Review Design and Development of Wheelchair Cum Stretcher for Patients

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***Abstract*—**
Currently, the global population of individuals with disabilities is on the rise annually. Addressing their mobility challenges has become a pressing issue, presenting a significant hurdle for engineers and scientists. The imperative is to conceive and implement innovative solutions in the realm of mobility assistance. These aids are instrumental in enhancing their autonomy and reintegrating them into daily life. They facilitate transportation and serve as effective alternatives to walking, both indoors and outdoors. Among the array of mobility aids available, wheelchairs and stretchers are the most prevalent. Wheelchairs are ubiquitous in hospitals, train stations, airports, shopping centers, and even household settings. Their primary application is in healthcare facilities, often alongside stretchers. Given their widespread use in various sectors, there's a need for enhancements in terms of flexibility and adaptability to address inherent issues and enhance their utility, particularly in medical settings. This paper proposes the development of a mechanism that integrates the advantages of both wheelchairs and stretchers. Such a mechanism should prioritize ergonomic design and adhere to safety standards. Additionally, this paper explores past advancements in mobility aid development aimed at improving the comfort of both patients and hospital staff.

Keywords*— *Mobility aids, Stretcher, Wheelchair, disable person, ergonomically etc.

I. INTRODUCTION

In medical research worldwide, significant strides have been made in the development of mobility devices over recent decades. Among these, the wheelchair stands out as one of the most prevalent aids utilized by individuals with disabilities. These mobility aids serve as essential tools for patient transportation and serve as substitutes for walking, particularly in various environments. Wheelchairs and medical beds are commonly employed for patient transport, yet the transition from wheelchair to stretcher or bed poses challenges for attendants and nurses. Addressing the issues surrounding mobility equipment and introducing improved designs would greatly benefit the medical field and offer valuable assistance to disabled individuals. There's a clear need for a versatile wheelchair-stretcher hybrid to enhance mobility for disabled patients and introduce innovative medical equipment for hospital use.

Despite advancements in technology, many disabled individuals still encounter difficulties when transferring from a wheelchair to a stretcher. This not only discomforts the individuals but also complicates the tasks of caregivers and nursing staff. Introducing a convertible wheelchair-stretcher could alleviate these challenges, offering ease of operation and user-friendliness. To address these issues, we're introducing a new concept: the wheelchair-stretcher hybrid. This product is cost-effective, compact, and user-friendly, designed to be easily operated by the patient themselves. It seamlessly transitions between wheelchair and stretcher modes, adapting to the patient's needs. Compared to existing products on the market, it offers enhanced utility and practicality in every aspect.

II. PROBLEM IDENTIFICATION

A wheelchair serves as a seated mobility aid equipped with wheels, enabling users to move themselves manually or through automated systems. It's indispensable for individuals facing difficulties or impossibilities in walking due to various health conditions or disabilities. Patients with conditions like paralysis, stroke, or organ failures often struggle with mobility, particularly in transferring from a wheelchair to a bed, posing challenges for both patients and hospital staff. To alleviate this discomfort, a fusion of wheelchair and bed is recommended to facilitate smoother transitions and enhance patient comfort.

Additionally, prolonged periods of sitting in a wheelchair can cause discomfort for patients. To address this issue, a solution in the form of a wheelchair-bed combination is proposed, aiming to provide a more comfortable seating option for patients. The challenge of patient transfer has persisted since ancient times, where the injured or ill were carried on stretchers made of wood and cloth or leather. While advancements in healthcare and technology have occurred, efficient solutions to this problem remain elusive, highlighting the ongoing need for innovation in patient mobility.

III. OBJECTIVES

Aim : The aim of this project is to enhance the reliability and performance of wheelchair by converting into stretcher for the safe and efficient operation of patients.

Objectives :

• The goal of this endeavour is to create a wheelchair/walker hybrid, utilising an existing wheelchair as a platform and doing in-depth research on market conditions, technology applications, and user needs.
• It helps elderly persons maintain better postural stability and balance. It is conveniently able to change from sitting to sleeping posture.
• Providing humans with specialized services in a secure and pleasant manner.
• Easily transitions from sitting to sleeping position; • Provides effortless mobility from one location to another.
• People with spinal cord injuries, paraplegia, stroke, and persistent vegetative state would benefit greatly from this kind of treatment. concentrating on providing bedridden people with mobility support.

IV. LITERATURE SURVEY

The journal papers and patents reviewed in this study are directly or indirectly relevant to the proposed project focused on designing and developing a Wheelchair-Stretcher hybrid. These resources serve to inform and guide the design process within this specific domain. A wheelchair, essentially a chair with wheels, is tailored to assist individuals with disabilities, facilitating their mobility. Conversely, stretchers serve as mobility aids for patient transportation within medical settings such as hospitals and clinics. While stretchers are relatively straightforward in construction, requiring assistance from a caregiver for patient transport, wheelchairs are designed to provide greater autonomy. Users can operate wheelchairs manually or with the assistance of a caregiver, offering enhanced mobility and independence.

According to Mr. Peter Axelson, Mr. Jean Minkel,and Mr.Denise Chesney, [1] Choosing the right wheelchair is crucial for ensuring the user's comfort and quality of life. When selecting between a manual or powered wheelchair, factors such as performance, safety, and dimensions should be carefully considered. A practical strategy for wheelchair selection involves prioritizing the user's mobility requirements and seating preferences. It's advisable for beginners to seek guidance from rehabilitation specialists to make an informed decision regarding the most suitable wheelchair for their needs.

James J. Kauzlarich, [2] Self-excited vibration stands as a compelling subject within the realm of vibrations, particularly concerning caster wheel shimmy. This phenomenon is marked by vibrations induced by the system's motion, such as wheelchair speed. Notably, many low-cost wheelchairs incorporate caster designs that utilize sliding frictional dampers in spindle supports to enhance shimmy characteristics. Delving into the theory of damping for casters sheds light on how shimmy prevention operates, especially in ultra-lightweight and powered wheelchair configurations.

Mr. Richard Simpson, [3] Studies reveal that nearly 10% of legally blind individuals also experience mobility impairments, with a significant portion relying on assistance from others for mobility. To address this issue, a Smart Power Assistance Module (SPAM) is under development for manual wheelchairs, aiming to offer independent mobility to this demographic. The SPAM-equipped wheelchair incorporates power assistance and features obstacle detection and avoidance capabilities tailored for individuals with visual impairments. Control of the wheelchair will be facilitated by a microprocessor, allowing the SPAM to deliver smoother and more nuanced control, enhancing the user's mobility experience.

According to Mr. Rory A. Cooper, [4]

Rehabilitation stands as a deeply human-centered profession, where precise measurements of both the user and the wheelchair are paramount for optimizing functional mobility. Biomechanics and ergonomics play pivotal roles in furnishing insights crucial for comprehending various facets of wheelchair utilization. These factors significantly impact seating comfort, posture, propulsion efficiency, and the alleviation of pain. The selection of a suitable wheelchair hinges greatly upon ensuring proper seating, with wheelchair cushions serving to offer essential pressure relief and some degree of postural support.

Dr. Daniel E. Jolly, [5]

It is essential to take adequate precautions before transferring a patient from a wheelchair to a bed or vice versa. For paraplegic patients, utilizing sliding boards can greatly aid in this process. Optimal sliding boards are crafted from smooth, tapered hardwood for enhanced functionality. Additionally, the support of two assistants, along with the utilization of support straps or belts, can facilitate a smoother and safer transfer. It's important to avoid simply sliding the patient into the chair; instead, lifting them from the wheelchair and executing a controlled transfer is the recommended and safest approach for patient transfers.

Mr. Debkumar Chakrabarti [6]

Emphasizing comfort is paramount, ensuring individuals can sit for extended periods without experiencing physical discomfort. Careful selection of materials for the seat surface and frame is crucial for achieving comfortable seating in the design. Neglecting to consider ergonomics and the intended application can lead to varying effects on the user. Seat

cushions play a pivotal role in wheelchair design, significantly contributing to user comfort and overall satisfaction.

V. PROPOSED SYSTEM

The fundamental design of the device has progressed from the idea of a convertible wheelchair. As a result, the initial sketches for the project's design solely featured the skeletal framework of a wheelchair.

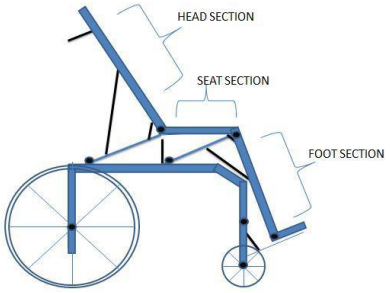

Fig.1. Preliminary sketch of the device in wheelchair position

The primary objective is to ensure comfort for both the patient and their caregiver. The mechanical arrangements of the device between the chair and stretcher were given significant attention to achieve this goal.

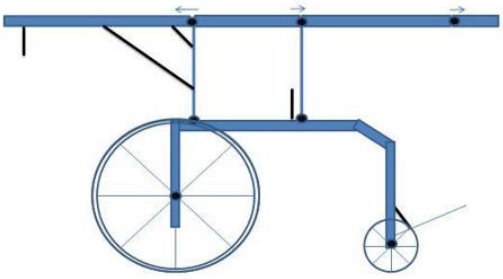

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Fig.2. Preliminary sketch of the device in stretcher position

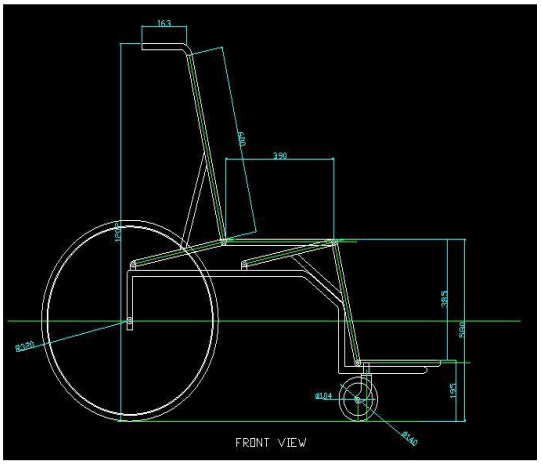

Fig.3. Front view of the device

The illustration depicts a 2D side view of the device. In this configuration, the head section measures 600mm, the seat section spans 390mm, and the foot section extends to 395mm. The distance from the head section to the ground measures 1202mm, while the foot section is situated 195mm above the ground. Furthermore, the front wheel boasts a diameter of 140mm, while the rear wheel measures 320mm in diameter.

VI. ADVANTAGES

- It is manageable and takes up less room.
- The operation of the ratchet mechanism is easier to use and smoother than that of the early pneumatic design.
- By switching modes, it may be utilised as a stretcher or a wheelchair at the same time.
- The process of moving patients from a wheelchair to a stretcher or the other way around is eliminated by the design.
- Less maintenance is required.

As a result, our design will provide the medical profession with effective mobility.

VII. APPLICATIONS

- Especially helpful in nursing homes and hospitals.

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VIII. CONCLUSION

This paper is intended to provide a review of the design and fabrication processes involved in creating a multi-utility wheelchair, aiming to surpass conventional wheelchair designs. Through various research methods, we identified key considerations including safety, hygiene, material selection, and manufacturing processes crucial for developing the product. The primary focus of this project lies in achieving cost-effectiveness and widespread acceptance. The wheelchair-stretcher design facilitates easier transfer and handling of patients within hospitals, minimizing the risk of external and internal injuries. Additionally, the mechanisms employed in the wheelchair's design and fabrication are straightforward and easily controllable.

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