

# EMERGENCY MEDICAL SMART STRETCHER TECHNOLOGY

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**Abstract:** Mobility aids are useful for disabled patients for transportation and a replacement for walking especially in indoor and outdoor environment. Wheel chairs and stretchers are the most commonly used medical equipment for the transportation of patients. Transferring the patients from wheelchair to stretcher or to the bed is always an issue for the patients and for the attendants 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 which is controlled by the Wi-Fi technology.

**Keywords:** Electricity Mobility aid, Ratchet mechanism, Wi-Fi Technology, Wheelchair cum stretcher

## I. INTRODUCTION

A wheelchair is a wheeled mobility device in which the user sits. The device is propelled either manually (by turning the wheels by the hand) or via various automated systems. Wheelchairs are used by people for whom walking is difficult or impossible due to illness (physiological or physical), injury, or disability. People with both sitting and walking disability often need to use a wheel bench. The earliest records of wheelchairs date back to the 6th century, and were found inscribed on a stone slate in China. Later dates relate to Europeans using this technology, dating back to the Renaissance. The various types of wheelchairs are manual wheelchairs, electric-powered wheelchairs and sport wheelchairs.

A basic standard manual wheelchair incorporates a seat and back, two small front (caster) wheels and two large wheels, one on each side, and a foot rest.

Wheelchairs are often variations on this basic design, but there are many types of wheelchairs, and they are often highly customized for the individual user's needs. The seat size (width and depth), seat-to-floor height, footrests/leg rests, front caster outriggers, adjustable backrests, controls, and many other features can be customized on, or added to, many basic models, while some users, often those with specialized needs, may have wheelchairs custom-built. Various optional accessories are available, such as anti-tip bars or wheels, safety belts, adjustable backrests, tilt and/or recline features, extra support for limbs or neck, mounts or carrying devices for crutches, walkers or oxygen tanks, drink holders, and clothing protectors. Experiments have also been made with unusual variant wheels, like the omni wheel or the mecanum wheel. These allow more directional movement options.

### 1.1 Objective:

The objective of this project is to analyze and prototype an automated wheel chair cum bed, based on an existing smart wheel chair with extensive fact findings and research on existing models, technology used, market scenario and customer requirements.

It improves the balance and postural stability of old age people. It can convert sleeping position from sitting position easily.



Fig1: Smart stretcher

## II. LITERATURE SURVEY

A wheelchair is chair with wheels, designed to help the disabled individuals. Stretchers are mobility devices used to transport the patients from one place to other. These both medical mobility aids are used in hospitals and clinics for helping the patients. Stretchers are simple in construction and the patient needs the support of an assistant to transport from one place to other. Whereas wheelchair is designed in such a way that either patient can control the device manually or with the help of someone's assistance.

According to Peter Axelson [1], selection of an appropriate wheelchair will lead a comfortable living to the user. Performance, safety and dimensions are the three categories which have to be considered while selecting a manual or powered wheelchair. An excellent approach to the wheelchair selection is to set priorities based on user's mobility and seating needs. It is highly recommended that a novice can consult with their habilitation specialists in order to select the appropriate wheelchair.

It can be observed that in most of the cheapest wheelchairs, the design of the casters makes use of a sliding frictional damper in the spindle support to improve the shimmy characteristics. Understanding the theory of damping for the casters show how shimmy prevention works in ultra-light and powered wheelchairs. Richard Simpson [3], studied almost 10% of all individual who are legally blind also have a mobility impairment and majority of these individuals are dependent on others mobility. A smart power assistance module (SPAM) for manual wheelchair is being developed to provide independent mobility for this population. The power assist wheelchair that provides for obstacle detection and avoidance for those with visual impairments. The control of the wheelchair will be carried out by the microprocessor and also allow the SPAM to provide a smoother and advanced control.

Amos Winter, [6], discussed following the mechanical principles will be helpful for a better design. Understanding the center of gravity location is important in wheelchair design. Weight should be the other important factor for wheelchair design. Reducing weight will results the comfortable use for the user and also lowers material cost. The best strategy is to maximize the strength and minimize the weight of the frame tubing. Calculating the moment of inertia and weight results the best strength and can be used to make the strongest frame at the least weight.

Debkumar Chakrabarti [7], says primary consideration should be given for comfort, so that people can sit for long time without feeling any physical discomfort. Considering the suitable materials for seat surface, frame and can make comfortable seating for the design. Without considering the ergonomics and application can make a diverse effect to the user. Seat cushions are so important in the design of wheelchair.

## III. WORKING PRINCIPLE

The main components involved in this project consists of hydraulic jack, screw rod, wheel, free wheel, waste lid and braking lever . In this project, we provide two lead screw setup with hinge joint is used to form the stretcher or bend to wheel chair. At the present position this model is a wheel chair type. Below the chair we provide two lead screw setup to connect the right or bottom side plate and left or top side plate by using hinge joint. For movement of bottom side plate , rotate the screw handle in counter clockwise direction then hinge goes inwards to form a flat plate. For movement of top side plate, rotate the screw handle in clockwise direction, then hinges goes outward to form a flat plate.

Now obtain the stretcher. To attain wheel chair we must rotate the lead screw handle in to reverse direction. At the middle part part with lid is provided to eliminate the human waste. Hydraulic jack is provided at the center to vary the height of stretcher or wheel chair. The purpose of free wheel is to balancing the weight acting on the right and left side plates. Brake lever is provided to stop the wheel chair movement.

### 3.1 Ratchet Mechanism

A ratchet is a mechanical device that allows continuous linear or rotary motion in only one direction while preventing motion in the opposite direction. Ratchets are widely used in machinery and tools. Though something of misnomer, "ratchet" is also often used to refer to ratcheting socket wrenches.

### 3.2 Armrest

Armrest is places to rest your arms when you are not moving. They can be wraparound, full-length or desk-length, fixed or height-adjustable, removable or flip-back. Fit is important because armrest position can alter the way you propel your wheelchair. Many individuals choose not to have armrests because they don't like the way they look or they get in the way of propulsion.

### 3.3 Backrest

Sling backrests are the most common, but provide little postural support. Adjustable tension backrests can provide more support and can be adjusted over time. Rigid backrests provide the best support, but may make it more difficult to collapse the chair. The weight and height of the backrest are important. In general, the lighter the better, with carbon fiber backrests being a nice option. If support is not needed, a lower backrest is better as it does not get in the way of pushing.

### 3.4 Leg Support

Leg support is the place where it supports your legs in wheelchair. They can be fixed, and folded.

### 3.5 Seat Cushions

Cushions come in a huge and ever-changing array of different types and materials and comprise a major topic unto itself. While pressure relief is an important consideration when selecting a cushion, you should also keep in mind that you want a firm base and a light-weight cushion. A firm base refers to feeling stable, not sliding on the cushion when reaching for an object or propelling your chair.

### 3.6 Tires

Tires are most commonly air-filled (pneumatic) and therefore lightweight. They also require maintenance and can puncture. If you maintain them, this is usually the best choice. Pneumatic tires may instead be filled with solid foam inserts; these won't puncture but are slightly heavier and don't perform as well. Solid tires are low-cost and no-maintenance, but make for an uncomfortable ride and are not usually recommended.

## IV. DESIGN AND SPECIFICATIONS



Fig 2 : wheel chair position

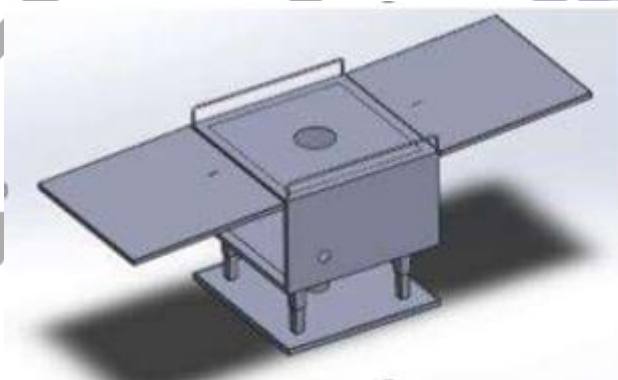


Fig 3: stretcher position

## V. DESCRIPTION OF EQUIPMENT

### 5.1 Hydraulic jack

A Hydraulic cylinder (also called a linear hydraulic motor) is a mechanical actuator that is used to give a linear force through a linear stroke. It has many applications, notably in engineering vehicles. Hydraulic jacks are jacks that are placed in a horizontal position. These jacks push against a lever, which lifts the main lift arm. Bottle jacks have a longer handle than most hydraulic jacks, however, and it is possible to get more lift per stroke with the increased leverage they provide when compared to regular models of jacks. Bottle jacks are versatile because their horizontal position makes it possible to place them in tight spots and provides good leverage. Recently bottle jacks have proven useful in search and rescue missions following earthquake damage. As a result, bottle jacks are standard equipment in firehouses and for search and rescue teams. They are also used for lifting, spreading, bending, pushing, pressing, or straightening requirements. The base and cylinders of bottle jacks are electrically welded for strength, and all models are capable of working in upright, angled, or horizontal positions.

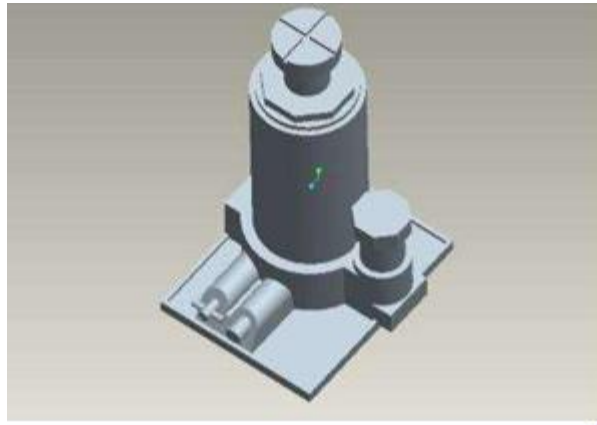


Fig 4: Hydraulic Jack

## 5.2 Lead screw

A lead screw, also known as a power screw or translation screw, is a screw used as a linkage in a machine, to translate turning motion into linear motion. Because of the large area of sliding contact between their male and female members, screw threads have larger frictional energy losses compared to other linkages. They are not typically used to carry high power, but more for intermittent use in low power actuator and positioner mechanisms. Common applications are linear actuators, machine slides (such as in machine), vises, presses, and jacks. Lead screws are manufactured in the same way as other thread forms (they may be rolled, cut, or ground). A lead screw is sometimes used with a split nut which allows the nut to be disengaged from the threads and moved axially, independently of the screw's rotation, when needed (such as in single-point threading on a manual lathe).

Power screws are classified by the geometry of their thread. V-threads are less suitable for lead screws than others such as Acme because they have more friction between the threads. Their threads are designed to induce this friction to keep the fastener from loosening. Lead screws, on the other hand, are designed to minimize friction. Therefore, in most commercial and industrial use, V-threads are avoided for lead screw use.

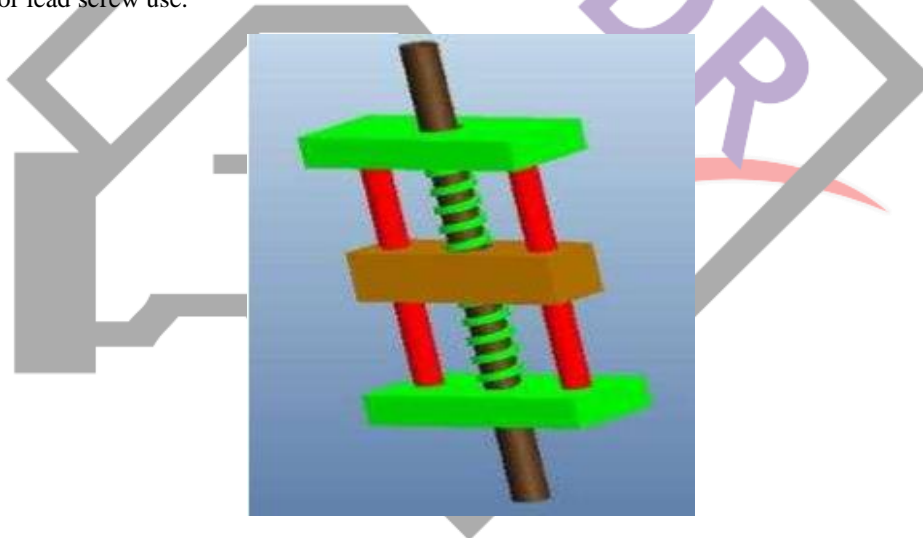


Fig 5: Lead Screw

## 5.3 Wheel

A wheel is a circular component that is intended to rotate on an axle. The wheel is one of the main components of the wheel and axle which is one of the six simple machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel and flywheel.

Wheels, in conjunction with axles allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labor in machines. Common examples are found in transport applications. A wheel greatly reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by application of another external force.

## VI. CONCLUSIONS

The project was aimed at designing and manufacturing a wheelchair cum stretcher that can overcome the shortcomings of a conventional wheelchair, with focus on cost effectiveness and utility.

The existing system has the limitation of shifting patients from wheel chair to stretcher. This product will be helpful for paralyzed patients, movement impaired persons, as well as for old age persons. Our product will eliminate the use of separate wheelchair and stretcher in the hospitals, so that we can eliminate the step of shifting patients from bed or stretcher to wheel chair and vice versa. The wheelchair will consume less space and is manufactured at low cost. Such equipment can induce self-reliability and satisfaction in the users. We achieved our goals by the use of engineering tools such as CADD/Analysis software's and knowledge of subjects such as Design of Machine Elements, Strength of Materials and Engineering Mechanics.

We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries. We are proud that we have completed the work with the limited time successfully.

## REFERENCES

- [1] Peter Axelson., "A guide to wheelchair selection", paralyzed veterans of America, Library of Congress Cataloguing-in-publication data, Washington 1994.
- [2] James J. Kaulzarich., "Wheelchair caster shimmy II: Damping", Journal of Rehabilitation Research and Development, Volume. 37, No. 3, pp 305- 313, May/June 2000.
- [3] Cooper R, Corfman T, Fitzgerald S, Boninger M, Spaeth D, Ammer W, Arva J., "Performance Assessment of a Pushrim Activated Power Assisted Wheelchair", IEEE Trans Control Sys Tech, Volume 10, ISSN: 1063-6536, Jan 2002.
- [4] Dr. Rory A. Cooper., "Wheelchair selection and configuration", ISBN 1-888799 18 – 8, March 1998.
- [5] Mr. Daniel E. Jolly., "Wheelchair transfer", The Ohio state university college, Columbus, ohio, retrieved on 24th Sept. 2010
- [6] Debkumar Chakrabarti, "Indian Anthropometric Dimensions for Ergonomic Design Practice", National Institute of Design, Ahmedabad, 1999.
- [7] Peter Axelson, A guide to wheelchair selection *paralyzed veterans of America* (Washington, Library of Congress Cataloguing in Public Data, 1<sup>st</sup> Edition, 1994).
- [8] James Kaulzarich, Wheelchair caster shimmy II: damping, *Journal of Rehabilitation Research and Development*, 37(3), 2000,305-315.
- [9] Cooper, Corfman, Fitzgerald, Boninger, Performance assessment of a pushrim activated power assisted wheelchair, *IEEE Trans Control Sys Tech*, 10(2), 2002, 1063-1072.
- [10] Rory, Cooper, *Wheelchair selection and configuration*, (New york, Springer Publishing Company, 1<sup>st</sup> Edition, 1998).
- [11] Daniel Jolly, Wheelchair transfer, *Proc, 15<sup>th</sup> IEEE Mediteranian electrochemical PES winter meeting*, Columbus, 2010, 170-178.
- [12] Amos Winter, Mechanical principle of wheelchair design, *International Journal of Mechanical Engineering and Technology*,7(2), 2010, 261-265.