Design and Fabrication of Hand Driven Recliner Wheelchair

Vaibhav Patankar[1], Mayur Vishwakarma[2], Rishikesh Nagalkar[3], Sanket Bhendarkar [4], Satyam Kumar[5], Sandeep Sarojkar[6], Pritam Dhobale[7]

[1]*Guide, Assistant Professor, Mechanical Engineering Department, G.H. Raisoni Academy of Engineering and Technology, Nagpur, Maharashtra, India.*

[2,3,4,5,6,7] *B.E Final Year Students, Mechanical Engineering Department, G.H. Raisoni Academy of Engineering and Technology, Nagpur, Maharashtra, India*

***Abstract*- Hundreds of millions of people are suffering through the disabilities. Our topic faced with the challenges to assist people with disabilities by easing mobility issues. After discussions with users, the final prototype of the wheelchair is purposed which is lighter, less expensive, and more efficient than similar products commercially available. The wheelchair has the recliner mechanism which gives seating and relaxing comfort to the user and a lever mechanism that helps in obtaining optimum mechanical advantage. Levers have to be seen more efficient than hand rim their use seems sensible in modern wheelchairs. This research and findings servers as a foundation for our proposed prototype.**

1.INTRODUCTION

The mechanical advantage which also affects the cardiorespiratory and musculoskeletal systems causing high strain. These factors in combination lead the wheelchair confined population to high physical strain which may cause them further disabilities and an inactive lifestyle. Wheelchair user who uses push-rim wheelchair to go out of home, their Hands and Nails often get dirty, and sometimes they end up having blisters on their palms. There might be some situations when users get shoulder injuries and rotator cuff tear. The lever propelled wheelchair seems less straining form of locomotion considering the long and continuous stroke pattern. flexor and extensor muscles in the arms are used with a less complex coupling of hands. Long continuous motion servers as a major contributing positive factor. In lever propelled wheelchair arms are seen to be in a more natural segmental position under which the user is capable of transmitting more human power. The passenger's seating comfort is considered by including the Recliner mechanism which allows the seatback to rotate forward & rearward direction from a pivot point at the base of the seatback according to the user. Thus the wellbeing of the person using the lever propelled wheelchair and having a recliner in it is preserved.

Manual wheelchair propulsion using push-rim is not a reliable form for human locomotion. Push-rim wheelchair comes with a poor.

2. LITERATURE REVIEW

Presently days scientists are so best in class and step by step they are discovering the advancement in each division. Thus, there is an immense improvement in the structure of the wheelchair. Some of the kinds of literature that include such developments are discussed. [2]

2.1 Manual Wheelchair: The manual wheelchair has great indoor mobility, what's more, it is anything but difficult to control forward way however for turning it requires more power likewise it requires high starting power to move. It might cause harm in the shoulder area of the user. It can't be utilized for outside works. These wheelchairs are unfit to be driven on the harsh surfaces like grass, rough places, rocky surfaces, inclines, and sand surfaces.

2.2 Lever Propelled Wheelchair:

The need for this paper is to present the wheelchair which won't require any outside help to be moved. The client must have the option to work the wheelchair on his/her own easily and freely. This paper would likewise attempt to make a wheelchair

that is reasonable and adaptable to be utilized in complex diversity like India.

2.3 Electric Wheelchairs:
The electric wheelchairs can be utilized by the individual who has more disabilities other than legs. They accompany the facilities like seat elevation, tilt, leg height, lean back, and other important highlights. So, the individuals, who can't move their legs and arm effectively, can utilize these wheelchairs.

2.4 Joystick Controlled Wheelchair:
Numerous individuals have a lower body is paralyzed. For such individuals, there are electric wheelchairs and some of them utilize a joystick controller. These wheelchairs make their life simple. By utilizing the joystick, the user can work the close-by PC. joystick which is utilized for the development of the wheelchair without altering the ordinary electric wheelchair.
Presently days scientists are so best in class and step by step they are discovering the advancement in each division. Thus, there is an immense improvement in the structure of the wheelchair. Some of the kinds of literature that include such developments are discussed.

2.5 Manual Wheelchair:
The manual wheelchair has great indoor mobility, what's more, it is anything but difficult to control forward way however for turning it requires more power likewise it requires high starting power to move [1]. It might cause harm in the shoulder area of the user. It can't be utilized for outside works. These wheelchairs are unfit to be driven on the harsh surfaces like grass, rough places, rocky surfaces, inclines, and sand surfaces.

2.6 Lever Propelled Wheelchair:
The need for this paper is to present the wheelchair which won't require any outside help to be moved. The client must have the option to work the wheelchair on his/her own easily and freely. This paper would likewise attempt to make a wheelchair that is reasonable and adaptable to be utilized in complex diversity like India [1].

2.7 Electric Wheelchairs:
The electric wheelchairs can be utilized by the individual who has more disabilities other than legs. They accompany the facilities like seat elevation, tilt, leg height, lean back, and other important highlights. So, the individuals, who can't move their legs and arm effectively, can utilize these wheelchairs.

3. PROBLEM STATEMENTS

3.1 Dirty Hands with Swelling:
Any wheelchair user who uses the manual wheelchair to go out of gets harm by moving the wheels which are already rotating continuously with some speed. Hands and nails often get dirty and there are times when they have to deal with blisters on the palms

Fig 3.1.1: Dirty Hands and Swelling

3.2 Shoulder Injuries & wrist pain:
Unfortunately, as the shoulder is the main joint for propelling a device or transferring to/from a wheelchair. It's a major pain point for many wheelchair users. The most common issue of wheelchair user face is a rotator cuff tear; Tears are caused by imbalances of muscles in your shoulder.

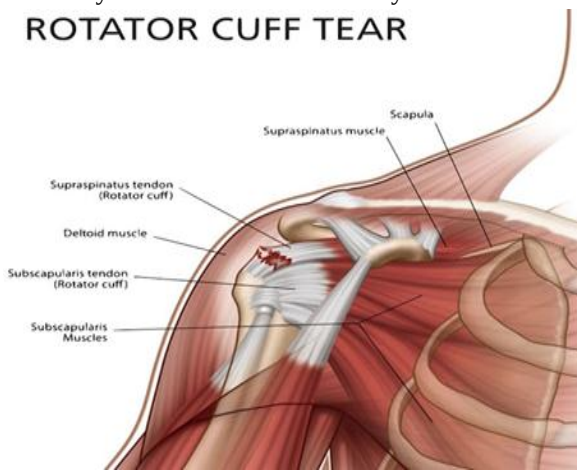

Fig 3.1.2: Shoulder Injuries

Fig 3.1.3: Wrist Pain.

4. MECHANISM

4.1 Lever Mechanism

The primary objectives of the lever mechanism are to obtain maximum load-carrying capacity by applying minimum effort [7]. So; it will be helpful for the patient to propel the wheelchair.

Using our designed mechanism for the propulsion of wheelchair users will require less effort to attain maximum distance in less time interval. It is nothing but increases the velocity of wheelchair also another advantage is that rack and pinion mechanism which is driven by hand-operated lever offers less cost, easy for maintenance and ease for propulsion the reason behind for selection of this mechanism is that it contain wheels of wheelchair chain used as rack and the sprocket use as the pinion. The main advantage of this mechanism is the patient can move the wheelchair on rough and uneven rocky surfaces easily.

The lever mechanism is nothing but mild steel rods which are pivoted at the end of another link where the small piece of roller chair is used at the rack the braking levers are mounted at the end of the main lever to control the speed of wheels and provide the direction to the wheelchair. By applying the brakes on anyone's wheel and moving another lever patient can change the direction of the wheelchair.

Fig 4.1.1: pivoted lever

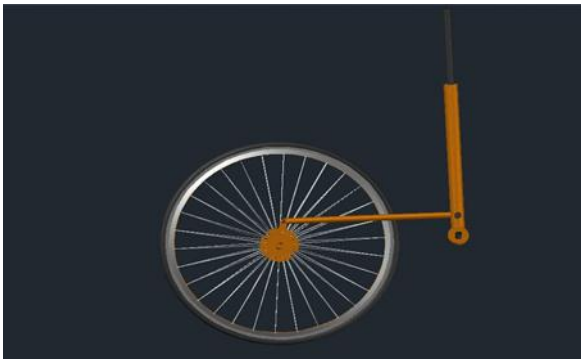

Fig 4.1.2: 3D Model of Lever

4.2 Rack and Pinion Mechanism

Rack and pinion gear mechanism is used to convert rotational motion into linear motion [8]. In general mechanism a bar of the rectangular cross-section having teeth cut on one side that will mesh with teeth on a pinion .but such teeth cut bar and pinion compatible to that bar is not easily available in the market and it is costly, hence to reduce the cost of machinery and for the convenience and maintenance point of view, we use bicycle chain welded on other link use as the rack which works similar to the rack and pinion mechanism.

There are two basic components of this rack and pinion mechanism:

1) Bicycle chain welded on connecting link.
2) Bicycle sprocket.

Fig 4.2.1: chain and sprocket use as rack and pinion

4.3 Recliner Mechanism

Recliner Mechanism chair is chairing that tilts to the backrest of the chair to achieve a comfortable position to the person who is sited on the chair. According to W.H.O. the comfort position for the wheelchair is about 140 degrees.

In the current market scenario, the reclining is present but the second person required for reclining of that chair, so our main aim is to eliminate the necessity of a second person.

There are three basic components of this recliner mechanism:
1) Adjustable Hand rest
2) Spring
3) Backrest
The mechanism containing various parts i.e. adjustable hand rest, backrest, and spring. Proper slots are formed on adjustable handrest.so first of all in case of working the Upper side of the adjustable hand rest is a move to the backward direction so due to this backrest tilts to the backside of the chair with help of slots (it is just like a gear mechanism)
After reclining if a person (handicapped) tries to move for certain work in a forward direction then the same adjustable hand rest is move in a forward direction with the similar meshing of slots.


Fig4.3.1: Recliner Mechanism


Fig 4.3.2: 3D Model of Recliner Mechanism

5. CALCULATIONS

WITH MECHANISM [1]
Length of Handle = 530mm
Average Human Force = 500N
Torque on Sprocket = Force on Handle * Length of Handle
= 500 * 0.53T
= 265 N-m
We have,
Power
P = 2*3.14*NT/60
Also, Average Velocity, V = 0.8-0.9 m/s
Diameter of Wheel = 700mm
Therefore,
V = 3.14 * D * N/ 60
0.85 = 3.14 * 0.7* N/ 60
N = 23.19 rpm ~ 24 rpm
Power = 2 * 3.14 * N * T / 60
P = 2 * 3.14 * 24 * 265/ 60
P = 666.01 W (Rated).

WITHOUT MECHANISM [1]
Torque on Wheel = Force on Rim * Radius of Wheel
= 500 * 0.35 = 175N-m
Power
P = 2*3.14*NT/60
Also, Average Velocity, V = 0.8-0.9 m/s
Radius of Wheel = 350mm
Therefore,
V = 3.14 * D * N/ 60
0.85 = 3.14 * 0.7* N/ 60
N = 23.19 rpm ~ 24 rpm
Power = 2 * 3.14 * N * T / 60
P = 2 * 3.14 * 24 * 175/ 60
P= 439.82W(Rated)

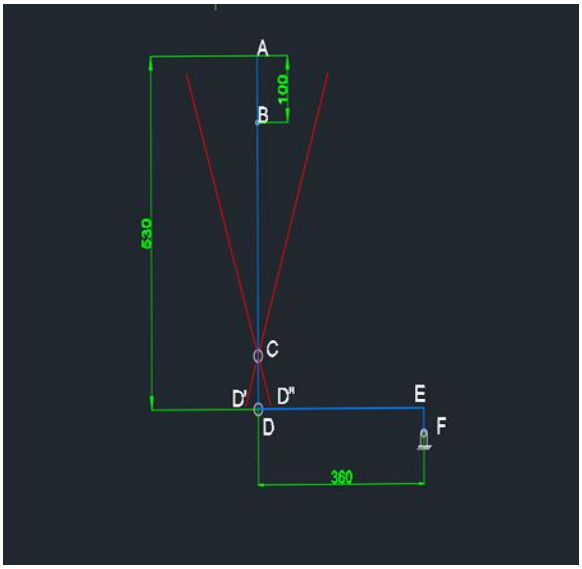

Fig 5.1: Line Diagram for Lever Calculation

Reading taken X-distance traveled & θ-angle covered BY HANDS

Sr. No	X-distance in (cm)	Θ-angle in degree
1	25	40.1
2	28	42.9
3	30	43
4	26	41.6
Avg.	27	41

USING MECHANISM

Sr. No	X-distance in (cm)	Θ-angle in degree
1	35	50
2	33	51.2
3	36	55
4	32	49.2
Avg.	34	51.2

6. CONCLUSION

The centerline of this project is to design a wheelchair to provide "THE WELFARE OF ALL" The census 2011 report said that in India 20% of the disabled person all having disabilities in movement.

In this project, we work on two things: - To modified exiting wheelchair by providing recliner mechanism in seat & lever mechanism for movement instead of rotation mechanism for rotation of the wheel. The recliner mechanism provides comfort for the rides. In case of the lever mechanism, the lever is attached to the frame and one end attached to the horizontal mounting having chain acts as a rack which is sliding over the sprocket acts as a pinion .so the motion of the lever is provided to chain (Rack) to the sprocket (pinion), the sliding motion converted into rotational motion.

This project able to the handicapped person to move their wheelchair in their direction without the help of any other person. The domestic application we can use a recliner to provide comfort by itself.

REFERENCES

[1] Prof. Nikhil V. Bhende, Mithun G. Kolhe, Dinesh S. Ahuja M. Waseem Saleem Ansari "Design and Fabrication of Lever Propelled Wheelchair" Vol: 04, Issue: 03, Mar - 2017International Research Journal of Engineering and Technology (IRJET).

[2] Arvind Prasad, Snehal Shah, Priyanka Ruparelia, Ashish Sawant, "Powered Wheelchairs", Vol. 2, Issue 11, ISSN 2277-8616, November-2013, International Journal of Scientific & Technology Research.

[3] AchuthaTamraparni, YashwanthDasappagari, "Design and Fabrication of a Lever Propelled Alternating Centre of Gravity Wheelchair", Vol. 6, Issue 4, April 2016, International Journal of Emerging Technology and Advanced Engineering.

[4] B. Vaidya, "Design and Fabrication of Wheelchair cum Tricycle for Physically Challenged and Elder People", Vol. 4, Issue 4, 2016, International Journal for Scientific Research and Development.

[5] P. Swapna, Dr. B. Sharmila, Y. Dharshan, "Electric Wheelchair for Physically Challenged", Vol. 3, Issue. 5, May-2016, International Research Journal of Engineering and Technology.

[6] The International MultiConference of Engineers and Computer Scientists "Dual-Purpose Wheelchair Mechanism Designs." 2009 Vol II IMECS 2009, March 18 - 20, 2009,

[7] COLIN A. MCLAURIN, Sc.D.; CLIFFORD E. BRUBAKER, PH.D. University of Virginia Rehabilitation Engineering Center, Charlottesville, Virginia 22903 "Lever drive system for wheelchairs"

[8] Shubham Torvi, Vaishnavi Ingale, Rajkumar E "Design and Analysis of Rack and Pinion Mechanism in Automobile Applications Using Structural Steel and PLA" Vol. 4: Issue 2 International journal of Production Engineering.