The level to which patients can be lifted is solely dependent on the assistant's strength. Because of the large effort required for the lifting, there is a significant risk of injury for the assistant and a risk of injury for the patient if the assistant drops them. To alleviate the required effort in patient lifting, several devices have been developed.

The first and most commonly used lifting device is the Hoyer Lift (figure 2). This device uses a non-automated hydraulic system to elevate patients. It also includes several adjusting mechanisms to widen or narrow the supporting base and wheels for easy transport. The cost of a Hoyer lift can range. To lift a patient, the device is first strategically positioned near the patient's desired destination.

The patient is then inserted into a nylon or cotton sling that supports their back and upper legs. After the patient is secured in the sling, the assistant elevates the patient by operating a foot or hand pump. When the patient is fully suspended in air, the assistant then rotates the patient over the destination and then releases the hydraulic system so that the patient is lowered slowly into position. Although the Hoyer lift lessens the amount of effort required by the patient and by the assistant, it can cause emotional unease for the patient since they are in full air suspension during the lifting process. Additionally, several expensive modifications to the Hoyer lift are available. These devices include automated systems, a larger weight capacity, finer adjustment mechanisms, and different sling sizes.

The most widely recognized difference is the difference between an electric wheelchair and a manual wheelchair. Electric wheelchairs are powered by batteries and electric motors, while manual wheelchairs provide propulsion by the wheelchair user/occupant pushing the wheelchair by hand. As for bedridden people, there are also a specific type of wheelchair for them, it usually a manual type wheelchair.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114101

II. LITERATURE REVIEW

This chapter presents the background information on the issues to be considered in the present research work and to focus the significance of the current study.

Bhaskar Vitthal Patwardhan, presented the A wheelchair with commode for a patient that coverts in to a bed is disclosed. The wheel chair includes an outer rectangular main frame standing on at least four wheeled legs, first, second, third, and four outer frame being connected to each other by pivots or hinges, a pair of additional wheels being connected to the third frame by means of links that prevent the chair or bed from tilting backward due to weight of first and second frames and the patient, a means for making movements of the first, second, third and fourth frames to convert chair into bed or vice-versa, inner frames being slid ably fitted inside the outer frames, and a commode pan or pot being fitted under the main frame, wherein a cushion is provided between said main frame and commode pan or pot.

Rashid Ahmed K and et al., presented the Mobility aids are useful for disabled patients for transportation and a replacement for walking especially in indoor and outdoor environment. Wheelchairs and stretchers are the most commonly used medical equipment for the transportation of patients. Transferring the patients from wheelchair to stretcher or to the medical bed is always an issue for the patients and for the attendants/ nurses as well. This may even result in musculoskeletal disorders to those who are not trained to do so especially, when it comes to the caretakers. So there is a need for a wheelchair cum stretcher to facilitate the disabled patient's mobility and to provide novel medical equipment for use in the Indian hospitals. 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 disabled individuals. This paper presents the design and fabrication of pneumatically powered stretcher-chair convertible device with movable support segments in an attempt to help such patients and caregivers. This helps the caregiver avoid heavy lifting situations that put their back at risk of injury. The caregiver can merely shift the patient from a bed on to the device while the device is in the form of a stretcher. Then the device can be converted into a wheelchair automatically with a press of a button. This can be done in the reverse direction as well, when the patients in sitting in the wheel chair can be converted to a stretcher smoothly for the purpose of diagnosis etc.

Gerhard van Baalen and et al., presented the goal of this project is to develop an assistive transfer device for use in a clinical setting with elderly or post-operative patients. Since most patients have difficulty lifting themselves onto an exam table, it is necessary to employ alternative methods to facilitate the lifting process. Current methods and devices are inefficient, demand much physical exertion by the medical assistant, or are uncomfortable for both the patient and assistant. The new device will be designed to safely transfer patients from the standing position to the top of an exam table. It will reduce the amount of necessary effort to lift the patient, and provide the patient with a sense of security during the lifting process. Additionally, the device will be easy to clean, user-friendly, cost-effective, and simple to store. After extensive brainstorming, several design alternatives were generated for transfer methods and lifting mechanisms. The alternatives were then evaluated using design matrices to determine which design was best suited for the project purpose. The scissor link, standing position design was ultimately chosen due to its compactness and simple operation. The proposed design was fabricated and assembled according to the client's specifications. This initial prototype was then tested for simple functionality and to establish the overall design as a viable proof of concept. The prototype was successfully able to lift 170 pounds, however; the after repeated usage, the frame failed while lifting from the lowest position. Though qualitative testing was carried out, the desired mechanical characteristics of the device were unable to be carried out. Future development of the device will include an improved hydraulic system, a reinforced frame, and friction reduction to all mechanical joints. In addition, the prototype will be run through a series of quantitative mechanical tests to fully understand the behavior of the lifting device.

Kalimuthukumar Sakthivel and et al., studied the recent years a census indicates that around 700 million persons suffer from some kind of disability or handicap. There is an increase in the elderly population around the globe. This increase their need of support structures for enabling comfort and independent life. The phenomenon increases attention to the scientific community. A wheelchair cum Stretcher the pre-existing technique in this domain includes either wheel cum stretcher that are joined by linkages or mechanical systems. The disadvantage of this technique mainly involves high mechanical strength needed for modifying or conversion .So therefore a solution by incorporates wheelchair cum stretcher. Therefore the goal of the survey is to criticize the researchers and compare between the various types of mechanisms involved in the designing of wheelchair cum stretcher in the previous decade. Thus by this way we would like to compare between various approaches their pros and cons, thus helping the upcoming researchers to design a device as per the necessities overcoming the problems or constraints faced in the existing design.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114101

Hani Haneefa Pookarath and M. Parameswaran presented the For a patient who is unable to move after a major surgery, an equipment to ease their transfer from a hospital bed to a stretcher would be a great help. The equipment should help in transferring by allowing less need for the patient's movement. Not only have the patients, even the nurses faced physical stresses during the transfer of patients. This paper will discuss the design of equipment which will reduce the difficulties faced by both the patients and the nurses while transferring a patient from bed to stretcher and vice versa.

Shashi Pratap Kushwaha and et al., studied goal of this project was to create a lowcost multipurpose wheelchair that would improve mobility and quality of life for persons who have difficulty walking. This tool allows users to lift the patient from the bed directly, which helps to reduce pressure injuries. Along with lowering the price of We also want to reduce pressure injuries and falls with our device. Another multipurpose expertise is We can use a wheelchair both indoors and outdoors. After that, we have successfully completed the project. In wheelchair, we accomplished what we set out to do. We created a superior multipurpose wheel chair with all of the necessary safety features. Low-cost, high-quality measures it allows for secure data transfer.

Manoj Kumar Tiwari and et al., presented the patient transfer has always been challenging, usually requiring a number of caregivers to perform this task together, which is time-consuming and can easily cause secondary injuries to the patient. In addition, when the world is in the distressing predicament of a global pandemic covid-19, the issue of patient transfer is even more critical, as caregivers are at a high risk of infection, causing significant damage to healthcare resources. The goal of using assistive devices is to minimize the risk of injury. A lifting device is an assistive device that allows patients in hospitals, nursing homes, and those receiving health care at home to be transferred between a bed and a wheelchair or other similar resting places using different lifting mechanisms. By choosing appropriate equipment and using it effectively, the risk of sustaining an injury is significantly reduced, and the quality of life for all concerned is often noticeably improved. This work aimed to propose a design of a lightweight, durable, and ergonomic assistive patient transfer device named "Patient Lifting Hoist" (PLH); it can assist caregivers in transferring patients, reduce direct contact between them, and avoid secondary musculoskeletal injuries for use in hospitals and homes. The authors concentrated on the partial elimination of manual lifting in order to device could work in two situations: with or without electricity. In the mechanical structure of this assistive device, a chain-drive mechanism and motorized jack lifting mechanism are proposed; they are the key points to the fundamental functional realization of the device and can reduce the cost of the prototype. Furthermore, the device can operate remotely, and a control strategy is applied to ensure the operation's stability and safety. Finally, some preliminary experiments are carried out to verify the device's reliability and lay the foundation for the clinical tests.

The World Health Organization defines a wheelchair as "a device provides wheeled mobility and seat support for the disabled it's difficult to walk or move around." Therefore, the wheelchair is to improve personal mobility. The purpose of the wheelchair the design is to produce good performance and can provide proper seat and posture support without compromise strength, durability and safety. The government can do these authorities, manufacturers, engineers, designers, service provider and users perform their respective design responsibilities. The design of wheelchairs is very different, and diversity should be considered user requirements with design functions, such as total length, weight, frame type and width, seat configuration, wheel and caster type, arm and footrest, axle position and propulsion mechanism, all have affect the function. To ensure that the wheelchair is suitable, Designer & provider must thoroughly understand the expected demand Users and their environment. The function must match the user's functional ability and posture support needs, as well as requirements for the environment and durability claim. Realize the ideal match between the user and the wheelchair design and environment can be both difficult and important. When there are multiple models to choose from, it can best meet the needs of users which one to choose. The design of the wheelchair should enable its users to use it participate in as many activities as possible. At least, wheelchairs should enable users to lead a more active life without have a negative impact on their health or safety. Comfort and safety, these are two important factors that affect the quality of life of long-term users.

III. CONSIDERATION OF WHEEL CHAIR

The purpose of wheelchair design was to produce a wheelchair that performs well and was able to provide a height - adjustable seat and appropriate postural support without compromising strength, durability and safety. The health and safety of users should never be compromised in order to reduce costs. A wheelchair should be designed to ensure the user's safety and health. There are many ways in which users can be injured by their own wheelchairs, as illustrated by the following examples:

A wheelchair without a cushion or with an inadequate cushion can cause pressure sores. This in turn may require the user to spend many months in bed; without appropriate care and treatment this often leads to bedsores, secondary complications and even premature death.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114101

- Unstable wheelchairs can tip and lead to users falling and injuring themselves.
- Wheelchairs that are too wide or are unduly heavy can cause shoulder injuries.
- Sharp edges on surfaces can cause cuts that in turn can lead to infection.
- Poor design can result in places on the wheelchair where the user or others can get their fingers or skin pinched.
- Wheelchairs that cannot endure daily use in the user's environment may fail prematurely and can injure the user.
- Strength and durability: Wheelchairs used outdoors are subjected to greater wear and tear than those designed for indoor use or use on smooth roads and paths. A wheelchair must be strong enough not to suffer a sudden failure while being used. The wheelchair should be built to have the longest possible useful life and require the fewest repairs. A wheelchair should be designed so it can be repaired near the user's home if it fails, and replacement parts should be easily available.
- Suitability for use: Wheelchairs should be appropriate for the environment in which they will be used and for the specific people who will use them. One wheelchair design will not suit everyone. When designing or selecting wheelchairs, it was necessary to think about the environment and the way in which the wheelchair may be used.

IV. CONCLUSION

Through this project, it helps develop creativity and critical thinking among us in figuring out solutions to any problems. Problems related to existing projects can be solved through some modifications and fabrications applied to the current design. Innovations made on Hydraulic Wheelchair are not just convenient to the bed ridden patient to move, but also to the guardian. The 'split' feature on the wheelchair will ease the guardian to assist the bed-ridden patient to sit on the wheelchair. The lifting feature also will make it easier for the guardian. The process would save a lot of time and energy compared to last time. There is still room for improvement which can be added to this project to make it more effective, durable and user-friendly. This project has a big potential in market and should be commercialized for advanced research and development.

REFERENCES

[1]. Sk. Muzeeb, V. Santharaju, K. Siva Kumar & T. Achyuth Kumar. "Wheel Chair Cum Stretcher for a Disabled Person". 2020. Department Mechanical of Engineering in Narayana Engineering College, Nellore, A.P, India. pp 348 – 353. ISSN: 0950-0707.

[2]. Victor Paquet & David Feathers. "An Anthropometric Study of Manual and Powered Wheelchair Users". 2003. Department of Industrial Engineering in University Buffalo, State University of New York. pp 191 – 204.

[3]. Martin Szénay & Martin Lopušniak "Movement parameters of persons with disabilities on evacuation by lifts". 2018. Institute of Architectural Engineering, Faculty of Civil Engineering, Technical University of Kosice Vysokoskolska 4, 042 00, Kosice, Slovak Republic. pp 181 – 188.

[4]. L. Fehr, W. E. Langbein & S. B. Skaar. "Adequacy of Power Wheelchair Control Interfaces for Persons with Severe Disabilities". A Clinical Survey, Journal of Rehabilitation Research and Development, Vol. 37, No. 3, 2000, pp. 353360.

[5]. J. Gorka. Assessment of The Corrosion Resistance, Properties and The Structure of TIG Braze Welded Galvanized Steel Sheets. 2020. Pp 47 – 54. DOI: 10.24425/amm.2019.131095.

[6]. Sunday Adeniran Afolalu, Samuel Olusegun D., Ikumapayi M.O, Oladipupo Seguin, Emetere Moses. Study of Mechanical Behaviors and Characterization of Steel Joints in MIG Welding under Varying Fluxes.2020. International Journal of Engineering Research and Technology. ISSN 0974-3154, Volume 13, Number 6 (2020), pp. 1300-1306.

[7]. Fabio Malizia. CFD simulations of an isolated cycling spoked wheel: Impact of the ground and wheel/ground contact modelling. 2020. Department of Civil Engineering, KU Leuven, Leuven, Belgium.

[8]. Zheng Wei Chen, Chang Li, Xing Han, Xing Gao & HeXin Gao. Sensitivity analysis of the MIG welding process parameters based on response surface method. 2020. Journal of Adhesion Science and Technology.

[9]. Lacombe, P.; Baroux, B.; Beranger, G. (1990). Les Aciers Inoxydables. Les Editions de Physique. ISBN 2-86883-142-7.

[10]. Kosmac, Alenka (2013). Adhesive Bonding of Stainless Steels. pp. 11–13. ISBN 978-2-87997-388-3.

[11]. Pozzobon, V.; Levasseur, W.; Do, Kh.-V.; et al. (2020). "Household aluminum foil matte and bright side reflectivity measurements: Application to a photo bioreactor light concentrator design

[12]. ISO 7176-24:2004. Wheelchairs – Part 24: Requirements and test methods for useroperated stair-climbing devices. Geneva: International Organization for Standardization; 2004. [9 March 2008].

