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DESIGN AND DEVELOPMENT OF SMART WHEEL CHAIR FOR THE PHYSICALLY CHALLENGED

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Abstract- Wheel Chair is a mobility device designed for shifting patients, moving physically challenged people from one place to another with the help of attendee or by means of self propelling. The wheel chair is divided into two different types based on the power used for mobility: 1. manually powered wheelchairs. 2. Electric powered wheelchairs. Manual powered wheelchairs are driven by manual power which is again classified into foldable and non-foldable with or without commode design. Electrical powered wheel chairs runs with electric power however manual operation is required to operate the joystick for the movement of the chair. The redesign of manual wheel chair with pneumatic system to lift the user is considered for this project.

Keywords- Wheelchair, pneumatic

1.0 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. The various types of wheelchairs are manual wheelchairs, electric-powered wheelchairs and sport wheelchairs. 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. Experiments have also been made with unusual variant wheels, like the omni wheel or the mecanum wheel and adjustable seats. These allow more directional movement options. Wheelchairs were also automated and designed for the ease and comfort of the user but are often very costly to buy. Hence cheap and multi-usable wheelchairs should be made available. There are many costly multi-usable wheelchairs but the main aim of our project is to make this product cheap and affordable to the needy.

Our design can induce self-reliability and satisfaction to the users.

a. Product Design

Product design is the concept of systematic approach in understanding the user requirement, existing deficits, possible improvement and inventing new designs through idea generation, concept development, and concept realization thereby bringing newer products and solutions for the better quality of life.

b. Wheel Chair

A chair with wheels designed as a replacement for walking is known as wheel chair. This is used for movement of physically disabled, elder people, children who have difficulty and are unable to walk. This device comes in many variations like self propelled, propelled by the

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motor or with the help of an attendee to push. Figure 1 & 2 shows the parts of rigid frame and X frame wheel chair and its parts.

Fig.1, NOMENCLATURE OF A SIMPLE RIGID FRAME WHEEL CHAIR

A. *Need for New Design in a Wheel Chair*

At present patients are facing problem while defecating. Patients needs to be lifted up and helped to remove the dress and make them defecate, which is discomforting to the patients in emergency condition. The design of back rest in the existing wheel chair creates repetitive stress injury if the patient is sitting for a long time. The present design of brake needs to be improved for better impact and application of brake in slope area. Arm rest creates obstruction while shifting the patient from wheel chair to vehicles, no solution in the existing design to make ease of shifting of patient to transportation vehicle.

FIG.2 PROTOTYPE OF SMART WHEEL CHAIR

2.0 LITERATURE REVIEW

A. *History and Evolution of Wheel chair*

The first wheel chair was invented in the 1595 called as invalids chair was made for the king of Spain called Phillip. Later in the year 1655 Stephen Farfler built a self-propelling chair on

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a three wheel chassis. In the year 1783 John Dawson of Bath Town England invented a wheel chair named as bath wheel chair. The chair was with two large wheels and one small one. In the year 1869 patent for a wheel chair with rear push wheels and small front casters were invented, in the year 1881 the push rims for self propulsion wheel chair was invented as shown in figure 4. In 1900 the first spoked wheel chair was invented and in the year 1916 first motorized wheel chair was invented by British Engineers. In the year 1932, Harry Jennings built the first foldable wheel
chair.

B. Types of Wheel Chairs

There are various types of wheel chairs; we are differentiating the wheel chair based on the mode of power used for drive. These wheel chairs are differentiated in to two types as below:
• Manual wheel chair
• Electric powered wheel chair

C. Manual Wheel Chair

Manual wheel chairs are driven with the help of man power as source of energy for moving the chair, these are self propelled or propelled with the help of attendee. The self propelled wheel chairs are driven by the user by using the rear wheels (diameter of 20-26”) which resembles to that of bicycle but has an additional rims know as hand rims are for the movement of the chairs by means of pushing forward or backward. The hand rims are of diameter lesser than the rear wheels. Use of two hand rims at a time gives straight movement of the chair, use of one of the rim gives the turning movement to the chair towards left or right.

Attendant propelled wheel chairs are those wheel chairs which are known as transport wheelchairs that require attendees help for the movement. The wheel chair is designed such that there is no big rear wheels with rim for the moving, moulded seating, light weight, push handles, support backrest, hand brake system. These chairs are commonly seen in airports to move passengers in to the seats. Manual wheel chair are again classified into two types as below

i. Rigid wheel chair
ii. Foldable wheel chair

FIG 3, MANUAL WHEELCHAIRS

D. Electric Powered Wheel Chair

The wheel chair that runs by means of Electric motor is known as electric-powered wheelchair, this wheel chair requires navigational controls, usually a small joystick mounted

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on the armrest. For users who cannot manage a manual joystick, head switches are provided and chin-operated joysticks are provided, other specialist controls may also be provided for independent operation of the wheelchair. Motorized wheelchairs are useful for those unable to propel manually or who require travelling for a long distance which creates difficulty for manual operation. These wheel chairs are not only used by traditional mobility impairments but also by cardiovascular patients.

FIG 4 ELECTRICAL WHEELCHAIRS

E.Problems Identified in the Present Wheel Chair

Gemba Kaizen study shows that the two main types of wheel chairs used in hospitals and houses are rigid frame wheel chair and foldable X frame wheel chair with and without commode design. Problems identified are as listed below:

1. Observation shows that there is no adjustable arm rest, knee rest and foot rest. Identification of problem 1

2. Observation shows that there is difficulty in shifting the patient from wheel chair to auto rickshaw and other vehicles due to bad braking system provided. Identification of problem 2

3. Shortage of the height of the back rest, no adjustable and cushioned back rest, no head rest in the existing design, Identification of problem 3

4. Observation shows problem in defecation shifting of patient to the commode in case of non commode wheel chair, removing and cleaning problem in case of existing commode wheel chair, Identification of problem.

5. Observation shows that problem in reaching the table and non adjustable height of table for ease of work which increases repetitive stress injuries like wrist, back, shoulder injuries

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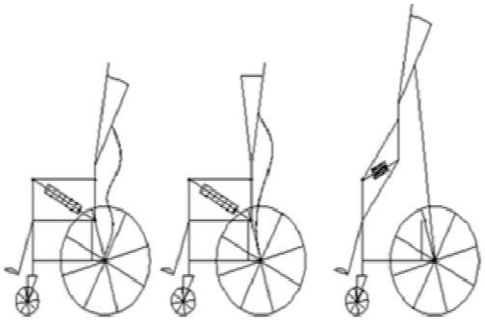

FIG6 UPRIGHT ALMOST STANDING POSITION

F.Design and development of cost efficient smart wheel chair:

Since the present wheelchair has many problems that have been identified and motorized wheelchair which are not affordable easily for everyone, we have designed a manual lifting wheel chair that can lift a person to his/her upright standing position and back to his sitting position, this can be achieved by studying the normal sitting dimension on a wheel chair to an almost standing position and by implementing pneumatic mechanism.

G.Working:

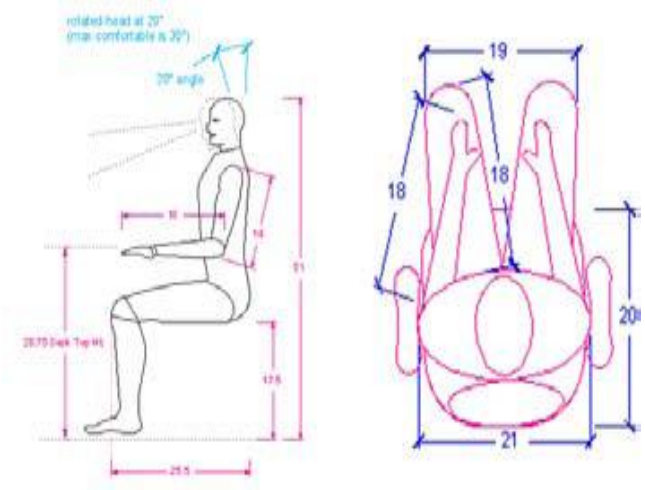

FIG5 HUMAN SITTING POSITION

3.0 CONCLUSION

The project was aimed at designing and manufacturing a wheelchair lifts and stands and 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 customized seats for toiletry purposes. This product will be helpful for paralyzed patients, movement impaired personals, as well as for old age persons. Our product will reduce the requirement of help from others, so that we can eliminate the step of worrying about the patients using wheel chair.

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TABLE I
WHEEL CHAIR DESCRIPTION

SI.NO	DESCRIPTION	SPECIFICATION
1	Structure	Steel tubing, plastic cushioned seat, hand rest with cardboard
2	color	Light green, white rims
3	Components Used	Pneumatic cylinder, solenoid valve, pressure tubes, activating switch, air pump
3	Customization process	Cutting, bending, welding, grinding and assembling parts
4	Features	Lifting up to almost standing position and back to seating position
5	Safety	Seat belts and Brake unit

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 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.

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